THE i5 APPROACH

LESSON PLANNING THAT TEACHES THINKING AND FOSTERS INNOVATION

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Preface

Veronica Armstrong, a high school biology teacher, called me on Skype to discuss the new unit plans she was drafting in order to reflect the revised sequence of science courses at her school. "Jane," she said, "before we start on planning, do you mind if we talk a bit about the online course I am taking?" The class was great, she told me. It was called "Using Technology in the Classroom." Veronica explained that the first part of the syllabus was dedicated to knowing about the state's commitment to provide 1:1 technology (one student, one device) in every classroom. Then the instructor showed lots of exciting apps for students to use on personal devices in addition to numerous software programs available to teachers.

Listening to Veronica, it was clear how much she genuinely enjoyed learning about the different ways to incorporate technology into her classes. Making podcasts, she laughed, was the real hit among the teachers. Veronica commented that she thought her students would like some of the programs and apps she'd seen, but she was concerned about whether the technology would really help them become critical and creative thinkers and learn the biology content more effectively. "Am I out of line to wonder if using devices in class really leads to better learning?" she asked.

The Conundrum

It is no secret, Veronica continued, that students don't always use personal devices in classrooms in the way teachers intend. Students might appear to be actively taking notes on a laptop or researching online, but anyone strolling behind them would be sure to catch that instant screen change—the universal signal of a student hoping to avoid being caught doing something unrelated to a lesson. "It was bad enough when students stopped paying attention *before* personal devices," Veronica noted. "But now, technology seems to encourage distraction! If they are distracted, it is a chore to get them thinking about science."

Veronica confessed a second concern about student engagement and learning. "Please do not think I am complaining, but making a podcast and incorporating apps into my lessons requires a lot of planning on my part," she said. "For all that preparation, the result should be gains in student achievement. Does research confirm that my teaching efforts to use and encourage students to use technology in the classroom improves learning?" She said she had asked this question in her course's online chat, but noted, "The instructors and other participants only responded by posting studies indicating that students, parents, and teachers all reported higher motivation and satisfaction with implementing technology; there was nothing about thinking and improving learning."

My conversations with teachers indicate the same. Students seem more motivated to work on assignments when they use technology, but this has not necessarily translated into increases in test scores or grades. Some surveys reveal, and some teachers report, that students find class more engaging when they can use personal devices or electronic notebooks (Cox, 2015). Parents seem to concur, saying that their children like class more when they use technology (National Association of Elementary School Principals, 2013). It makes perfect sense, since students and everyone else seem to use technology effortlessly in everyday life. But very few studies show that incorporating technology into lessons improves overall student achievement (Hattie, 2009).

In fact, it seems the opposite may be true. In an article in *Psychological Science*, Pam Mueller and Daniel Oppenheimer (2014) share that taking notes on a laptop is a bad idea if you want to remember the information later. Their research showed that people who wrote out their notes longhand learned more deeply and remembered information much longer than those who word processed their notes on a digital device. If research shows that longhand note taking increases knowledge retention and deepens understanding, should teachers encourage students to use electronic note-taking programs? How can we advocate for "going paperless" in schools if going paperless does not improve learning?

Nicolas Carr, a journalist and Pulitzer Prize finalist, wrote about the quandary of digital vs. print in *The Shallows: What the Internet Is Doing to Our Brains* (2011). The title of the book foreshadows what he found: the internet is making us forget. Carr recounts his personal quest to determine how using technology was affecting his output; ultimately, he concluded that he could not. The problem, he says, was that he forgot much of what he read online, meaning that he was not able to think about topics in depth—and forgetting information is an anathema to a journalist. Acknowledging the risk of becoming known as a modern-day Socrates, who allegedly renounced the alphabet and writing, Carr cautions that using technology may increase consumption, but it's not likely to improve production.

In schools today, we use technology to present material and increase engagement, but is the time and money invested in classroom technology worth what seem to be negligible gains in achievement? I was determined to find a way to ensure that in-class technology use would magnify gains in student learning, productivity, and thinking.

Using Technology

I began the way Nicolas Carr did—by addressing my own experience using technology.

Electronic devices give me access to an almost infinite amount of information and visual representations through pictures or video. I use

a laptop or other device to read news, studies, and books online, and I often click on links to see pictures or videos to give meaning to what I am reading. Inevitably, I send an e-mail or text, and I often contact the recipient afterward to discuss the information I've sent. Without a doubt, technology improves my life by giving me immediate access to information, images, and interaction with others, and this capability is not trivial. Perhaps the key to effective teaching with technology involves teaching students to tap into those environments—information and image seeking and interaction—rather than choosing an app or a program for a task.

