Notes on Urban Myths about Learning and Education by Pedro De Bruyckere, Paul A. Kirschner, and Casper D. Hulsof Elsevier, 2015

Bev Bramble

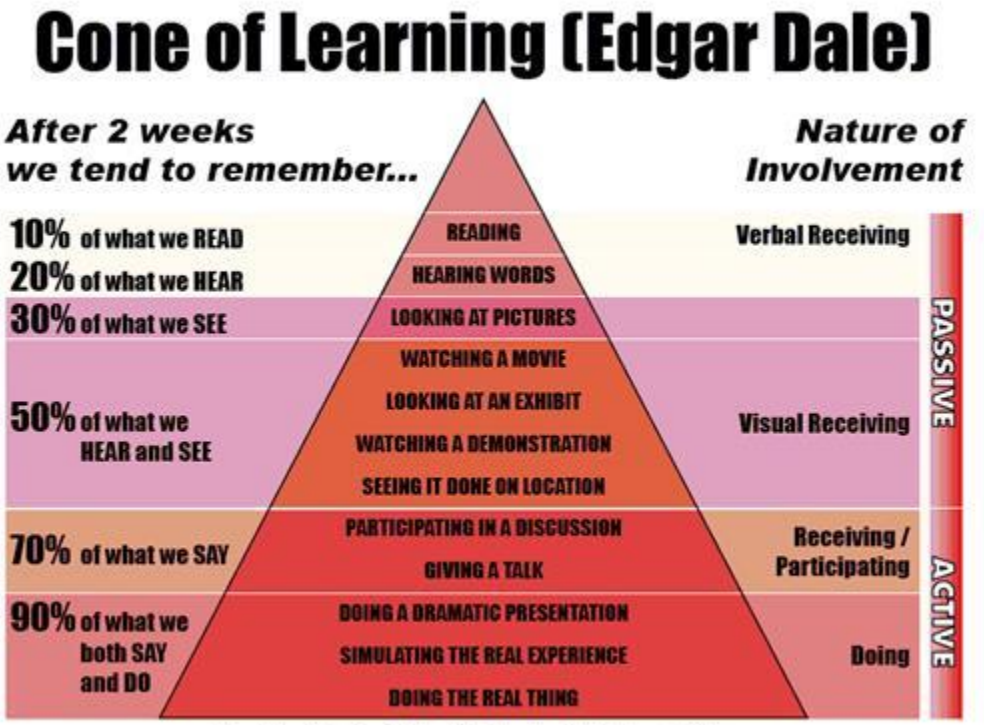
Myths about Learning

1. People have different styles of learning

No research to back it up. People do learn better when they describe how they study and learn (p. 23). Also, a lot of studies show the effectiveness of physical activity combined with learning (24ff).

2. The effectiveness of learning can be shown in a pyramid

No research basis for any of the "learn X% from listening, more from doing" pyramids. The pyramids contradict the learning theories myth so fake science is not even consistent in its fakeness. Dale never approved Dale's Cone of Experience. Studies have shown no statistical difference in the effectiveness of the different methods in the cone or pyramid (33). The first 2 myths suffer from business consultants trying to monetize the basic findings to create systems that change behaviour with easy-to-follow heuristics that grossly misrepresent the ideas. Many of the others do as well.



Edgar Dale, *Audio-Visual Methods in Technology*, Holt, Rinehart and Winston.

Microteaching (teaching a mini-lesson and getting feedback) only works because of immediate, personalized feedback and discussion, so it works for teaching teachers in training. 34

3. People learn 70% informally, 20% from others, and 10% from formal education.

No evidentiary basis.

4. If you can look everything up, is knowledge so important?

Research shows that learners of all ages cannot effectively choose good search terms, combine them properly, select relevant web sites, and assess the validity of the sources they find, or use the information effectively.

