WHY DON'T STUDENTS LIKE SCHOOL?
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Why don't students like school?

- Contrary to popular belief, the brain is not designed for thinking. It is designed to save you from having to think because the brain is actually not very good at thinking. Thinking is slow and unreliable. Nevertheless, people enjoy mental work if it is successful. People like to solve problems, but not to work on unsolvable problems. If school work is always just a bit too difficult for a student, it should be no surprise that she does not like school much.
- People are naturally curious, but we are not naturally good thinkers; unless the cognitive conditions are right, we will avoid thinking.
- By thinking, I mean solving problems, reasoning, reading something complex, or doing any mental work that requires some effort.
- Tasks that you take for granted – for example, walking on a rocky shore where the footing is uncertain – are much more difficult than playing top-level chess. No computer can do it.
- Compared to our ability to see and move, thinking is slow, effortful, and uncertain.
- When we can get away with it, we don't think. Instead we rely on memory.
- Most of the time what we do is what we do most of the time. Using your memory does not require much of your attention, so you are free to daydream.
- Despite the fact that we are not that good at it, we actually like to think. We are naturally curious, and we look for opportunities to engage in certain types of thought. But because thinking is so hard, the conditions have to be right for this curiosity to thrive, or we quit thinking rather readily.
- Solving problems brings pleasure. Problem solving means any cognitive work that succeeds; it might be understanding a difficult passage of prose, planning a garden or sizing up an investment opportunity.
- When you solve a problem your brain may reward itself with a small dose of dopamine, a naturally occurring chemical that is important to the brain's pleasure system. It is notable that the pleasure is in the solving of the problem. Working on a problem with no sense that you are making progress is not pleasurable. It is frustrating. Then too there is not great pleasure in simply knowing the answer.
- Thinking occurs when you combine information (from the environment and long-term memory) in new ways. That combining happens in working memory.
- Your long-term memory contains factual information and procedural knowledge, or your knowledge of the mental procedures necessary to execute tasks.
- Working memory has limited space, so thinking becomes increasingly difficult as working memory gets crowded.
- Successful thinking relies on four factors: information from the environment, facts in long-term memory, procedures in long-term memory and the amount of space in working memory. If any one of these factors is inadequate thinking will likely fail.
- What can teachers do to ensure that each student gets the pleasurable rush of solving a problem?
- Be sure that there are problems to be solved…not a question addressed to the class by the teacher a string of explanations, or a mathematical puzzle. I mean cognitive work that poses moderate

challenge including such activities as understanding a poem or thinking of novel uses for recyclable materials.

- Respect students' cognitive limits. If they lack the appropriate background knowledge, the question you pose will quickly be judged as "boring. Overloads of working memory are caused by such things as multistep instructions, lists of unconnected facts, chains of logic more than two or three steps long, and the application of a just-learned concept to new material. The solution to working memory overloads is straightforward: slow the pace, and use memory aids such as writing on the blackboard that saves students from keeping too much information in working memory.
- Clarifying the problems to be solved. Sometimes I think that we, as teachers are so eager to get to the answers that we do not devote sufficient time to developing the question. It is the question that piques people's interest. Being told an answer does not do anything for you.
- Reconsider when to puzzle students. Every fact or demonstration that would puzzle students before they have the right background knowledge has the potential to be an experience that will puzzle students momentarily, and then lead to the pleasure of problem solving.
- Accept and act on variation in student preparation. To the extent possible assign work to individuals or groups of students that is appropriate to their current level of competence.
- Change the pace. Change grabs attention. Plan shifts and monitor your students' attention to see whether you need to make them more often or less frequently.
- Keep a diary. The core idea presented in this chapter is that solving a problem gives people pleasure but the problem must be easy enough to be solved yet difficult enough to take some mental effort. Even if it is just a quick scratch on a sticky note try to make a habit of recording your success in gauging the level of difficulty in the problems you pose for your students.

