FROM THE RESEARCH DESK: Thinking about Teaching Thinking Part 2, How Can We Do It?

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This is the conclusion of a two-part series begun in the May 2013 issue of ***Connections****, entitled* ***Thinking about Teaching Thinking, Part 1: Why the Urgency?*** *Follow this link to the May issue to review that article.*

"Thinking is hard. Thinking about some problems is so hard it can make your head ache just thinking about thinking about them." – Daniel Dennett

"Everyone thinks. But not everyone thinks equally well." – Robert and Michele Root-Bernstein

"We come to know what it means to think when we ourselves try to think." – Martin Heidegger

"Can critical thinking actually be taught? Decades of cognitive research point to a disappointing answer: not really." – Daniel Willingham

According to these authors, thinking is hard and not everyone does it well. Thinking about how to teach critical thinking involves thinking, but may actually not be very teachable! In the initial article in this two-part inquiry into "Thinking About Teaching Thinking," I noted how crucial the various aspects of thinking are for students of today, and promised that in this part 2 I would share some specific strategies for teaching not only critical thinking, but its near relatives: creativity, imagination, feelings, intuition, even emotions; all as essential aspects of thinking!

I begin by stating that I disagree with Willingham. Let us start by asking and answering a key question as posed by Jane Healy in her book, ***Endangered Minds: Why Children Don't Think and What We Can Do About It***:

Are so-called 'thinking skills' best taught by setting aside a special time for mental calisthenics and then hoping they will transfer to other sorts of learning? Or are 'thinking skills' better served by teaching all subjects in ways that draw students toward higher-level reasoning by the nature of the materials and the problems presented? The most generally prevailing opinion (aside from the purveyors of 'thinking skills' programs) is that persistence and flexibility in problem-solving should be incorporated into overall teaching goals, modeled and supported in every discipline – provided, of course, that the teacher's own thinking skills are up to the task.

To give a specific example of how to teach these thinking skills, Healy suggests several simple "meta-cognitive" activities, including this one:

When confronted with a problem, children may be taught to follow a four-or five-step plan such as the following:

1) Stop. Think. What is my task? (identify the problem in words)

2) What is my plan? (talk through possible steps to solution)

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3) How should I begin? (analyze first step)

4) How am I doing? (keep on task)

5) Stop. Look back. How did I do? (analyze the result)

With this perspective firmly in mind, I next turn to some specific examples of teaching the interrelated aspects of critical thinking, beginning with "hand tools of the mind" as Dennett calls them, and what the Root-Bernsteins simply call "thinking tools."

Daniel Dennett, in ***Intuition Pumps and Other Tools of Thinking,*** begins with this math puzzler [didn't you hate these in Algebra?!]:

Two trains, 100 miles apart, are approaching each other on the same track, one going 30 miles per hour, the other going 20 miles per hour. A bird flying 120 miles per hour starts at train A (when they were 100 miles apart), flies to brain B, turns around and flies back to the approaching train A, and so forth, until the two trains collide. How far has the bird flown when the collision occurs? [Check your answer in the footer of this page.]

Did you solve this puzzler correctly? How did you do it? Is there more than one way to do this? What thinking tools did you use? Did they work? Since we're not in math class now, I'm less interested in whether you found the correct answer, but in the thinking involved. Dennett presents dozens of "handy prosthetic imagination-extenders and focus-holders [that] permit us to think reliably and even gracefully about really hard questions. The first of these is 'making mistakes.'" He maintains, "making mistakes is the key to making progress…. Mistakes are not just opportunities for learning; they are, in an important sense, the only opportunity for learning or making something truly new."

Did your math teachers return your homework papers and quizzes expecting you to correct your mistakes before going on?; or did they simply return the papers and move on, never emphasizing the importance of learning from your mistakes? Among numerous others, Dennett initially describes these four simple "hand tools of the mind:"

1) Labels – Sometimes just creating a vivid name for something helps you keep track of it while you turn it around in your mind trying to understand it.

2) Examples – Some philosophers think that using examples in their work is, if not quite cheating, at least uncalled for – rather the way novelists shun illustrations in their novels…. Good for them, but they can't expect me to recommend their work to any but a few remarkable students.

3) Analogies and metaphors – Mapping the features of one complex thing onto the features of another complex thing that you already (think you) understand is a famously powerful thinking tool.

4) Staging [scaffolding] – Some of the most valuable thinking tools in this book are examples of staging [scaffolding] that take some time to put in place but then permit a variety of problems to be tackled together.

These all no doubt sound familiar; do you use them regularly in your teaching at whatever grade level and with whatever subject matter? In mathematics we have long division and finding-the-average, each of which describes a clear arithmetical process which when named can quickly remind us how to solve a problem. This simple, four-part summary is a useful reminder for all of us. And then there is Dennett's last hand tool, what he calls "intuition pumps" or thought experiments.

