

Educating Tomorrow's STEM Leaders in Third-Space Skills

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ABSTRACT

Companies worldwide are facing an acute shortage of qualified graduates in STEM disciplines, in particular those with more non-technical skills, such as teamwork, innovative thinking, communication, adaptability and emotional intelligence. A top U.S. university calls it the missing "third space" set of skills beyond hard business and technical knowledge. Recent findings of neuroscience affirm the critical role of emotions, "heart" intelligence and mind-body links in learning and cognition. A core foundation of the "third skills set" is mindfulness based emotional intelligence, consistent with ancient Eastern wisdom traditions. The author passionately believes we have to think outside-the-box to bring such skills into the education of STEM graduates in Asia as well as around the world.

An Acute Gap

Companies worldwide are facing an acute shortage of qualified graduates in the STEM disciplines, particularly those that require non-technical skills, such as teamwork, innovative thinking, communication, adaptability and emotional intelligence. Highly reputed University of Southern California is calling it a "third space" of skills beyond hard business and technical knowledge. Many IT companies, such as Google, SAP, and Facebook are now training their employees in a similar skill set.

However, according to research conducted by the Hay Group, a global HR company, the reality is that college students do not think these skills are important to succeed in the workplace. This results in a huge gap in perception between what the best companies are seeking and what students are learning. More recently, Korn Ferry, the global HR and recruiting giant has started to advise their clients on the criticality of the third set of skills from top to bottom.

In a 2015 article in *FORTUNE Magazine*, the author writes, "Ask senior executives in New York, Los Angeles, Palo Alto, Seattle, Shanghai, Beijing or London what their biggest concern is and they will all tell you the same thing. It's not capital, technology, regulatory changes or economic uncertainty. It's talent. And not just talent generally, but talent possessing some specific soft skills beyond conventional business and engineering training." (Wilson III, 2015)

In a survey conducted by The Hay Group, it was found that employers believe that graduates overlook the importance of soft skills, including self-awareness, self-management, empathy, listening, teamwork and understanding others' concerns. On the other hand, their report shows that graduates "have been focused on, and rewarded for, their academic expertise and knowledge, not necessarily developing people skills while in college". (Wilson III, 2015)

According to a report by the BBC on the skills gap in China, "All the companies interviewed said that a lack of soft skills posed a much greater challenge than the absence

of hard skills. Notable soft skills mentioned as posing the greatest business and organizational challenges in China include leadership, communication and self-motivation. The soft skills gap is still seen as being most prominent in middle management roles, with wages for these positions continuing to see rapid increases (Chan, 2015).

There is a growing recognition among the top companies that today’s graduates are not bringing an essential set of “third-space” skills beyond the conventional engineering, science and business knowledge.

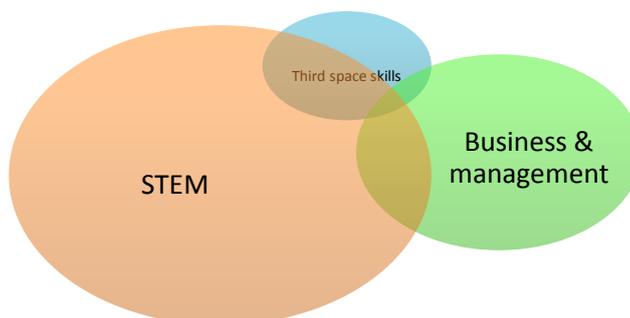
EDUCATING FOR TODAY’S COMPLEX WORLD

Clearly, there is a gap between what companies are demanding and how universities are educating their students. In south India, industry and universities have begun to collaborate to meet the rapidly changing engineering skills needed for the IT industry. However, even there, this “third space” of skills is not taught.

As countries like Thailand focus on educating more graduates with professional skills in STEM disciplines, what they may be missing, beyond the conventional inputs of money, infrastructure, faculty, and curriculum is this “third space” of skills so critical for success.