<u>How can I teach students the skills they need when standardized tests require only facts?</u>

- There is no doubt that having students memorize lists of dry facts is not enriching. It is also true that trying to teach students skills such as analysis or synthesis in the absence of factual knowledge is impossible.
- Factual knowledge must precede skill.
- Data from the last thirty years lead to a conclusion that is not scientifically challengeable: thinking well requires knowing facts, and that is true not simply because you need something to think about. The very processes that teacher care about most – critical thinking processes such as reasoning and problem solving – are intimately intertwined with factual knowledge that is stored in long-term memory (not just found in the environment.) We must ensure that students acquire background knowledge parallel with practicing critical thinking skills.
- Why do writers leave gaps? Don't they run the risk that the reader won't have the right background knowledge and so will be confused? That is a risk, but writers cannot include all the factual details. If they did prose would be impossibly long and tedious.
- The phenomenon of tying together separate pieces of information from the environment is called chunking. The advantage is obvious: you can keep more stuff in working memory if it can be chunked. The trick however, is that chunking works only when you have applicable factual knowledge in long-term memory.
- Background knowledge allows chunking, which makes more room in working memory, which makes it easier to relate ideas and therefore to comprehend.
- Four ways that background knowledge is important to reading comprehension:
    - It provides vocabulary

- It allows you to bridge logical gaps that writers leave
    - It allows chunking which increases room in working memory and thereby makes it easier to tie ideas together
    - It guides the interpretation of ambiguous sentences.
- Fourth grade reading slump for students from underprivileged homes may be due to the lack of background knowledge. At this grade, the shift is from decoding to comprehension.
- When we see someone apparently engaged in logical thinking, she is actually engaged in memory retrieval.
- Most or all of what we tell students about scientific thinking strategies is impossible to use without appropriate background knowledge.
- Researchers have painstakingly analyzed the contents of the many ways that students can spend their leisure time. Books, newspapers and magazine are singularly helpful in introducing new ideas and new vocabulary to students.
- Einstein: Imagination is more important than knowledge." I hope you are now persuaded that Einstein was wrong. Knowledge is more important because it is prerequisite for imagination or at least for the sort of imagination that leads to problem solving decision making, ad creativity.
- It is certainly true that facts without the skills to use them are of little value. It is equally true that one cannot deploy thinking skills effectively without factual knowledge.
- We may still be distressed that much of what writers assume their readers know seems to be touchstones of the culture of dead white males. From the cognitive scientist's point of view, the only choice in that case is to try to persuade writers and editors to assume different knowledge on the part of their readers. This would not be easy to bring about as it really amounts to a change in culture. Unless and until that happens, I advocate teaching that material to our students.
- Cognitive science leads to the rather obvious conclusion that students must learn the concepts that come up again and again the unifying ideas of each discipline. Some educational thinkers have suggested that a limited number of ideas should be taught in great depth beginning in the early grades and carrying through the curriculum for years as different topics are taken up and viewed through the lens of one or more of these ideas. From the cognitive perspective that makes sense.
- Knowledge pays off when it is conceptual and when the facts are related to one another and that is not true of list learning.

<u>Why do students remember everything that is on television and forget everything I say?</u>

- Your memory is not a product of what you want to remember or what you try to remember; it is a product of what you think about.
- To teach well, you should pay careful attention to what an assignment will actually make students think about (not what you hope they will think about), because that is what they will remember.
- If you don't pay attention to something you cannot learn it
- Another possible reason you do not remember is that the process by which things are drawn from long-term memory has failed.
- Memory researchers see no reason to believe that all memories are recorded forever.
- A reasonable guess is that we remember things that bring about some emotional reaction.
- Things that create an emotional reaction will be better remembered but emotion is not necessary for learning.
- Material may be repeated almost indefinitely and still not stick in your memory.
- Wanting to remember has little or no effect. Memory is the residue of thought.

