SMART SCHOOLS: BETTER THINING AND LEARNING FOR EVERY CHILD

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- We do not have a knowledge gap – we have a monumental use-of-knowledge gap.
- The art of remembering is the art of thinking; …when we wish to fix a new thing in either our own mind or a pupil's our conscious effort should not be so much to impress and retain it as to connect it with something else already there. The connecting is the thinking; and if we attend clearly to the connection, the connected thing will certainly be likely to remain within recall. William James
- Instead of knowledge-centered schools, we need thinking-centered schools.
- **Inert knowledge**: Startlingly often, students have knowledge that they remember when directly quizzed, but do not use otherwise. It does not come to mind in more authentically open-ended situations of need, such as writing an essay, pondering the morning's headlines, considering alternative professions, selecting a new stereo, or studying another subject.
- *A Private Universe*: Movie of Harvard graduates who were asked a very basic question, but could not answer it.
- **Naïve Knowledge**: When students are asked to repeat facts or apply formulas, they are very often right. But when they are asked to explain or interpret, students often reveal the old naive theory is intact.
- **Ritual Knowledge**: Rather than coming to a full understanding of something, students apply formulas that work in a school situation, but are inaccurate in real world. "If there are only two numbers I subtract. If there are lots of numbers, I add. If there are just two numbers and one is smaller than the other, I divide to see if it comes out even and if it doesn't' I multiply."
- According to research conducted by cognitive psychologists Carl Bereiter and Marlene Scardamalia at the Ontario Institute for Studies in Education, most students write using a tacit "knowledge-telling strategy." If spelled out in so many words, this strategy basically says, "Write down something you know about the topic. Then write down something else you know. Then write down something else. And when you have enough, write down something that sounds like an ending and hand it in.
- Learning is a matter of accumulating a large repertoire of facts and routines.
- Naïve theory: Success in learning depends on ability much more than effort.
- Probing students' tacit theories of learning, Dweck and colleagues have classified learners along a continuum ranging from "entity learners" to incremental learners. The latter are more aggressive learners. They believe that learning comes by increments; you have to hang in there and persist, winning your way to an understanding. In contrast, entity learners harbor the philosophy that learning something new is taking in an entire entity all at once. You either get it or you don't.
- Interestingly, sometimes relatively bright learners, in an IQ sense, are also entity learners; they may lack stamina and strategies for dealing with situations when the learning gets tough.
- One might say that American schools are virtual empires of ability. The teaching is there to feed those of greater ability all they can take and to herd along the rest. Ability, not effort, is seen as the primary determining factor in how much a student can learn. In other cultures as well as in laboratory research, this premise has been challenged and has been proven false to a considerable degree.

- Allan Collins: Key moves of Socratic teaching
  - Select both positive and negative examples to illustrate all qualities relevant to the issue under consideration
  - Vary cases systematically to help focus on specific facts.
  - Employ counterexamples to question students' conclusions.
  - Generate hypothetical cases to encourage reasoning about related situations that might not occur naturally.
  - Use hypothesis identification strategies to force articulation of a particular working hypothesis.
  - Use hypothesis evaluation strategies to encourage critical evaluation of predictions and hypotheses.
  - Promote identification of other predictions that might explain the phenomenon in question.
  - Employ entrapment strategies to lure students into making incorrect predictions and premature formulations.
  - Foster tracing of consequences to a contradiction to encourage the careful formation of sound and consistent theories.
  - Encourage the questioning of answers provided by authorities such as teacher and textbook to promote independent thought.
- Didactic teaching serves a need that arises in instructional contexts, that of expanding learners' repertoire of knowledge. Coaching serves another need: ensuring effective practice. Socratic teaching serves yet others: helping learners to work through concepts for themselves that they might not truly grasp in any other way, as well as giving them a chance to engage in and learn about inquiry.
- Theory One: People learn much of what they have a reasonable opportunity and motivation to learn.
- Contrary to Piaget's belief that stage advance comes at its own pace, a number of teaching experiments have accomplished stage advance by using a variety of instructional methods. Contrary to Piaget's notion that stages have a universal cross-disciplinary character, it appears that the progressive mastery of more sophisticated patterns of reasoning is often discipline specific. And in regard to the precept that certain patterns of logical reasoning are simply not accessible to young children, investigators have found again and again that children can display such patterns of reasoning when the content is familiar, representations are concrete, and supports for short-term memory (e.g. paper and pencil) are available.
- Strong extrinsic reward tends to undermine intrinsic interest. If an activity is both interesting in itself and rewarded in extrinsic ways, children's intrinsic interest tends to wane.
- Intrinsic interest is related to creativity: People are more likely to perform creatively if driven by strong intrinsic motivation.
- The emphasis on the quest for new and better instructional methods is a mistake. Not how we teach, but what we try to teach is our most important choice.
- Virtually all educators want students to understand what they are learning, not just acquire rote knowledge and skills. But most educators do not get students to practice their understandings. Instead, students end up practicing remembering.
- To a startling extent, we do not really try to teach what we want students to learn (e.g. connections to life outside of school)
- Knowing is a state of possession, and I can easily check whether learners possess the knowledge they are supposed to. But understanding somehow goes beyond possession. Understanding is not a state of possession, but one of enablement.

