I before E precipitates Cs: 
Rethinking Instruction without Emotion in Light of Neuroscientific Alternatives

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Abstract

The average academic lecture leaves college students with an unlucky 13 percent success rate in identifying core understandings of the discipline being covered. In contrast, brain research reveals that deep and lasting learning is discovered through interactions with emotionally competent stimuli that engage multiple brain regions, where learning is constructed rather than bestowed. In light of these empirical findings, this paper invites management studies faculty to consider the evidence that suggests curriculum driven by information—in the absence of relevant learner emotion—leads to academic mediocrity. This paper then identifies neuroscientifically-sound pedagogies for robust 21st century management studies education.

Key words:

Pedagogy, Education Neuroscience, Teaching, Learning, Reform
Minimally Instructive Education Procedures

It’s long been conjectured that the lecture is the best way to get information from the notes of the teacher to the notes of the students without passing through the students’ minds. Recently, researchers have done the math on this conjecture and identified that adult learners typically retain and accurately apply an underwhelming, unlucky 13 percent of the information lectured to them [12].

In other words, if our methods and our students are similar to those researched, our lectures are failing to accomplish our learning objectives 87 percent of the time. And the site of the research: Harvard’s physics department. The principal investigator? Harvard’s own celebrated physics professor and one-time lecturer extraordinaire, Dr. Eric Mazur, who concluded, “The lecture is one of the oldest and least effective forms of education there is” [12]. These findings suggest that academia’s default method for expending considerable faculty energy while having very little impact on the insights or behavior of their learners is a decidedly minimally instructive brain procedure for students.

As these colleagues have been courageous enough to recognize and map the chasm between their best teaching intentions and their students’ underwhelming learning, might we also take a more candid look at our own teaching practices and the assumptions that underlie these? Might the cognitive dissonance associated with our longstanding 87 percent failure rate in constructing deep foundational, conceptual understandings signal our opportunity to fail intelligently? Failing intelligently, explained Fullan [4], is an opportunity to learn from mistakes made, by uncovering often-tacit operating assumptions, in order to make more informed decisions going forward. And because the data are unequivocal in their exposure of our failure to lecture our students toward developing more than a modicum of enduring understandings, our best option might be choosing to fail intelligently and better understand what has been missing in our teaching, in order to construct more effective learning with our students.

In light of this empirical evidence that suggests our traditional approach to teaching-as-information-giving is ineffective, this paper attempts to facilitate a closer discussion of: (a) how the teaching profession inherited and continues to adhere to comparatively ineffective delivery methods; (b) cognitive neuroscientific alternatives to our current teaching practices—particularly through the power of what Medina [13] referred to as emotionally competent stimuli (ECS), which serve as a master key to accessing the brain’s sensory, temporal, frontal, and motor regions for robust learning; and; (c) how these findings may inform our construction of the most effective face-to-face, eLearning, and distance learning alternatives for robust 21st century education.

The Irony of Content Coverage

For the most part, it’s understandable how we as teachers and learners may have defaulted into our current minimally instructive educational procedures. Our earliest scholars were those who had access to texts, and they generally held forth before a largely bookless student body, which then scrambled to re-create an accurate record of the professed word. And so, during those times, teachers tended to assume the role of orators and students tended to assume the role of scribes. If all involved were to be most efficient and cover a great deal of
academic content, the more quickly that teachers spoke, and the faster that students took notes, the better, right? Well, quite the opposite. What developed was a remarkably efficient pattern of getting information from the notes of the teacher to the notes of the students without passing through many cortices of the students’ brains. And of course, involving fewer brain cortices leads to less elaborate information encoding, less synaptic intimacy, less neuronal impact, and less learning [11, 13, 16, 17, 21, 22, 23]. In short, the irony of teachers hastening toward greatest content coverage has had the unintended effect of concealing central content understandings among more information than can be meaningfully processed.