Dennett's friend and co-author of ***The Mind's I,*** Doug Hofstadter, offers this familiar sounding list of hand tools: "wild goose chases, tackiness, dirty tricks, sour grapes, elbow grease, feet of clay, loose cannons, crackpots, lip service, slam dunks, and feedback." Each of these short-hand words or phrases, when used in a conversation, conjures up a process that quickly helps us understand the other person. Take, for instance, "sour grapes." No doubt you'll recall this comes from Aesop's fable, "The Fox and the Grapes."

[It] draws attention to how sometimes people pretend not to care about something they can't have by disparaging it. Look how much you can say about what somebody has just said by asking, simply, 'Sour grapes?' It gets her to consider a possibility that might otherwise have gone unnoticed, and this might very effectively inspire her to revise her thinking, or reflect on the issue from a wider perspective…

I believe that teaching young people these kinds of simple stories and simple thinking tools can help them become better thinkers.

 [240 miles!]

In ***Sparks of Genius: The 13 Thinking Tools of the World's Most Creative People,*** Robert and Michele Root-Bernstein present their own list of thinking tools and believe strongly in the importance of integrating these as a central part of our educational system:

Our educational system is the embodiment of our cognitive and creative understanding of ourselves. If we fail to understand creative thinking, we cannot hope to have an educational system that will produce creative individuals. Conversely, a society that understands the nature of creativity will be able to foster it in the classroom. Indeed, we intend that these tools be used to cultivate imagination along with intellect, to reintegrate knowledge of mind with knowledge of body, to reveal in glorious detail the ways in which artists, scientists, dancers, engineer, musicians, and inventors think and create, so that the most unexpected surprises may illuminate all our lives.

The authors believe deeply in a need for a new kind of "trans-disciplinary, synthetic education that does not require a change in what we teach, rather a synthetic education that requires only that we change how we teach, drawing on these eight basic goals":

First, we must emphasize the teaching of universal processes of invention in addition to the acquisition of disciplinary products of knowledge.

Second, it follows that we must teach the intuitive and imaginative skills necessary to inventive processes.

Third, we must implement a multidisciplinary education that places the arts on an equal footing with the sciences.

Fourth, we must integrate the curriculum by using a common descriptive language for innovation.

Fifth, we must emphasize the trans-disciplinary lessons of disciplinary learning.

Sixth, we must use the experiences of people who have successfully bridged disciplines as exemplars of creative activity within our curricula.

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— Daniel Dennett

Seventh, to reach the widest range of minds, ideas in every discipline should be presented in many forms.

Finally, we must forge a pioneering education, whose purpose is to produce the imaginative generalists who can take us into the uncharted future.

With these goals in mind, the authors draw on extensive interviews with people from all fields of endeavor in deriving their list of 13 tools for thinking, involving the creative integration of "emotional feelings, visual images, bodily sensations, reproducible patterns, and analogies." They propose these as a kind of meta-logic which they feel is close to what others, i.e. Dennett, call intuition. These 13 tools are divided into two sets. Here are the first set of nine, which the Root-Bernsteins call primary tools:

1) Observing – paying attention to what is seen, heard, touched, smelled, tasted or felt within the body.

2) Imaging – images can be recalled or created for any sense or sensation, seeing in the mind, hearing sounds and songs, feeling not yet touched.

3) Abstracting – the process of pairing down complicated things to simple principles is the same.

4) Recognizing patterns – discovering nature's laws, the rhymes and rhythms of language, dance, music, and formal intentions of the painter.

5) Forming patterns – almost always begins with combining simple elements in unexpected ways, and patterns to pattern forming itself.

6) Analyzing – the realization that two apparently different things share important properties or functions.

7) Body thinking – pre-verbal and pre-symbolic thinking that occurs through physical sensations, awareness of muscle, sinew and skin.

8) Empathizing – related to body thinking, losing themselves in the thing they are studying [like "in flow" as Mihaly Csikszentmihaly describes].

9) Dimensional thinking – the imaginative ability to take a thing mentally from a flat plane into three dimensions or more.

The Root-Bernsteins view none of these as absolutely independent of any of the others, but see them all as integrated and as connected. I believe these are all highly teachable at whatever grade level and within whatever subject matter context. These authors then go onto describe four additional higher order tools for thinking, relying on the nine primary tools:

10) Modeling – often requires combinations of primary tools.

11) Playing – involves a childlike joy in the endeavor at hand, playfully challenging the limitations of a science, an art, or a technology just to see what happens; a common way in which novel ideas are born.

12) Transforming – becoming aware of problems through feelings of mental or bodily discomfort, yet having to express the solution logically in words, movements, equations, or as an invention, requiring a series of steps to transform the problem into a solution, often integrating one or more of the other tools of thinking.

13) Synthesizing – finally, and most importantly, understanding always involves synthetizing, combining many ways of experiencing (e.g. "synesthesia," and "synosia").