- Understanding is not a matter of either you get it or you don't. It is open ended and a matter of degree. You can understand a little or a lot about something, but you cannot understand everything about something because there are always more extrapolations that you might not have explored and might not be able to make.
- The mental images that students have are often pivotal to their understanding of a subject matter. The mental images are often not part of what is ordinarily called content. They are more general and overarching.
- Rebecca Simmons and David Perkins developed a four-tier analysis of levels of understanding
  - Content: Knowledge and know-how concerning the facts and routine procedures of a subject matter (repeating, paraphrasing, executing routine procedures). The mental images are particular and, although important, somewhat parochial: the layout on paper of long division, a synoptic mental movie of the Civil War, etc. Conventional education exposes students to a lot of knowledge at this level.
  - Problem Solving: Knowledge and know-how concerning the solution of characteristic textbook problems in the subject matter. The relevant performances are one kind of understanding performance: problem solving in the textbook sense; for instance solving word problems or diagraming sentences in English. The mental images involve problem-solving attitudes and strategies. Conventional education provides abundant practice in problem solving, but very little direct instruction in problem-solving-related knowledge.
  - Epistemic: Knowledge and know-how concerning justification and explanation in the subject matter. The relevant understanding performances include generating justifications and explanations; for example, justifying a critical opinion in literature or explaining causes in history. The mental images express the forms of justification and explanation appropriate to the discipline. Apart from Euclidean geometry, conventional education gives very little attention to justification and explanation. In contrast with problem solving, students are generally not even engaged in activities of justification and explanation.
  - Inquiry: Knowledge and know-how concerning the way results are challenged and new knowledge constructed in the subject matter. The relevant performances include advancing new hypotheses (new to oneself at least) and challenging assumptions. Noting such contrasts and extrapolating their implications for activities within mathematics, physics, and other disciplines are part of what it is to understand the subject matters individually and collectively.
- Mayer discovered that students' verbatim recall of the concepts taught did not differ much with or without the conceptual models. But when the conceptual models make up part of the lesson, recall of the gist of the message was superior. Moreover, the students showed much better performance on problems that asked them to extrapolate from what they had learned.
- Mayer also discovered that conceptual models presented after a lesson yielded no positive effects. Mayer suggest that conceptual models presented after a lesson about a concept run up against students' already formed ideas and fail to penetrate.
- Pedagogy of understanding invites reorganizing the curriculum around generative topics that provoke and support a variety of understanding performances.
- Standards for a good generative topic:
  - Centrality: the topic should be central to a subject matter or curriculum
  - Accessibility: the topic should allow and invite teachers' and students' understanding performances rather than seeming sparse or arcane
  - Richness: the topic should encourage a rich play of varied extrapolation and connection making.

- The trivial pursuit model has led to huge compilations of bits and pieces of information. The smart school wants it just the other way. Working toward informed, energetic, and thoughtful learning, the smart school encourages teachers to think deeply about what they are teaching and what gives them time and background information to help. In the smart school, there are fewer bits and pieces, and they cluster around more general and pregnant generative topics.
- Key components of the metacurriculum
  - Levels of understanding: kinds of knowledge above the level of content knowledge in their abstraction, generality and leverage
  - Languages of thinking: verbal, written, and graphic languages that assist thinking in and across subject matters
  - Intellectual passions: Feelings and motives that mobilize the mind toward good thinking and learning
  - Integrative mental images: Mental images that tie a subject matter or large parts of it together into a more coherent and meaningful whole
  - Learning to learn: Building students' ideas about how to conduct themselves most effectively as learners
  - Teaching for transfer: How to teach so that students use in other subject matters and outside of school what they learned in a particular subject matter.
- Whereas thinking skills generally do not focus on the subject matter, the metacurriculum concerns their conceptual organization as well.
- Whereas thinking skills usually are seen as cross-disciplinary, the metacurriculum emphatically includes discipline-specific skills.
- Whereas thinking skills by name and nature center on thinking, the metacurriculum includes integrative mental images and teaching for transfer.
- In summary, then, the general area of languages of thinking offers a major body of content for the metacurriculum, including
  - Restoration to the classroom of such familiar English thinking terms as belief, hypothesis evidence
  - Cultivation of concepts and strategies for decision-making, problem solving, and related kinds of thinking
  - Introduction of ways of thinking on paper, such as concept maping and use of tradition text forms, to help manage the problem of cognitive load and afford more opportunities for capturing thoughts and reflecting on them
  - Generally steering the culture of a thoughtful classroom.
- Seven dispositions of the good thinking
  - The disposition to be broad and adventurous.
  - The disposition toward sustained intellectual curiosity.
  - The disposition to clarify and seek understanding.
  - The disposition to be planful and strategic.
  - The disposition to be intellectually careful
  - The disposition to seek and evaluate reasons.
  - The disposition to be metacognitive.
- Strategies that foster transfer
  - Bridging: teacher helps the students to make connections between what they are studying and other areas