Victims of Habituation

As centuries have passed, many of today’s universities have access to not only innumerable print and electronic instructional resources, but also with the functional magnetic resonance imaging (fMRI) technologies that enable researchers to observe activity within the brains of those subjected to the well intended but poorly retained academic pontifications that tend to dominate the lecture hall. FMRI images reveal that the brain’s reticular activating system (RAS), when engaged in an activity such as passionate teaching prompts neuronal networks connecting sensory and frontal brain regions become alight with intellectual engagement of academic content [18]. In contrast, fMRI images also reveal that when student brains are occupied by scribe-like copying of notes, as is often the case in lecture halls, sensory and motor regions get a brisk workout, while temporal and frontal regions of the brain are allowed little opportunity to do the reflective meaning making and analysis work that these important regions do best [21, 23]. Lectures, then, typically result in much ado about note-taking. And the brains of those students who opt out of taking notes also tend to fall victim to a process called habituation, which renders students increasingly unresponsive to repetitive stimuli, thus relieving students of much learning after about ten minutes [13, 14, 21, 23].

Feelings: Not Futile But Fertile

And so it has tended to go, for centuries. Our adherence to longstanding academic rituals has revealed our propensity to place blind—if not opaque—faith in prevailing methods and traditions. So as habitual people operating within habituating education systems, we’ve tended to go forward doing great quantities more of the same sorts of lecturing we’ve already done, hoping for qualitatively different, quantitatively better results. Sound vaguely familiar? Yet feel vaguely (if not 87 percent) disappointing? Well, our disappointment may be a key to more carefully considering the merits of our current practices, as research tells us that in the physiology of learning, feelings matter [1, 3, 7, 8, 10, 11, 13, 21, 23]. Feelings—including disappointment—can be fertile rather than futile for stimulating the prefrontal cortex’s critical thinking.

I before E Precipitates Cs

Brain research suggests that analogies can be powerful teaching tools, as these allow us to connect our own concrete experiences to comparatively abstract concepts that may lead us to construct new insights. To better understand the contrast between how we typically teach and what brain research tells us about how we actually learn best, let’s consider the following analogy.
Remember the *I before E—except after C* English language spelling rule? Let’s revisit it for a short time, in order to illustrate how our proclivity for content coverage has contributed to our problem of generating only about 13 percent real learning success. Then let’s use the rule to illustrate and emphasize a key educational neuroscience insight that underlies the difference between passively recording information and actively learning through multiple engaged brain regions.

Orthographically, we’ve learned that for the most part, *I* precedes *E—except after C*. That’s a pretty effective guideline for success in spelling bees and related exhibitions of erudition. But pedagogically and andragogically, our tendency to teach to *I (information)* before *E (emotional cogence)* has lead to many disappointing *C* grades.

In the context of our prevailing classroom practices, we love imparting information. Understandably enamored by our own beloved academic content, we tend to spend our teaching hours doling out copious amounts of this information upon learners who in many cases have not yet discovered in relationship this information much of their own *E—or emotional engagement*. And so we, steeped in the traditions that have shaped us, hoping against hope, tend to hold forth across instructional units, learning modules, and semesters. After this, we’re typically disappointed by how little our learners retain, let alone deeply understand—or love—of all the beauty and majesty associated with the information we so regularly dispense. Sound vaguely familiar? *(information)* before *(emotional)* engagement has resulted in innumerable, disappointing *C* grades. Cs, of course, for many who teach and learn, represent lessons not impressively learned—and probably, despite our most sincere efforts, not very scientifically taught. Indeed, for many of us who believe in the transformative potential of our organizations, *I before E* has led to so many disappointing online, hybrid, and face-to-face Cs.