- Ninety-five percent of what students learn in school concerns meaning, not what things look like or what they sound like. Therefore a teacher's goal should almost always be to get students to think about meaning.
- For material to be learned (that is, to end up in long-term memory), it must reside for some period in working memory – that is a student must pay attention to it. Further, how the student thinks of the experience completely determines what will end up in long-term memory.
- I would not recommend getting students to think about meaning by trying to make the subject matter relevant to the students' interests.
- Content is seldom the decisive factor in whether or not our interest is maintained.
- The emotional bond between students and teacher – for better or worse – accounts for whether students learn. The brilliantly well-organized teacher whom fourth graders see as mean will not be very effective. But the funny teacher or the gentle storytelling teacher whose lessons are poorly organized won't be much good either. Effective teachers have both qualities. They are able to connect personally with students, and they organize the material in a way that makes it interesting and easy to understand.
- The human mind seems exquisitely tuned to understand and remember stories – so much so that psychologists sometimes refer to stories as "psychologically privileged," meaning that they are treated differently in memory than other types of material. Organizing a lesson like a story is an effective way to help students comprehend and remember.
- A story follows four principles
    - Causality: events are causally related to one another
    - Conflict: a main character pursues a goal, but s/he is unable to reach it
    - Complications: sub-problems that arise from the main goal
    - Character: strong interesting characters and the key to those qualities is action.
- Formal work in laboratory settings has shown that people rate stories as less interesting if they include too much information thus leaving no inferences for the listener to make.
- Stories are easy to remember. Because comprehending stories requires lots of medium-difficulty inferences you must think about the story's meaning throughout.
- Structure your lessons the way stories are structured using the four Cs. The story structure applies to the way you organize the material that you encourage your students to think about not to the methods you use to teach the material.
- The material that I want students to learn is actually the answer to a question. On its own the answer is almost never interesting. But if you know the question, the answer may be quite interesting. But I sometimes feel that we, as teachers, are so focused on getting to the answer, we spend insufficient time making sure that students understand the question and appreciate its significance.
- Stories are easily comprehended and remembered and they are interesting; but one can't get students to think about meaning if the material has no meaning. In that case, it may be appropriate to use a mnemonic device.
- It's usually the middle of the lesson that needs a little drama to draw students back from whatever reverie they might be in.
- Discovery learning is probably most useful when the environment gives prompt feedback about whether the student is thinking about a problem in the right way. One of the best examples of discovery learning is when kids learn to use a computer.

Why is it so hard for students to understand abstract ideas?

- We understand new things in the context of things we already know and most of what we know is concrete.
- Understanding is remembering in disguise. Every new idea must build on ideas that the student already knows.
- Another consequence of our dependence on prior knowledge is our need for concrete examples. Abstractions are hard for students to understand even if all the terms are defined. They need concrete examples to illustrate what abstraction mean.
- To get a student to understand, a teacher must ensure that the right ideas from the student's long-term memory are pulled up and put into working memory. In addition, the right features of these memories must be attended to, that is, compared or combined or somehow manipulated.
- Rote knowledge might lead to giving the right response, but it does not mean the student is thinking.
- Much more common than rote knowledge is what I call shallow knowledge meaning that students have some understanding of the material but their understanding is limited. We have said that students come to understand new ideas by relating them to old ideas. If their knowledge is shallow, the process stops there. Their knowledge is tied to the analogy or explanation that has been provided. They can understand the concept only in the context that was provided.
- A student with deep knowledge knows more about the subject, and the pieces of knowledge are more richly interconnected. The student understands not just the parts, but also the whole. This understanding allows the student to apply the knowledge in many different contexts, to talk about it in different ways, to imagine how the system as a whole would change if one part of it changed, etc. Deep knowledge means understanding everything- both the abstraction and the examples, and how they fit together.
- Not paying attention results in shallow knowledge.
- Two problems differ in what psychologist call their surface structure – the problems have the same deep structure because they require the same steps for solution. The surface structure of each problem is a way to make the abstraction concrete. (e.g. amount of seeds needed to reseed a lawn or paint needed to paint a room)
- To see the deep structure, you must understand how all parts of the problem relate to one another, and you must know which parts are important and which are not. The surface structure on the other hand, is perfectly obvious.
- To help student comprehension, provide examples and ask student to compare them.
- Make deep knowledge the spoken and unspoken emphasis.
- Questions assignments and assessments are sources of implicit messages about what is important: facts or deep knowledge.
- Deep knowledge is hard-won and is the product of much practice. Have realistic expectations.

Is drilling worth it?

- It is virtually impossible to become proficient at a mental task without extended practice.
- Less obvious are the reasons to practice skills when it appears you have mastered something and it is not obvious that practice is making you any better. Odd as it may seem, that sort of practice is essential to schooling. It yields three important benefits: it reinforces the basic skills that are required for the learning of more advanced skills, it protects against forgetting and it improves transfer.
- The lack of space in working memory is a fundamental bottleneck of human cognition.