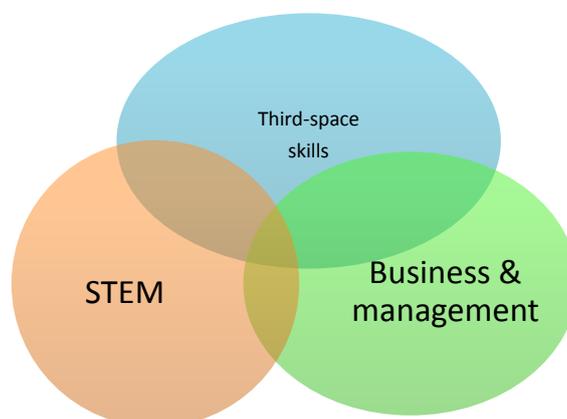
Ironically, the conventional term is “soft” skills even though universities the world over are finding that so-called soft skills are hard to teach and learn. They are non-cognitive skills and require a very different pedagogy and world view of learning.

CURRENT MODEL IN SCHOOLS/COLLEGES



CURRENT DEMAND FROM INDUSTRY

Business-engineering + third space skills



The New Core Competency

The world is calling for a more innovative type of education and skill set – required to address the complex challenges and opportunities facing each and every country. Fundamentally, for STEM graduates, a skill set that stands out is the capacity to be an innovative problem solver, to create solutions that require going outside-the-box of today's knowledge. There's a whole subset of skills under the umbrella of "third-space" skills, such as critical thinking, learning to learn, taking initiative, working collaboratively across disciplines, emotional intelligence, self-management, inspiring others, adapting and persevering, and communication. In fact, this third set of skills is really the new core competency, since the knowledge and skills of STEM disciplines are changing rapidly. In a February 2016 conference between IT executives and universities in India (ICTACT, Chennai), it was acknowledged that 50% of the contents of the first year of IT college becomes outdated by the third year.

So, in addition to the need to train students in a rapidly changing knowledge base in STEM, how can students be educated in what are essentially non-cognitive skills in an academic paradigm that values cognitive skills? The demand from companies cannot be ignored.

The Emerging Field of Educational Neuroscience

Recent discoveries from neuroscience are pointing to a new type of pedagogy that can help develop these skills. Over the past ten years a new specialty called "Brain Mind and Education (MBE) or "educational neuroscience" has emerged, which incorporates pedagogy, psychology and neuroscience. Many U.S. universities, including Harvard, Johns Hopkins and Vanderbilt, now offer a post graduate diploma in BME.

According to neuroscientists, cognition involves the thinking area of the prefrontal cortex, the emotional or limbic brain, and the body. In essence, the brain, mind, emotions and body/actions are naturally interconnected and affect and are in turn affected by learning. The new science of neuroplasticity says that new learning and training of the mind/emotion/body can change the very structure and functioning of the brain, and it in turn influences the mind and body (Davidson & Begley, 2012).

Many experts now challenge the current established pedagogy of education in schools and colleges. Of course letting go of old legacy beliefs is much harder than it seems, particularly in the teaching and learning of STEM. One reason it seems so difficult to adopt a more experience based pedagogy stems from the widely accepted Western paradigm of intellectual and cognitive knowledge and skills, based on Bloom's taxonomy, as being the real aim of university education. In particular, STEM disciplines involve inquiry, curiosity, research and experimentation to understand the physical or materialistic world. It also means being intellectually curious, suspending one's previous knowledge, and having an open, innovative mind for dealing with existing problems or generating out-of-the-box solutions. As Tony Wagner (2012), formerly at Harvard writes in his book *Creating innovators: The making of young people who will change the world*, the reluctance of universities and their faculty to adapt and evolve represents a major obstacle. He goes on to say that Harvard and other top universities do not see an incentive to change their core curriculum and teaching methodologies, and it will be second tier universities that will lead innovations in university education.

The following summary is based on two books representing the collected thinking of the top thinkers in this field (Immordino-Yang, 2015, Tokuhamma-Espinosa and Willis, 2011).