In other words, we as obedient rule followers have adhered to an information-first model of instruction, and in doing so forfeited key opportunities to engage in increasingly scientific teaching, despite much evidence that suggests that information alone is insufficient for constructing enduring understandings of our learning objectives. An example of increasingly effective teaching and learning through the power of analogy is the subject of Ratey’s research on the positive correlation between exercise and cognitive function [15]. Ratey’s research identified the proliferation of a protein called brain derived neurotrophic factor (BDNF) in frontal integrative regions of research participants’ brains after they engaged in regular intervals of aerobic exercise. Ratey noted that increases of this BDNF protein appeared to be associated with neurogenesis, dendrite growth, synaptic exchanges, and neuroplasticity. But instead of communicating through neuroscientific jargon, Ratey is renown as the Harvard physician who first introduced students and teachers to Miracle Grow for the human brain. Miracle Grow, of course, is a popular culture reference to some savvy combination of fertilizers reputed to transform unremarkable plant sprouts into jolly green giants. In the midst of a proliferating lexicon through which researchers explain the human brain’s 100 billion neurons and their functions, Ratey analogized BDNF as Miracle Grow, and thus made it memorable, intriguing, and even an object of inquiry. As a result of Ratey’s smart us of analogy, educators across the globe have initiated pilot programs to test the power of the teaching and learning connection between exercise, brain stem stimulation, and frontal cortex function that has enabled BDNF-rich brains to outperform their comparatively sedentary peers on standardized
measures of math, science, and literacy [15]. Powerful, cogent, and memorable learning analogy, teacher.

Let’s look, then, at the educational neuroscience—which Sousa [17] described as a trans-disciplinary field of empirical research with its roots in psychology, neuroscience, and pedagogy—behind Emotionally Cogent Stimuli (ECS).

**ECS: The Most Powerful Stimuli Ever**

The educational neuroscientific research community has much insight to share about the transformative power of ECS in education. Medina, for example, described ECS as the most powerfully processed sort of external stimuli ever measured [13]. “Emotionally charged events,” he continued, “persist much longer in our memories and are recalled with greater accuracy than neutral [or informationally-isolated] memories” [13]. What’s more, explained Zull, “Even though it may run contrary to common belief, there is good reason to think that such feelings are essential to rationality” [21]. Moreover, “emotions are critical for human behavior,” explained Immordino-Yang because they are the things that help to push our behavior in a particular direction; they help us to be able to think in ways that are going to match the circumstances that we’re facing. Without emotions, our cognition has no impetus to match itself, to make us fit ourselves well into what’s going on around us” [9].

Emotionally charged, persistent, easily recalled, accurate, essential, critical, compelling, and rich in behavioral impetus: that’s how researchers have described emotionally competent stimuli. Sound worthy of further consideration in relationship to powerful learning? Let’s do so by putting ourselves in a bit of a pinch.

**ECS On Campus: The Teacher Is In The House**

Visualize yourself standing in front of a group of a couple thousand of your organization’s prospective stakeholders. No small amount of energy has been expended to gather these fresh faces to your site. (Side note: shortly, you’re about to choke, or drown, or experience some degree of what you perceive to be public disgrace in their midst, while they sit, and watch. But you’re not aware of that yet). It’s a beautiful spring day, and you’ve been chosen by your leadership to make a public case for what you reason are the most compelling reasons for investing in your organization. So in this role as the du jor goodwill ambassador of your organization, things begin beautifully, as you feel prepared, welcoming, articulate, and confident enough to do yourself and your organization well. The group seems to be paying attention. They’re smiling and nodding. You’re off to a Minnesota-nice start.

And then it happens. Midway through your shtick, as you speak and move purposefully about the audience while sharing big ideas and pointing to the Keynote data that you’ve assembled to back your assertions up, you notice what may or may not be a critical mistake in a key mathematical representation which you’ve intended as a descriptor of your organization’s vitality. This (perhaps) mistake is projected enormously across the biggest screen in the house for all to see. With all eyes expectantly upon you, you’re now feeling intensely uncertain about whether your numerical data are confirming or completely contracting the message you’re now straining to make in front of a couple thousand onlookers who now appear to become increasingly attentive to your quandary. Cold waves of self-doubt drown your analytical brain. Are you really drowning? Say something smart. Or are you choking?
That’s when your analytical frontal integrative cortex kicks back in, and a voice from within reminds you that the remote is in your hand. You control the presentation. So you smile, move on, forgive yourself for being either wrong or dense enough to not know you were right all along. The crowd is still smiling and making eye contact. You rediscover breathing, and you move on.