5. Knowledge is as perishable as fresh fish

Everyone acknowledges that information, reliable and unreliable and everything in between, is being produced and replicated at quickly increasing rates. No one knows by how much. However, this myth does not account for old knowledge being relevant. Also, it confuses information with knowledge. Knowledge is what to do with information to put it to useful purposes. Our ability to search, find, select, process, evaluate and organize information (turn it into knowledge) remains fraught with issues of literacy, misinterpretation, and propagandizing (45). And Problem-Based Learning is not a fix, because it relies on prior knowledge, which novice learners don't have (46). "The amount of information coming at us daily is increasing and an ever faster rate. But the knowledge that we need to understand and interpret that information is still fairly stable. Although the knowledge in certain domains does increase and change, it is more important to teach students to deal with these changes than to view knowledge as being unimportant!" (45)

6. You learn better if you discover things for yourself rather than having them explained to you by others.

Discovery learning does have a clear positive effect. However, it is difficult to figure out exactly why. Bruner, the father of discovery learning, later moved to guided discovery. It is now known that many students are insufficiently capable of constructing and processing knowledge without some assistance (49). Using discovery learning with novice learners ignores the limitations of working memory. Without some domain knowledge, students can't search for relationships between two or more variables adequately using systematic approaches to exploration and experimentation, which creates a working memory overload. This makes working memory unavailable to learn (50). Novice learners are not miniature experts. They don't learn the different, more effective ways experts work in a discipline through discovery. "Pure discovery is a myth, but inquiry can still be effective with the right guidance and support." Case-based learning is better (52).

7. You can learn effectively through problem-based learning

Does not work with novice learners acquiring new knowledge (because of working memory limitations), but only for those who have developed schema for those types of problems, to help them develop experience that makes them more like experts in the field. The most effective way for novices to develop those schema is through a series of worked out examples, then complete solutions to partially solved problems (the parts to solve increase over time), under the guidance of an experienced teacher, and finally move to solving problems on their own after lengthy practice (56).

8. Boys are better at math than girls

No. Just no. Some studies show girls score slightly higher. This is attributed to the stereotypical way parents attribute boys success in math to ability and girls to effort, which leads to differing study strategies being adopted by each, to the advantage of boys. If more parents encouraged girls on the basis of ability, girls advantage may be larger (60). Some Norwegian studies have shown that willingness to practice is a determining factor in high math scores. Girls are more willing to do that (61).

9. In education, you need to take into account different types of intelligence

Gardner's multiple intelligences are better thought of as talents, the way they were used by the great intelligence researchers. There is no evidentiary basis for their existence as separate intelligences.

Gardner's theory is best thought of as a philosophy rather than a proven theory. Multiple intelligences correlate highly with each other, and so can't be thought of as separate intelligences, but just intelligence. Multiple intelligences theory, which is considered to have a biological basis, is really a theory of human development that assumes biological characteristics have corresponding mental characteristics. Gardner himself warned against using his theory as a prescription for schooling (67).
A research-based alternative model is Guilford's Structure of Intellect model (68):

- 6 operations: cognition, memory recording, memory retention, divergent production convergent production, evaluation
- 6 products: units, classes, relations, systems, transformation, implications
- 5 contents: visual, auditory, symbolic, semantic, behavioural

(the dimensions are independent, so there are 180 combinations: (6x6x5).

10. Our memory records exactly what we experience

No. there is always some selection and distortion. By the 5 senses, information enters sensory memory, which selects what will enter working memory according to what we pay attention to. Working memory is a temporary scratch pad in which new information can be processed for storage in long-term memory. Working memory (made up of a visuospatial sketchpad for written words and pictures, and a phonological loop for sounds, coordinated by an executive function that retrieves information from elsewhere in the brain) can handle only up to seven new items at a time, and each persists for up to only 30 seconds unless processed ("consolidated"). Long-term memory concepts or schema are brought into working memory and refined. Schema from long term memory are exempt from the 30-second rule and can persist in working memory as long as needed. Long-term memory is the repository for knowledge and skills that are not currently being used but which are needed to enable understanding. Its capacity is unlimited and its contents permanent. We are not aware of long-term memory. It is accessed only through working memory.