- To a surprising degree, scoring well on a working-memory test predicts scoring well on a reasoning test, and a poor working-memory score predicts a poor reasoning score.
- Sadly, exercises do not exist to improve working memory. It is more or less fixed – you get what you get, and practice does not change it.
- The first way to cheat the limited size of your working memory is through factual knowledge. The second ways is to make the processes that manipulate information in working memory more efficient, even automatic (e.g. tying shoes, driving).
- Alfred North Whitehead: "It is a profoundly erroneous truism that we should cultivate the habit of thinking of what we are doing." The precise opposite is the case. Civilization advances by extending the number of important operations which we can perform without thinking about them.
- The only way to develop mental facility is to repeat the target process again and again and again.
- Researchers have examined student memory more formally and have drawn the same conclusion: We forget much (but not all) of what we have learned and the forgetting is rapid.
- Studying hard does not protect against forgetting. Continued practice does.
- If you pack lots of studying into a short period, you will do okay on an immediate test, but you will forget the material quickly. If, on the other hand, you study in several sessions with delays between them, you may not do quite as well on the immediate test but, unlike the crammer, you will remember the material longer after the test.
- Practice means continuing to work at something that you have already mastered it.
- Working lots of problems of a particular type makes it more likely that you will recognize the underlying structure of the problem. Practice is a significant contributor to good transfer.
- Your mind stores functional relationships between concepts (such as the idea of a permission) just as it stores the meaning of individual words.
- Practice helps transfer because practice makes deep structure more obvious.
- Practice can help the mental process become automatic and thereby enable further learning; it makes memory long lasting; and it increases the likelihood that learning will transfer to new situations.
- Basic skills need to be practice, but can be practiced in the context of more advanced skills.
- The smart way to go is to distribute practice not only across time but also across activities.

<u>What is the secret to getting students to think like real scientists, mathematicians, and historians?</u>

- It is a flawed assumption that students are cognitively capable of doing what scientists or historians can do. It is not just that students know less than experts; it is also that what they know is organized differently in their memories.
- The hours of practice in which an expert has engaged make a qualitative, not quantitative difference in the way they think compared to how a well-informed amateur thinks.
- Experts-in-training often know as much or nearly as much as experts, but experts can separate the wheat from the chaff, seeming to have a sixth sense about what is important and what should be ignored.
- Experts show better transfer to similar domains than novices do.
- It is not just that there is a lot of information in an expert's long-term memory; it is also that the information in that memory is organized differently from the information in a novice's long-term memory.
- Experts do not think in terms of surface features, as novices do; they think in terms of functions or deep structure.

- Experts think abstractly. They have representations of problems and situations in their long-term memories and those representations are abstract. That is why experts are able to ignore unimportant details and hoe in on useful information; thinking functionally makes it obvious what is important. That is also why the show good transfer to new problems.
- Experts save room in working memory through acquiring extensive, functional background knowledge, and by making mental procedures automatic. They use this room to talk to themselves about the problem in the abstract. Talking to yourself demands working memory, so novices are much likely to do it. If they do talk to themselves, what they say is predictably more shallow than what experts say. They restate the problem, or they try to map the problem to a familiar formula. When novices talk to themselves they narrate what they are doing, and what they say does not have the beneficial self-testing properties than expert talk has.
- Offering novices advice to "talk to yourself "think functionally" will not work. Experts do those things, but only because their mental toolbox enables them to do so. The only path to expertise, as far anyone knows, is practice.
- The great minds of science were not distinguished as being exceptionally brilliant, as measured by standard IQ tests; they were very smart, to be sure, but not standouts that their stature in the fields might suggest. What was singular was their capacity for sustained work.
- A number of researchers have endorsed what has become known as the ten-year rule: one cannot become an expert in any field in less than ten years.
- Study and practice do not end once one achieves exert status. The work must continue if the status is to be maintained.
- Students are ready to comprehend but not to create knowed.ge She can understand how a discipline works and progresses, even if they are not yet capable of using that process very well or at all.
- The goal is to provide students with some understanding of how others create knowledge rather than to ask students to engage in activities of knowledge creation.
- Don't expect novices to learn by doing what experts do.
- Whenever you see an expert doing something differently from the way a non-expert does it, it may well be that the expert used to do it the way the novice does it, and that doing so was a necessary step on the way to expertise. Every artist was first an amateur.

How should I adjust my teaching for different types of learners?

- Children are more alike than different in terms of how they think and learn.
- Cognitive ability: the capacity for or success in certain types of thought.
- Cognitive styles: biases or tendencies to ink in a particular way (e.g. sequentially or holistically)
- Abilities are how we deal with content and they reflect the level of what we know and can do. Styles are how we prefer to think and learn.
- A cognitive style theory must have the following features: it should consistently attribute to a person the same style, it should show that people with different styles think and learn differently, and it should show that people with different styles do not on average, differ in ability. At this point there is not a theory that has these characteristics. That does not mean that cognitive styles do not exist, but that after decades of trying, psychologists have not been able to find them.
- People do differ in their visual and auditory memory abilities.
- We do not store all of our memories as sights or sounds. We also store memories in terms of what they mean to us. Meaning has a life of its own, independent of sensory details. Most of what teachers and students to know is stored as meaning.