That poignant experience was one of ours not long ago. Poignancy, of course, implies a measure of well-earned, experiential regret—for mistakes publicly made and lessons formerly unlearned. But poignancy is also deeply instructive, if we allow ourselves to attend to the underlying lessons. When we’re passionate about our work, we take additional risks that inevitably bring additional mistakes. But in that passion is also directive for reflective learning, because we feel our need to fail intelligently, or to fail toward future success [4].

Chances are this experience will not soon be forgotten, with all the trimmings of lessons of mathematical representations, data analysis, proofreading, dress rehearsals, public speaking, and more. Chances are also good that most of us have been in similar spots, and likely will be again some time. Might these emotionally competent stimuli be key, teachable, learning moments when the teacher is clearly in the house and learning becomes deeply personal—perhaps as an extension of our own existential need to better understand content? Before that, I, like many, had never yearned to understand mathematical expressions. Before that, for me, these mathematical expressions were devoid of emotionally competent stimuli. And now, that has changed, and I’m excited about mathematical formulas.

**Emotion + Cognition = Synergy**

Notably, research does not try to dissuade us from allowing these poignant ECS lessons to be instructive in our professional and personal lives. For example, Immordino-Yang & Faeth explained, “Neuroscience is revealing that rather than working to eliminate or ‘move beyond’ emotion, the most efficient and effective learning incorporates emotion into the cognitive knowledge being built [10]. In effect, efficient learners build useful and relevant intuitions that guide their thinking and decision making” they explained [10]. Immordino-Yang & Faeth continued to reveal that while much prevailing instinct in formal education remains to prevent emotion from interfering with formalized learning, empirical research demonstrates that “the role of emotion in learning is critical” [10]. In fact, neuroscience research positively correlates motivation and engagement in learning with emotional valence [22]. The emotion chemicals in the brain such as adrenalin (the fight or flight chemical), dopamine (the reward chemical), and serotonin (the sleep and calm chemical) contribute significantly to attention, perception, memory, and problem solving. Emotions tend to synergize cognition. That is, “our emotions influence our thinking more than our thinking influences our emotion” [21].

So, in the absence of poignant ECS, what should move the learners in us to compare our existing knowledge and behavior against opportunities for more informed and potentially transformed understandings, insights, and actions? Might ECS be key in unlocking the very intrinsic values and rewards that research suggests we will work harder, smarter, and longer for than extrinsic rewards which fail to move us to deeper competencies and understandings? Might ECS not be the key to unlocking the need to engage whole-heartedly, whole mindedly in deep pursuit of consequential academic content? Research suggests that the rational brain is
indeed e-lluminated to engage in complex rational work when the learner perceives the matter to be of emotional consequence [10, 13].

**ECS: The Cognitive Neuroscientific Millennium Arrives Home**

Remember being a cash-strapped college student and returning home for the holidays? A few years back, when such a student arrived home from college for the holidays, she kicked off her new (read: expensive) Air-Jordans and proceeded to magnetize her admiring siblings and parents with what she stuck to the family fridge. There, next to her young siblings’ reading logs, math tests, and still-life paintings, she posted a grayscale fMRI of her very own brain. The image was visible evidence of a research study in which she participated. The research not only measured her brain’s blood flow in response to a set of emotionally laden images, but it also paid her enough cash to buy the hipster purple Jordans. As her siblings traced her tell-tale cranial silhouette with their young fingers, their big sister described the varying regions of her own brain that were illuminated in response to emotional imagery when the image was captured. All throughout that holiday break, as her dad toiled to interpret and rewire the kitchen’s aging electrical circuitry, he gazed admiringly at the mysteries of neuronal wiring in her brain scan that had made its way to their Midwestern family fridge. It seemed to say to him, “Welcome to the cognitive neuroscientific millennium.” And then it both taunted and enticed him to complete the remedial study of kitchen wiring and progress to the much more dynamic work of studying the cranial circuitry that enables our own cognition.