    - Hugging: keeping the instruction close to the very target performances one tries to cultivate, so that transfer is less of a problem.
- Research by Bransford shows that problem-based learning leads to more flexible and generative application of the knowledge later. It is a matter of hugging: Because students learned the knowledge in the context of problem-solving tasks, knowledge is better organized in their minds for later problem solving.
- Knowledge as design asks learners to analyze things as designs that serve a purpose (i.e. What is the purpose of the preamble?)
- Students are not so much encouraged to think on paper as to use the paper and pencil to display their thinking.
- In summary, in all sorts of ways, learners and others commonly cede executive control to some part of the surround – the text, the worksheet, the teacher. Ceding executive function to the surround is one of the most effective cognitive strategies we have. In everyday life, we do it all the time. When you follow a map or a set of direction for assembling a bicycle, you are ceding executive function, and soundly so.
- Textbooks and teachers do virtually all the problem choosing for students, deciding which problems are worth attention and usually in what order. When you no longer have the exercises at the end of the chapter, students often do not know what to do.
- How to distribute intelligence
    - Physical distribution of intelligence: Notes, diaries, portfolios, calculators, computers, etc.
    - Social distribution of intelligence: Learning in groups with common group test. Pair problem solving. Socratic teaching, drama activities
    - Symbolic distribution of intelligence: Essays in mathematics and the sciences. Diagrams, taxonomies in literature. Varied text forms stories, essays, lists, concept maps, charts, two-dimensional tables
- What to watch out for
    - The reliable fingertip effect: Benefits of new physical, social and symbolic configurations not automatic. Needed: help in recognizing opportunities, managing the cognitive burden, careful design for motivation
    - Executive function in managing tasks: Good executive somewhere in the system, not necessarily the student. The student naturally gets the executive function.
- Complex cognition demands much more effort. It creates greater risk of failure. It introduces the discomforts of disorientation, as learners struggle to get their heads around difficult ideas. No wonder, then, that students perfectly reasonably do not automatically gravitate toward complex cognition.
- Good choice of a limited set of generative topics can help teachers evade the token investment strategy, where they spread themselves thin and "cover" curriculum.
- Fermi problems, after Nobel Prize winning physicist Enrico Fermi, offered unstructured problems for fun. (e.g. Estimate the number of pencils in Chicago.)
- Only the most courageous and even outrageous teachers can build hot cognitive economies in classrooms within schools and school systems. States are timid in their aspirations and comfortable with cool cognitive economies.
- We need to put to work the principle that learning is a consequence of thinking. If we do not, we simply will not get the amount or kind of learning that we want. Instead, students will acquire fragile knowledge that is often inert, naïve or ritualized.

- Pursuit theory of learning says that learning is a matter of accumulating facts and routines, not a consequence of thinking.
- The Ability-Counts-Most theory says that ability influences achievement far more than anything else, when in fact effort counts at least as much.
- Expert tutors often do not help very much. They hang back, letting the student manage as much as possible. And when things go awry, rather than help directly, they raise questions: Could you explain that step again? How was this case different?
- Another interesting characteristic is very little direct praise. Expert tutors commonly emphasize beforehand how tough a problem is, rather than praising the learner's ability afterward. The front-end emphasis on difficulty is an artful move: If the student succeeds with the problem, it is self-rewarding because the student has surmounted an impressive obstacle. If not, the problem has been framed as quite difficult – it is only reasonable to look at some more tractable ones before reattempting the tough one.