1. **The brain (and hence the mind) is changed by all kinds of experiences.**
According to neuroscientists, the "brain is a complex, dynamic and integrated

system that is constantly changing through experience even if most of it happens at a subconscious, microscopic level. With repetition, these changes become embedded with both positive and negative effects. Hence the common saying that neuronal patterns that fire together get wired and those that don't lose their strength and atrophy (Davidson & Begley, 2012).

2. **The brain is highly plastic.** One of the most exciting discoveries of the late 20th century is that the brain is highly plastic, that through learning and experiences the brain can and does change and develop. This finding challenges the century old belief that only specific areas of the brain could develop and that there was a limit to its growth. The most dramatic evidence comes from actual cases of children born with only half a brain or damaged brain who nonetheless are able to function because the other half reorganizes itself with new patterns. In fact, scientists claim that the brain as a whole recognizes sensory experience, not just a single part. Hence the saying "we see with our brains and not with our eyes". Neuroplasticity affirms the "growth mindset" concept that Carol Dweck, psychology professor at Stanford University, promotes through her book *Mindset: The new psychology of success* (2006). (See also Stein, 2014)

3. **Emotions are integral to learning and executive functioning.** In her book *Emotions, learning and brain* Immordino-Yang (2015) says, "In short, learning is dynamic, social and context dependent because emotions are and emotions form a critical piece of how, what, when and why people think, remember and learn." This new thinking is really a revolution among scientists and is just filtering into educational institutions. The predominant belief has been that emotions interfered with thinking, decision-making and learning. A new insight for education is that "we only think deeply about things we care about".

According to a study done at the Brain and Creativity Institute at the University of Southern California, complex emotions, such as inspiration, drive/motivation, compassion and trust actually help students connect "isolated algorithmic equations to meaningful, subjective and emotional experiences". As a result, scientists now say that emotions are skills or "organized patterns of thoughts and behaviors" that can be learned and developed. *Emotions are not separate but naturally interconnected with cognitive thinking skills.*

It could be said that in the current pedagogy, high-level cognitive skills such as reasoning, analysis, comparison, synthesis and decision making involved in language arts and mathematics are seen as "rational disembodied systems.... detached from emotions and the body", (Immordino-Yang, 2015). Many neuroscientists argue, based on recent research, the interconnections between learning and emotions help us manage our bodies and minds in service living and relating with other people.

For STEM education, this revolutionary concept of emotions and cognition means that just rote learning, without intrinsic motivation, will not help students apply what they learn into the real world of problems, challenges and opportunities. In fact, a safe, caring, appreciative environment where it is ok to make mistakes, ask "stupid" questions, and try out crazy ideas are essential to learning. On the other hand, fear of embarrassment, or being punished, looking bad, or being put down by the teacher, or not being allowed to question the teacher can close down genuine learning. In the typical classroom environment in most Asian schools, students are under a lot of stress, anxiety, and fear, which can shut down learning.

INNOVATION AT THE CORE

How can we educate STEM students in this new core competency, essentially non-cognitive skills, in an academic paradigm based on cognitive skills such as Bloom's Taxonomy? The answer is a core pillar of the new skill set of mindfulness based emotional skills that studies show enable students to regulate their negative reactions, increase their positive emotions, deal with stress and anxiety, and build better relationships as well as improve their academic performance (CASEL, 2015).

The metaphor of a dojo may help here. A dojo (in Japanese literally "place of the way") is traditionally a training place for martial arts *and* meditation. One goes to a dojo, not to acquire the theoretical knowledge of a martial art, such karate or aikido, but to develop and embody the skills in body, mind and heart. This is done through instructions in mind-body skills, practice on the mat, practice with peers, making mistakes, and feedback from the trainer/master who is more of a coach than a lecturer. It is a continuous cycle of practice, intellectual understanding, peer learning, feedback, reflection and practice – and from time to time, testing oneself in a "tournament" or the real world. A key piece of this approach is in the skill set and "way of being" that are exhibited by the teachers. With regard to teaching these skills, a teacher, like a coach, goes beyond being simply a lecturer or expert.

Clearly, more schools are now incorporating practical hands on experiments and research on real world issues, field visits, internships, practical contests to build prototypes, and so on. What is missing is the "third" set of skills as mentioned at the beginning of this essay.