Since that time, years have passed, and while that Midwestern kitchen wiring is finally complete, most of us are still novice interpreters of the hemodynamics that correspond to the mental operations captured in learners’ fMRIs. But thanks to the research by cognitive neuroscientists, we now better understand why and how ECS aid cognition. Medina, for example, offered the following metaphor to explain how emotions affect our neuronal networks:

ECS . . . involve the prefrontal cortex, that uniquely human part of the brain that governs ‘executive functions’ such as problem-solving, maintaining attention, and inhibiting emotional impulses. If the prefrontal cortex is the board chairman, the cingulated gyrus is its personal assistant. The assistant provides the chairman with certain filtering functions and assists in telephone conferencing with other parts of the brain—especially the amygdala, which helps create and maintain emotions. The amygdala is chock-full of the neurotransmitter dopamine, and it uses dopamine the way an office assistant uses Post-It notes. When the brain detects an emotionally charged event, the amygdala releases dopamine into the system. Because dopamine greatly aids memory and information processing, you could say the Post-It note reads, ‘Remember this!’ Getting the brain to put a chemical Post-It note on a given piece of information means that information is going to be more robustly processed. It is what every teacher, parent and ad executive wants [13].

Here it seems that Medina, in concert with others, has confirmed that ECS heighten cognition and enable biochemically-vigorous memory encoding by connecting adjacent brain regions with intrinsic dopamine-induced neuronal networks. This process appears to construct emotionally intelligent memories of what we interpret to be important interactions. In short,
one might say that the rational brain’s circuitry becomes e-lluminated by emotionally significant interactions.

The Essentiality Of Emotional Intelligence

Back in 1995, Goleman’s prescient inquiries into the emerging study of emotional intelligence identified that information and intellect alone are insufficient to meaningfully shape us into leaders of our respective professional, civic, and personal endeavors. Well-developed emotional acuity, found Goleman, “guides focused work, clear thought….and the qualities that make us more fully human” [7]. In his work, Goleman provided salient evidence—exemplified by the problematic professional and personal lives of highly intelligent, but emotionally obtuse individuals ranging from anonymous college classmates to the scientist Robert Oppenheimer—that while intelligence indeed matters, after a certain point, an abundance of intellect in the absence of emotional intelligence renders one professionally and personally inferior to peers with a well-proportioned synergy of intellectual and emotional intelligence. The otherwise impressive arc of intellect—decoupled from an emotionally competent counterpart—leads to a disappointing life trajectory.

ECS Stimulating Brain Development

While our intellectual and emotional intelligence may not at present be what we might desire these to be, the opportunity remains ours, through the brain’s remarkable ability to physiologically change itself through remapping and rejuvenation processes known as cognitive plasticity and neurogenesis. Cognitive neuroscience bolsters the prevailing view that learning is realized by synaptic plasticity in the brain.

According to Doidge, “The cerebral cortex [the thin outer layer of the brain] is selectively refining its processing capacities to fit each task at hand. It does not simply learn; it is always ‘learning how to learn’...it is like a living creature with an appetite, one that can grow and change itself with proper nourishment and exercise....the shape of our brain maps changes depending on what we do over the course of our lives” [3]. Thus the human brain’s approximately 100 billion neurons demonstrate continued, regular ability to rewire themselves by strengthening or weakening neuron-to-neuron connections that occur at synaptic clefts. The stimuli to which they respond affect this growth. Hence, neurons that fire together wire together—thus creating memory and ability bonds. Moreover, synapses are strengthened and neuronal network responsiveness is considerably developed when connections are enriched with emotionally-rich chemicals [22]. Conversely, neurons that fire apart wire apart—thus decreasing the likelihood that certain stimuli and behaviors will co-occur.

In addition to repurposing existing brain cells, we are also able to grow new brain cells, in response to novel stimuli. “The brain,” noted Lehrer, “far from being fixed, is in a constant state of cellular upheaval...and the amount of neurogenesis is itself modulated by the environment, and not just by our genes.” [11]. Furthermore, Willis, observed “When students understand that their brains can develop stronger, more efficient, accessible, and durable neural networks through their actions, they have the positivity, resilience, and motivation to do their part to develop the skills, knowledge, and intelligence to achieve their goals” [20]. Thus, when we more fully understand and teach our students of the powerful roles of ECS and
neuroplasticity, students can find themselves in control of their learning and their effectiveness in their larger lives. So why all the discussion of brain change? What is its relevance to quality cognition and learning by way of ECS?

