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COMMENTARY

From STEM to ST2REAM: Reassembling Our Disaggregated Curriculum

By Kenneth Wesson

Countless millennia before the acronym STEM—for science, technology, engineering, and mathematics—entered our modern lexicon, early man was already engaged in STEM endeavors. Our ancestors spent significant portions of their days experimenting, tinkering, and thinking their way through myriad problems and challenges. During those prehistoric periods, the dreamers, the designers, and the builders identified the urgent problems, and subsequently crafted tools, crude instruments, and strategies to resolve them, working collaboratively for both survival and human progress.

Columbus' historic trans-Atlantic journey in 1492 was driven as much by innovation as it was by exploration. Fifteenth-century art, design, engineering, and innovative technologies made his expedition achievable. Once the highly maneuverable caravel sailing ships were invented, the travel time between continents was cut in half. Caravels were smaller, faster, and easier to navigate than other large vessels of that time. The mariner's compass and astrolabes made long-range voyages fast and feasible. Cartography, map-printing accuracy, and European printing techniques had taken a quantum leap forward courtesy of Johannes Gutenberg. Advances in mathematical procedures for estimating the earth's circumference gave greater precision to calculating global distances.

The European discovery of the New World constituted a prime example of the real-world synergies among science, technology, engineering, art, and mathematics. However, Columbus' impressive voyage has been academically quarantined to social studies, rather than viewed through a transdisciplinary lens where STEM content overlaps.

Problem-solving in the "real world" requires integrated solutions, in which science, language, mathematics, engineering, visualization, scientific reasoning, and technology are regularly intermingled in various combinations, sequences, proportions, and durations.

Similarly, the components of STEM can merge into a "ST2REAM" model of connected learning, where science, technology, thematic instruction, reading/language arts, engineering, art (visual/spatial thinking), and mathematics converge to reveal not only what "human knowledge" is, but how we know it is so. Critical and creative thinking come by way of one's ability to mentally manipulate information and to do so from a broad range of divergent perspectives.

We can "hook" students on the value of learning best by "hooking" the curriculum back together through content integration in meaningful learning contexts. In the process of "acquiring" knowledge, what occurs inside the brain is more accurately described as the integration of new information into existing relevant neural networks. Thus, "learning" is hardly a process of acquisition, but instead is the integration of new elements into a complex web of ever-expanding intertwined knowledge that has personal meaning. The subsidiary benefit of these massive connections includes the capacity for complex and flexible thinking, strategic reasoning, and recognition of the possibility of multiple solutions and fused answers, rather than a single one.

Understanding our external world would be extremely complicated without knowing how to produce and interpret models, illustrations, and visual information. If students lack the capability to visualize a concept, it becomes correspondingly difficult for them to describe it verbally, understand it in print, recognize it in another context, or reproduce it during subsequent assessments. When our students say, "Oh, now I see!" their declarations underscore the learning power derived from constructing the relevant visual image.

The hippocampus is a subcortical structure responsible for establishing memories and plays a crucial role in daydreaming, imagination, and creativity. Thirty percent of our days are devoted to these states, when our brains shift from concentration to "wander and wonder," paving the way for innovations and inventions.

Contrary to popular belief, the evolution of memory was not governed by a need to recall the world of the past. Instead, memory evolved to assist us in predicting and navigating the future based on intelligent forecasts substantiated by our prior knowledge. We developed the capacity to solve likely problems visualized as lurking in the immediate or distant future. Synthesizing useful information is the goal of long-term learning, not memorizing disjointed information from a broad academic menu of "specialties."

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Approximately 4 billion bits of information are processed by our brains every second, regardless of the school schedule or the time of day.

Our brains naturally organize incoming stimuli based on any recognized connections to stored information, rather than by academic designation. Memories are reinforced and expanded upon when related pathways are activated within a relevant context. The brain grants itself a chemical reward for making these connections, which is why "aha" experiences are emotionally lifting and addicting.

To capitalize on the finite number of hours in each school day, educators can extend the current STEM model to incorporate visualization and language. Developing visual literacy is an essential ingredient in design and engineering. STEAM adds art to the equation, while reading, writing, listening, and speaking are embedded in the ST2REAM model, in which each of the composing disciplines is intentionally deployed to explain and comprehend its counterparts. Scientific articles use more high-frequency, high-utility, and polysemous words than any other subject area, making science the richest source for teaching academic vocabulary. Science can indeed serve as the centerpiece for language development. These two curricular arrangements encourage us to boldly cross the conventional curricular borders and give students new bridges that contribute overtly to making each discipline comprehensible.

Our instructional focus should be on the points at which the ST2REAM disciplines naturally intersect in the course of producing knowledge in realistic situations. Students seldom ask, "Is this going to be on the test?" when they appreciate the transdisciplinary relevance, irrespective of our insistence that they perceive concepts through the lens of traditional subject-area silos. The ST2REAM disciplines all converge, allowing the learner to construct knowledge from context, because it makes sense rather than because it might be assessed.

"Learning is deepest when it engages the most parts of the brain," according to neurobiologist James Zull. When we increase the number of neural pathways linking markedly different regions of the brain, we can make substantive changes to brain circuitry, physiology, and architecture. Instead of attempting to enhance student learning through the conventional delivery systems—subject-area isolation and memorization—ST2REAM helps achieve our learning goals via situated learning, where the content resembles the wafer-thin layers composing a hologram. When stacked together, those layers are barely 12 millimeters thick. The beauty lies in an image that appears to be 3 feet deep but is derived from a half-inch-thick hologram.

The power of our incomparable human brain comes by way of maximizing its ability to make deep and long-lasting transdisciplinary connections, which permit us to dissect, reassemble, and make sense of the ever-changing world around us. The density of those connections is central to memory and comprehension, giving depth and stability to our knowledge.

The metadiscipline ST2REAM makes learning with rigor possible. Instead of merely mandating that more-rigorous math and science standards be delivered in the customary manner to advance the stem agenda in America faster and more permanently, we must take advantage of the unifying ST2REAM model for learning. Redesigning our daily curricula with "coherence" as the primary driver will surely increase the number of academic success stories in which the constituent subject areas are learned well, applied often, and modified in the "real world" when circumstances demand. If you have any lingering doubts, just ask Columbus.

Kenneth Wesson is a former psychology professor at San José State University in San José, Calif. He delivers keynote addresses on the neuroscience of learning for educational organizations and institutions throughout the United States and overseas. His research appears and is often referenced in the journal Brain World and in Parents magazine. He can be reached at kenawesson@aol.com.

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