Types of memory:

- Declarative: conscious and explicit recall of stored information.
    - Semantic memory (facts, meanings, concepts, and knowledge about the external world taken independent of context)
    - Episodic memory (serial events and experiences specific to a particular context, such as a time and place in our lives)
- Procedural: implicit learning (motor skills, learned by repetition and practice) ("automaticity") We have trouble describing this kind of memory.
- Topographic: ability to orient oneself in space, follow a schedule, recognize faces
- Flashbulb: clear episodic memories of unique and highly emotional events

We remember very little detail. The brain stores only the most necessary elements and fills in the fine detail while remembering. The filling in is often not correct because:

- Memory is general and blurred
- Memory often encodes perceptual information automatically and unconsciously in a general verbal form and not as an image.
- We interpret what we see so that it fits schemas and mix them with personal or vicarious (from reading, hearing, watching movies…) memories. Stereotypes can affect recall.
- Memory is personal so we interpret events in terms of our world view.
- Memory changes over time (the original trace deteriorates) and with retelling (the trace is updated with new information). Accuracy declines with each new version.

11. Schools kill creativity

Debunks TED-talk-famous Sir Ken Robinson's contention that children are born geniuses, and have genius removed by schooling. He measures genius by being able to find 200 uses for a paper clip (a divergent thinking test). He says children before schooling find many. After schooling, only 10-15 like everyone else. Issue: are creativity and intelligence the same thing? Research shows low correlation (77). Research also shows that by learning we become more creative, and that as we become older we become more creative (78). Also, 5-year-olds engage in more improvisational play (after they know more) than 3-year-olds. Creativity requires a high degree of domain knowledge. Schools are good at providing that (79).

Brainstorming is not effective: "Decades of research have consistently shown that brainstorming in a group produces fewer ideas than if the same number of people had thought up their own ideas individually, before sharing them collectively." Debate of ideas (criticism and discussion) is also effective (79).

12. Ninety-three percent of communication is nonverbal

Albert Mehrabian's 7-38-55 rule (words-intonation-body language). Even Mehrabian has said these are rough proportions, and apply only to situations where people are talking about feelings and attitudes (82). The original research required participants to label 9 words as positive, neutral, or negative as they saw them, heard them, and vocalized as participants looked at pictures of faces looking positive, negative or neutral, so was limited in scope.

These are effective teaching techniques: (86)

Feedback: (Hattie and Timperley 2007)

- Task oriented
- Process oriented
- Self-regulatory (how to focus attention, feelings, behaviour)
- Person-oriented

Guasch, Espaxa, Alvareza and Kirschner:

- Corrective feedback
- Suggestive FB (advice that invites exploration, expansion or improvement, rather than prescription)
- Epistemic feedback (explanations and clarifications)

Best to move from task-oriented to process-oriented to self-regulatory feedback. (or combining epistemic and suggestive) Don't give too much FB at the same level. Don't give the mark until after you have provided the FB. Research shows that if you give written comments and a mark at the same time, students check the mark and ignore the FB.

Link concepts to emotions if you want students to remember.

Identify at the beginning the key information you want students to know at the end of the lesson. Think of questions (preferably surprising) or problems to solve.

People are not made to think too abstractly, so give frequent specific examples. Involve senses where possible—what one would taste, smell or feel. Tell stories—people are psychologically privileged to

remember and understand stories. Good stories have strong characters, a conflict and complications that lead to the resolution of conflict 88.

Give students variety and surprise, at least every 15 minutes. (story, visuals, image, different perspective…)

Provide breaks. Students need time to process.