This last tool of a "synthesizing education" connects to the third of the ***5 Minds for the Future,*** the synthesizing mind, in the recent book by Howard Gardner. The other four are "the disciplined mind, the creating mind, the respectful mind, and the ethical mind." Within this category of the synthesizing mind, Gardner sees eight elements:

a) Narratives – the synthesizer puts material together into a coherent narrative; examples range from the Bible to a contemporary history or social science textbook as well as in fiction.

b) Taxonomies – materials are ordered by some essential characteristic; e.g. the Dewey decimal system in the library, the Linnaean classification of plants and animals, double-entry balance sheets in an annual report [similar to the "labeling" of Dennett].

c) Complex concepts – newly stipulated concepts can tie together or blend a range of phenomena; e.g. Darwin's evolution, Freud's "unconscious" [similar to the integrating of concepts described by the Root-Bernsteins].

d) Rules and aphorisms – much folk wisdom is captured and conveyed to short phrases, designed to be memorable and widely applicable; e.g. "Think first, act second," or "An ounce of prevention is worth a pound of cure." [again as seen in Dennett's "hand tools for thinking"]

e) Embodiments without words – as in works of art [as emphasized by the Root-Bernsteins].

f) Theories – concepts can be put together into an over-arching theory; e.g. Adam Smith's theory of a market economy weaving together ideas of supply and demand, labor, production, profit, and loss.

g) Metatheory – as in an overall framework for knowledge, as in a "theory of theories."

Gardner goes on to describe the creative mind, noting the connections and similarities to the synthesizing mind, much as in the ***Sparks of Genius***, the Root-Bernsteins emphasize the interrelatedness of their tools of thinking. Gardner also points out, usefully, that much of the synthesizing and creative thinking is not done simply by the individual, but by teams of as few as two, or as many as hundreds when speaking of the sharing of experimental results within the scientific community. He calls for students to learn how to be collaborative

and how to give and receive effective feedback, again, recalling the Root-Bernsteins' tools.

Over thirty years ago, I, along with one of the teachers from my school, had the opportunity to participate in a series of four, two-to-three day workshops over a year, in the use of a series of "Instrumental Enrichment" booklets of student activities, designed originally by the Israeli educator, Reuven Feuerstein in the mid-1970s. [See the most recent book about this amazing work still being carried on by Reuven Feuerstein, Refael Feuerstein and Louis Falik, ***Beyond Smarter: Mediated Learning and the Brain's Capacity for Change.***] Feurerstein defines intelligence as a "force that drives the organism to change itself and change the structure of thinking and reaction in order to answer the needs that appear before it and change before its eyes…. A dynamic energetic agent or state that is unstable and responsive to the person's need to modify him- or herself in order to adapt to situations and cope with them successfully."

Feuerstein created these fourteen instruments along with the "Learning Potential Assessment Device." These booklets were designed to address the needs of the flood of Jewish immigrants settling in Israeli from throughout the world, to help fill in the gaps in the education of these students from widely divergent backgrounds. Intended to be used over a three-year period, these booklets addressed such cognitive skills as organization and relationship, orientation and directions in personal space, comparisons, analytic reasoning, classification and categorization, temporal relations, numerical relations, and hypothetical thinking.

After learning how to work with these tools, I used them with high school students in a special project that met weekly. My colleague used them, most particularly the "organization of dots" booklet as seen in the figure on the next page, with her sixth graders. We found these tools were most useful when taught in the context of specific subject matter, e.g. using the organization of dots activities (making geometric shapes out of patterns of dots – see the next page) in a middle school math class. In "New Neuroscience Findings on the Brain/Mind's Capacity for Change: An Epilogue," the closing chapter of Beyond Smarter, in support of their years of research, the authors note:

[T]he neurosciences bring us evidence not only of the modifiability of the individual's mental functions… not just change in the structure of the behavior, of the mental processes, but are actually related to changes in both the hardware and the software of the neural system.

I strongly recommend the work of the Feuerstein Institute and their Instrumental Enrichment activities, in light of what is happening to our current students and the increasing importance of the development of their creative thinking abilities.

This brings me to two thoughts from ***Education and Democracy in the 21st Century,*** by Nel Noddings. The first, from the closing chapter, "Critical Thinking on 21st Century Education:"

There may be no more powerful diagnostic tool that the method of overt thinking that Piaget used in his research. The idea is to ask the student, 'Let me hear you think.' Clearly, the success of this method depends on a level of trust maintained between teacher and student.

And her ending to this insightful book:

If we value our democracy, we will remember that it is perpetually a cooperative work under construction. So is education. We have much to gain from a critical and appreciative appraisal of the past and, perhaps even more, from a cooperative and imaginative exploration of the future.

Last, I'd like to add these thoughts from Meira Levinson in her recent (2012), challenging book, ***No Citizen Left Behind.*** She describes cogently the "civic empowerment gap" of today's students, particularly our students of color. Levinson makes a strong case for what she calls "action civics," the active engagement of our students in the real issues of the day, for which they will need to be creative, imaginative, intuitive, and caring, critical thinkers:

Ultimately, this is for our own benefit as much as theirs. If we want to live in a better world, in a stronger democracy, in a United States that truly stands one day for 'justice for all,' we need the insights, energy, and knowledge that young people – including low-income youth of color – bring to the struggle. We also need the wisdom they will bring when they are older. Tackling the civic empowerment gap today expands the ranks of active citizens both now and in the future. This long-term, communal, and equitable engagement is essential for achieving the 'more perfect Union' to which we all aspire. It is time for us to move forward together.