To clarify, here is a story from my teaching past. In the days before students had personal devices in the classroom, I assigned research tasks that sent students to the textbook, the encyclopedia, or other print material in the school library's limited collection. For example, in a unit on the Industrial Revolution, I might have directed students to read about the conditions of workers in garment factories, meatpacking factories, and coal mines. Although I intended for them to find information that would allow for thoughtful comparison of these different working environments, support reasoned conclusions about the lives of these workers, and inspire original perspectives on the economies of the age, what students usually produced were well-organized sets of the same, predictable observations and conclusions. What I now realize was that the three or four paragraphs in the textbook, the encyclopedia, and our school library's print collection didn't give my students enough information to do what I wanted them to do—engage in deep thinking to generate original ideas. The resources available to them left them with literally *not enough to think about*. What's more, the student products didn't give me the evidence I needed to evaluate their analytical abilities or assess deep learning. I was left to determine grades by focusing on criteria such as whether they met the project deadlines, the appearance of the material, and presentation style.

Today, students using technology could approach a task focused on researching working conditions during the Industrial Revolution very differently. With ready access to the internet, they could synthesize

information from numerous sources, including diaries, charts of the ages of workers, and documentation of work injuries. Images, photographic stills and video interviews with descendants of those who worked in factories or mines would provide critical details and generate interest. The task could easily be expanded beyond two or three types of environments to many other workplaces, and students could use the wealth of information available to engage in analyses and draw a wide range of conclusions about the impact of industrialization on different geographic areas or population settlements. Let's take a moment here to appreciate how invaluable digital devices are for tasks that require research and information gathering, because they provide such a breadth of information and images to support and drive inquiry, questioning, and reflection.

For many of us, digital devices are synonymous with communication. As events happen around the world, we reach out to others to seek clarification, find new or more or expertly curated information, get feedback, and receive correction. Now think of how students working on the Industrial Revolution task might interact with one another by editing shared text files and using video chats or messaging to join in conversations among themselves or with outside experts.

As I engaged in this kind of reflection, the need for using technology to teach thinking in class started coming into focus. The way to plan lessons for using technology in the classroom had to include opportunities for students to learn how to effectively access information and images, and for students to engage in some form of interaction for correction and clarification.

Eureka!

In *The New Executive Brain: Frontal Lobes in a Complex World* (2009) cognitive neuroscientist Elkhonon Goldberg writes about the prefrontal cortex, the brain's control center. It's here that each of us combines the information that we take in through our senses, processes it with labels and language, factors in our past or current interactions and

experiences with one another and the world—and turns this all into *meaning.* Goldberg describes human cognition as forward looking and gives a name to the process humans use to manipulate and transform current and past information into a model of something that does not yet exist—*thinking*.

Reading Goldberg was my *Eureka!* moment.

The frontal lobes of the human brain are designed to seek out and process sensory information to use to generate new ideas. Consider students' lives in the noisy (ears), odorous (nose), and highly stimulating (eyes, touch, taste) outside world, and then consider a classroom where students have been primarily relegated to listening (ears) and seeing (eyes). If using technology in the classroom could increase sensory data about any given topic by providing an expanded supply of information, images, and interaction, then students would more likely do what comes naturally to the brain: think to generate new ideas. We may not be able to provide the tasting and touching sense in schools, but brain studies show that brains can make amazing adaptations when there is a need to compensate (Doidge, 2007). When teachers design lessons that expand the range of sensory inputs available to students, they increase the odds that students will engage in critical and creative thinking—otherwise known as *inquiry.*

And there I had my criteria for using digital devices not only to support learning, but also to build stronger thinking. Within lessons, technology should be employed in ways that encourage students to access *information*, *images*, and *interaction* that will power *inquiry* and lead to the generation of new ideas—otherwise known as *innovation.* The i5 approach was born.

The i5 Approach

To recap, the concept of the i5 approach emerged from blending the expectation that students use technology in class with the neurological explanation that a person needs sensory information—literally, something to "think about"—before he or she can generate original ideas.

Today, we can move forward from schools where chalkboards and hornbooks provided the environment for only the three r's (*r*eading, '*r*iting, and '*r*ithmetic) to the 21st century classroom where digital devices provide the learning environment for the five i's: information + images + interaction + inquiry = innovation.