The corporate world has recognized the tremendous value of mindfulness and EQ (Emotional Quotient or EI "Emotional Intelligence") as seen in companies such as Google, Facebook, SAP, General Mills, Blackrock, Aetna, Facebook, and many others. In October 2015, a cross section of MPs in the UK parliament issued a report titled *Mindful Nation UK* calling for funding of pilot projects in teaching mindfulness in schools and in making it available as a treatment for mental health (Mindfulness all-party parliamentary group, 2015).

In the 1960's Thomas Watson, Jr., the CEO of IBM called a senior executive to his office to discuss their new initiatives, which had failed. Before leaving his office to meet Watson, the executive wrote out his resignation letter and took it with him. Upon entering the office, the executive took out his letter and stretched his hand to give Watson the letter.

With a surprised look, Watson reportedly remarked, "We knew there was a chance of failure. Why would I want to fire you, when I have just invested in an expensive lesson for you?"

SIMPLE STEPS FOR THE CLASSROOM

Recommendations from a 1000-ft view:

Teaching "failure" as an essential process in learning STEM disciplines

Failure is often seen as being a negative, harmful experience that generates embarrassment, fear, anxiety and often leads to severe self-criticism and doubt. How can STEM be taught so that failures illuminate pathways to new solutions? Clearly, an essential shift in the very meaning of failure as an essential part of the learning process is the key. This does not mean failing the entire semester or year. Teachers have to design opportunities for students to generate solutions to complex, novel problems before teaching them the concepts required to solve those problems. In essence, compelling students to confront "failures" or "I don't know".

A great example are video games, which are based on the concept of “zone of proximal development” (Vygotsky, 1978) in which a player goes through increasingly challenging levels and where failure is part of the learning process but a player is not punished. Each level, while challenging, is not overwhelming nor boring but very compelling. Players are highly motivated and focused – so essential for any kind of learning.

Learning is beyond finding the right solutions as per the books or what the teacher expects. Therefore, it is absolutely essential for the teacher to model failure as essential to learning, to openly recognize it, drawing lessons from such experiences, as well as giving incentives in different ways.

Mindfulness based emotional skills as a daily practice

Over the long run, a mindfulness based emotional skill practice can strengthen the scientific mind in students in investigating and cultivating their minds and hearts and why and how it can strengthen their cognitive or intellectual capacities. It includes being a beginner, curious, engaging in an inquiry/investigation, examining their own deceptive perceptions, making observations and proposing a hypothesis, or a tentative solution, accepting failure as being essential to learning and creating new solutions, open to critical feedback with taking it personally, being internally motivated to learn and experiment, and cooperating and collaborating with others as being necessary to finding new solutions to complex challenges.

Many studies offer compelling evidence as to the benefits of educating school teachers who can then teach students in the four practices of mindfulness, emotional regulation, conversational intelligence and deep breathing, all of which strengthen their cognitive, intellectual capacity plus more (Napoli et al., 2005; Wall, 2005 and Flook et al., 2008).

A 10-ft view: A simple daily routine:

- At the start of class, practice deep breathing to reduce effects of stress, calm the body and mind.
- At the end of class, share one positive experience (in small groups).

Total time about 5 minutes

- As part of health or social science class, include 5-10 minutes of mindfulness practice: deep breathing and focusing on the present moment (body sensations, thoughts, feelings) despite distractions.

At the heart of teaching and learning, non-cognitive “third” skills for STEM students is a strong foundation in mindfulness awareness/meditation, emotional skills, self-regulation, conversational intelligence and mind-body methods. Ironically in Asia, we have to re-appraise the value of ancient wisdom traditions as well as think outside-the-box of current educational paradigms to merge these innovative skills into the education of tomorrow's STEM leaders.



Ravi Pradhan recently retired as an international management consultant and coach. Ravi's new mission is to introduce mindfulness based EQ and conversational intelligence into schools, colleges and companies in Asia. He believes passionately that this skill set is consistent with Eastern wisdom traditions and must be a core foundation of education. (www.mindfulnessdojo.com)

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