- Matching the preferred modality of a student does not give that student an edge in learning. What are being tested is not the auditory or visual images, but the meaning of the images. (Exceptions: visuals may remember shapes of countries, and auditory learners may remember sound of foreign language accent.)
- Confirmation bias: once we believe something, we unconsciously interpret ambiguous situations as being consistent with what we already believe.
- The different abilities (or intelligences) are not interchangeable. Mathematical concepts have to be learned mathematically, and skill in music will not help. You cannot take one skill you are good at and leverage it to bolster a weakness.
- When differentiating among students, craft knowledge trumps science.
- Think in terms of content differentiation, not in terms of students.
- Chang promotes attention. Rather than individualizing the required mental processes for each student, give all of your students practice in all of these processes, and view the transitions as an opportunity for each student to start fresh and refocus his or her mental energies.
- It is never smart to tell a child that she is smart. Believe it or not, doing so makes her less smart.
- Cognitive styles and multiple intelligences are not helpful ways to characterize how children differ.

How can I help slow learners?

- Our genetic inheritance does impact our intelligence, but it seems to do so mostly through the environment.
- Children do differ in intelligence but intelligence can be changed through sustained hard work.
- That some people reason well and catch on to new ideas quickly captures most of what we mean when we say "intelligence."
- Genetics seems to play a huge role in general intelligence; that is, our genes seem to be responsible for something like 50% of our smarts. The 50% figure is actually an average, because the percentage changes as we age. For young children, I is more like 20%, then it goes up to 40% for older children, and it is 60% or even higher later in life.
- In the last half-century IQ scores have shown quite substantial gains.
- Genetic effects can make you seek out or select different environments.
- Small differences in genetic inheritance can steer people to seek different experiences in their environments, and it is differences in these environmental experiences, especially over the long term that have large cognitive consequences
- Intelligence is malleable. It can be improved. Slow students have the same potential as bright students, but they probably differ in what they know, in their motivation, in their persistence in the face of academic setbacks, and in their self-image as students.
- You want to encourage your students to think of their intelligence as under their control, and especially that they can develop their intelligence through hard work.
- Praise for effort rather than ability.
- Praise processes (e.g. effort, persistence, taking responsibility) rather than ability.
- If you want to increase your intelligence you have to challenge yourself. That means taking on tasks that are a bit beyond your reach, and that means you may very well fail, at least the first time around.
- Failure means that you are about to learn something
- Don't take study skills for granted. Make a list of all the things you ask students to do at home. Consider which of these things have other tasks embedded in them and ask yourself whether the sower students really know how to do them.

- To catch up, the slower students must work harder than the brighter students. Working at the same rate keeps them behind others.
- Show students that you have confidence in them.
- Be wary of praising second-rate work in you slower students. It is an indication that you do not have high expectations of them.

What about my mind?

- Teaching, like any complex cognitive skill, must be practiced to be improved.
- In the last ten years or so, many observers have emphasized that teachers ought to have rich subject-matter knowledge, and there do seem to be some data that students of these teachers learn more, especially in middle and high school and especially in math.
- In addition to content knowledge, you need pedagogical knowledge.
- A great deal of research shows that teachers improve during their first five years in the field, as measured by student learning. After this, the curve gets flat, and a teacher with twenty years of experience is on average, no better or worse than a teacher with ten.
- To counteract this: practice in a way that results in getting feedback from knowledgeable people. Without feedback, you do not know what changes will help. You cannot watch your own classroom, because you are too busy teaching.
- Self-serving bias: When things go well, it is because we are skilled and hardworking. When things go poorly, it is because we were unlucky or because someone else made a mistake.
- Working on your teaching will be a threat to your ego.
- Identify another teacher tor two with who you would like to work
- Tape yourself and watch the apes alone
- With your partner watch tapes of other teachers.
- Consider firs what surprises you about the class. Spend time observing. Don't start by critiquing.
- http://www.videoclassroom.org
- http://www.learner.org
- http://www.myteachingpartner.net
- Make comments that are supportive. Be concrete and comment on the behaviors you observe, not on qualities you infer.
- Unless you are asked for ideas, do not slip into the role of the expert fixer, regardless of how confident you are that you have a good solution.
- Set priorities for what you want to fix.
- Keep a teaching diary

Conclusion

- Reading is a mental act that literally changes the thought processes of the reader.
- Teaching is an act of persuasion.