The i5 approach is a powerful lens that any teacher, from primary to secondary school and beyond, can use when planning lessons. Ask yourself, when should students look up more *information*? How would an *image*, video, or audio component deepen a student's understanding of a topic? Would *interacting* or receiving ongoing feedback through shared documents or instant communication clarify, correct, or deepen understanding that students can use to make meaning?

The i5 approach was immediately compelling to me, but I realized that it could not be about technology alone; teaching the *inquiry* skills needs focused attention. Think of it this way: in a world where information is only a click away, teachers should help students acquire and develop the critical and creative thinking skills to transform information, images, and interaction through inquiry into *innovation*.

Back to the Future

Nearly every school mission statement and strategic plan promises to increase critical and creative thinking skills, and many teachers say they use Bloom's taxonomy when planning and delivering instruction. But it's fair to say that most teachers do not explicitly teach thinking skills. My next step in refining the i5 approach was to figure out the best way to teach the thinking skills.

Looking back to the 1980s, the concept of teaching thinking in schools came to the forefront in education. Professional development for teachers in the United States responded to the memorable *A Nation at Risk* report issued in 1983, which identified an urgent goal for U.S. educators. Schools had to change; teachers needed to teach students how to become critical and creative thinkers.

If you search online for thinking skills programs that germinated during this time, you will find de Bono's *CoRT Thinking* (1986), Richard Paul and Linda Elder's *Critical Thinking* (2014), Art Costa's *Developing Minds* (1985), and Dimensions of Learning, a framework that I coauthored with our team at McREL Laboratory (Marzano et al., 1997). Based on evidence that most teachers wanted to teach thinking but needed a curriculum to show them how to do it, the different programs offered steps for teaching critical and creative thinking. What was not obvious to us at the time was that students and teachers, who faced a paucity of information in print materials, literally lacked the information that merited using robust thinking or inquiry processes. Teachers sensed the problem, but in the print world of the 1980s, we did not see any easy solution.

Then, the standards movement of the 1990s happened. The standards that emerged might have expanded and deepened content knowledge in a manner that would have given students more to "think about" and fueled critical and creative thinking, but political agendas steered educators away from this. The energy and funding that went into developing standards for testing and testing for standards was a devastating distraction to educators.

Thirty years later, not all is lost; in fact, with the dramatic advance of technology since 2007 and the widespread popularity and greater affordability of smartphones and tablets, timing may be in our favor. Based on the current standards and the available online content, there is plenty for students to think about. Students can search broadly for information and images about topics, and interact with many others, but they still need explicit instruction on how to inquire: analyze and evaluate what they find. We can revisit the thinking skills program, update the skills based on current neurological research, and produce the steps for teachers to teach inquiry.

This is a good time to clarify that in this book, the phrase *inquiry skills* is used synonymously with *critical and creative thinking skills. To inquire* is to ask a question and seek information, but *inquiry* involves studying, scrutinizing, and exploring. Some programs use the word to

describe any unit of study that includes gathering information about a topic to resolve a problem, clarify doubts, or increase understanding. As noted, with the i5 approach, we make the distinction that teachers need to provide students with explicit instruction for learning inquiry or thinking skills; we do not assume that students know how to apply the steps of thinking to new information they encounter in school.

Rather than encouraging teachers to have students use technology, we can encourage teachers to teach students critical and creative thinking skills, *and that requires technology use*.

In This Book

In this book, my colleague and contributing author Susan Hensley and I describe that process. We explain how to design lessons that thoughtfully incorporate the wealth of inputs and options that technology makes available in today's classrooms and how to explicitly teach critical and creative thinking in a way that makes students skilled and powerful thinkers and ready innovators.

Chapter 1 gives an overview of teaching thinking for innovation, drawing on the works of neuroscientists who write for public awareness and practical uses. V. S. Ramachandran (2011), author of *The Tell-Tale Brain*, writes, "Brain science has advanced at an astonishing pace over the last 15 years, lending fresh perspectives on—well, just about everything" (p. xii). Although Ramachandran is well-versed in the new research, he has not abandoned traditional approaches that get positive results. For example, he suggests that his amputee patients seeking therapy for phantom limb pain use a cardboard box and a mirror at home rather than endure trips to hospitals to wait to use high-tech machinery. Ramachandran's work was a reminder to me that many teachers work in schools that do not have the latest technology—schools where students might still learn in a shared computer lab or use low-cost netbooks. The i5 approach doesn't require state-of-the-art technology; it works in any classroom with whatever technology is available to help teach students to think.