ECS: Toward Scaffolding Increasingly Meaningful Learning

In the presence of ECS, the human brain becomes attentive and engaged; the attentive and engaged brain directs its neuronal power to the objects of engagement, and when neurons are engaged, they fire together and wire together, creating robust and extensive networks between neurons in the brain’s sensory, associative, analytical, and motor regions. In short, ECS e-luminate the brain’s neurons to fire together, wire together, and recruit varying lobes to conspire together to analyze, understand, and act upon the learning opportunities at hand.

So stepping back from a physiological exploration of our human brains and returning to our larger purpose of increasing the quality of learning in our organizations, we again ask the question: Are these the understandings that drive our current teaching and learning? Is this the way we’ve long understood and conducted education? If yes, we likely have some valuable lessons to share. If not, might we now be better prepared to design increasingly meaningful teaching and scaffold professionally nuanced learning?

Designing e-Illuminated Learning

In these financially challenging times, many of our organizations are understandably experiencing pressures to be more effective while using fewer resources. Equipped with powerful e-learning, distance learning, and hybrid teaching technologies, many of our organizations are reaching out to address teaching and learning needs through these innovative means. In the process of doing so, aware that “Emotions get our attention, and attention equals better learning,” what processes will guide educational neuroscientific curriculum development, so that resources are most effectively directed to support intended learning objectives and outcomes? [13]. How confident are we that we’re designing educational “environments, activities, and techniques that naturally generate positive feelings and that automatically lead students to declare, ‘I have to learn’”? [23].

Bitten By Emotionally Significant Inquiry

Envision yourself, for a moment, transported back to your first year out of college. Pursuing possibility, you sign up to spend the year as a volunteer teacher in an emerging alternative school at the edge of the Central American rainforest. On your first day of school, you have no idea that one of your students would, in time, save your life. You fancy yourself as the lifesaver, but you’re wrong, and by the mid-semester break, you learn this the hard way, when your wise-beyond-his-years student Gonzalo saves your life during a 100 mile trek through the Maya Mountains. Before you can stumble into a venomous death inflicted by a coiled and camouflaged yellow-jawed-tommygoff, Gonzalo stiff arms you and saves you from an all-but-certain demise. A single bite from the tommygoff, warn local villagers, cause victims to internally bleed to death in a matter of hours—unless immediate medical attention can be secured. Because you have ventured for days by bicycle to reach the temples of the lost city of Caracol, your chances of survival would be about as slim as is your jungle IQ.
Years later, in your work as a designer of learning experiences, you look back upon this and similar journeys with Gonzalo. You now ascribe a certain perpectiveness of teaching method to his decisions. Gonzalo enticed you and your co-explorers with big questions like “Maestros, would you be interested in exploring the rediscovered ruins of a lost ancient Mayan city of 100 thousand?” He enticed you with learning objectives such as, “I’ll bet you could bike the hundred miles there and back over a long weekend.” He designed assessment challenges like,” Now it’s your turn to paddle your bike across this river in that dugout canoe.” And he scaffolded a learning plan that included informational studies of the ruins, smaller journeys to pilot, dry runs of portages, and healthy doses of watchful monitoring. In retrospect, you increasingly admire what your nontraditional student helped you learn in relationship with the rainforest. His years as a guide in the bush helped him to develop and apply impressive command of teaching and learning insight—insight that you wish you had brought equal measures of into the classroom when you taught the twenty-year old Gonzalo couple of academic courses each day throughout his senior year of high school.

By now, if not much earlier in this paper, patient reader, you’re probably aware that this story of snakebite narrowly averted and the resulting human development in relationship to authentic learning are another attempt to scaffold the ECS that research suggests should be present and pertinent to an audience in every ten minutes of instruction in order to help learners effectively receive, encode, recall, own, and use the lessons therein. In other words, learning emerges when we viscerally feel that we need to know more, learn more, and discover more. Because the most enduring learning is developed from emotionally cogent commitment to understanding, the most effective teachers, like Gonzalo, cultivate learners’ authentic emotional engagement before expecting intellectual investment. Doing otherwise and expecting different results is to forget that I before E precipitates Cs.

Designing 21st Century Curriculum

Informed as we now are that the brain’s prefrontal, rational, integrative cortex feels compelled to learn more about that to which it feels emotionally cogent investment, our next step is to better understand how to develop highly effective, 21st century curriculum around these insights. Success in doing so, explained Wiggins & McTighe [19], comes from constructing Understanding by Design (UbD) curriculum for electronic, distance, hybrid, and face-to-face environments. UbD directs us to identify the most important learning outcomes first (in stage one), followed by specifying authentic ways that learners could give evidence of such learning (stage two), which leads to identifying quality experiences though which such learning could be constructed (stage three).

As Gonzalo demonstrated decades ago, stage one of UbD must be driven by emotionally competent essential questions that engage the heart and the mind of the learning objectives. For example, Gonzalo offered, “Maestros, would you be interested in personally exploring the rediscovered ruins of a lost ancient Mayan city of 100 thousand? What might you want to experience there?” In addition to essential questions, UbD curriculum designers will be wise to identify in this stage enduring understandings, which, long after the experience has concluded, will continue to guide learners’ emotional and intellectual insights into not only this experience, but also those that learners may view as explicitly and implicitly informed by such learning. Gardner described such learning as supporting the synthesizing minds that will lead our way
forward to insight and innovation in the 21st century [5]. Moreover, learner objectives are also appropriate for this stage in curriculum design. Examples of these will include what Bloom, Krathwol, Masia, and Dave [2] have expertly taxonomized as affective, psychomotor, and cognitive domains—and perhaps even in this order, as affective objectives, specifically those that challenge us to explore perspectives, attitudes, values, and beliefs, demand the rich cognition and situated application associated with our most enduring learning.

In stage two of Wiggins & McTighe’s UbD curriculum framework, assessment evidence is the crucial next step in aligned teaching and learning. Assessment evidence will include learner performances to be demonstrated (showing what one understands about essential questions, enduring understandings, and learning objectives in contexts reflective of real world demands and performance expectations). Stage two evidence should also include related formative assessments that provide learners with timely feedback on their developing understandings of curriculum objectives.

Stage three, then, unfolds from the larger understandings described in UbD stages one and two. Stage three includes a variety of differentiated learning activities that generally revolve around engaging the brain’s sensory, temporal, prefrontal, and motor regions through emotionally competent sensory stimuli, reflective meaning association activities, critical thinking discourse, and trying one’s hand at newly informed actions [6].

**ECS: The Sounds of Science**

As educators who work diligently to make learning real—and perhaps even transformative for our students—we’ve habitually applied numerous theoretical and time-honored teaching practices that tend to be effective for those learners who arrive ready to connect with our teaching outcomes. And for this quality work, we have much to be proud of. And still, for those educators who seek richer learning experiences for all students, and not just those who are able to comport themselves to our informationally-abundant but emotionally impoverished curriculum, educational neuroscience has much to offer. For there is much sound science that invites us to rethink instruction that hopes against hope that information alone will produce quantitatively and qualitatively better learning. There is much sound science that points to the need to rethink our I before E approach to teaching information in the absence of emotionally competent learning stimuli.

Now, in the second decade of the 21st century, we know that academic erudition is an excellent option for getting information from our heads and hearts into the notes—and perhaps habits—of our students with minimal effect on our students’ minds. But continuing to conduct such minimally instructive education procedures, fully aware of the nominal learning effects for all students, is not only unaligned with our larger curriculum objectives but is also a failure undeserving of the trust learners place in us as professionals. In contrast, the opportunity is ours to rethink and redesign educationally neuroscientific instruction informed by contemporary brain research.

Understanding that I before E precipitates Cs, the opportunity is now ours to rethink instruction without emotion, so that our learners’ brains become the sources of emotionally engaged knowledge construction rather than depositories of a fleeting 13 percent of the information bestowed upon them. What, then, informed by this sound science, will we choose to do with our professional teaching opportunities in global management studies and beyond?
References