Rosenshine's 10 principles of good instruction, based on research in cognitive science, classroom practices of master teachers, and cognitive supports (89):

1. Review some pervious leaning every day
2. Present new material in small steps, and assist students in practicing new material.
3. Ask questions—they help students practice new information and connect it with prior learning.
4. Provide models and worked examples
5. Guide student practice
6. Check for understanding
7. Obtain a high success rate
8. Provide scaffolds for difficult tasks
9. Require and monitor independent practice
10. Engage students in weekly and monthly review

Neuromyths

We really know little about the brain currently. And what we do know is difficult to turn into precise steps for influencing behaviour. Also, teachers most interesting in applying neuroscience in the classroom are also the most inclined to believe neuromyths.

1. We are good multitaskers

Only people very experienced in the tasks at hand can multitask because the processes have become automated and can be done without conscious attention. We can't think two different thoughts at the same time. We task-switch. When we switch back and forth in short bursts, it looks like multitasking. The brain has set limits on the number of cognitive processes it can handle (the cognitive bottleneck) (96). Almost no one can multitask. Studies repeatedly have shown that simultaneous execution of tasks inevitably leads to loss of concentration, the need for longer periods of study, and poorer performance. And there is a mental switching cost that reduces performance of individual tasks further. Furthermore, what you learn while multitasking is more difficult to recall and use later. Perceptions of multitasking ability are negatively correlated to performance (multitaskers don't realize how much poorer their performance is than others) (97). People who play computer games regularly are no better at multitasking than others (98).

2. We use only 10% of our brains

No. We use all of our brain all of the time.
Damage to any part of the brain results in loss of function (you would expect loss of function only if the 10% that is used were damaged) (100).
Evolution: our brains make up 2% of our body weight, but use 20% of blood oxygen. If we used only 10% of our brains, small brained creatures would have a considerable evolutionary advantage. In millions of studies of the brain, no one has found an unused portion (101).
Brain scans how there is neurological activity throughout the brain, even while sleeping.

No leftover functional areas of the brain have been detected, unlike other parts of our bodies. The brain is comprised of many different functional areas which work together. There is no known nonfunctional area.
Degeneration: unused brain cells would die off, since that is what happens to cells that no longer have a useful function.
Synaptic pruning: brains develop because those parts that are used grow and those that do not, shrink. (so unused parts don't linger)

3. The left half of the brain is analytical, the right half creative

While generally the left half of the brain controls the right half of the body and vice versa, and the left half is mostly the part that handles language and the right half handles spatial skills, creativity and analysis requires all of the brain. And there is no difference in brain lateralization between men and women (105).

4. You can train your brain with brain games

Brain training does not confer any more benefit that using the same time to surf the internet to answer questions 108. What does improve memory is mnemonic devices, repetitive sequences of the same stimulus or creating mind maps or information trees which give meaning to things you want to remember 109. These techniques lead to some improvement in specific memory tasks, but so far have not shown overall memory improvement. Using your brain regularly, exercising regularly, and eating a balanced diet all improve brain function 110.

5. Men's and women's brains are different

On average, men's brains are larger. The language area in women's brains more active in general that that of men's. Women have performed better in school than men in studies over the last 100 years, but this is likely due to cultural factors. Boys and girls do not learn in different ways, women are no better at multitasking, and women's brains do not behave more empathetically (113). Differences were found in the amygdala (memory and emotion) and hippocampus (memory processing). How these effect behaviour is unknown (114).
Women don't talk more than men.
Women only marginally reveal more personal details about themselves than men.
Men and women are equally capable of interrupting, which is a function of social status, so depends on the gender of those with higher levels of it (114).

6. We can learn while we are asleep

Some people can remember conversation that happened while they were anesthetized, but being anesthetized is not the same as being asleep. Russian studies showing some agents can learn foreign languages while asleep have not been replicated in the West. Russian studies did not check whether their subjects slept throughout the night 115. We can be conditioned in our sleep (e.g., associate smells with tones). But we cannot learn content while asleep 116.

7. Babies become cleverer if they listen to classical music

Neural processing of sounds (especially understanding speech in crowded environments) is improved in later life if practicing and playing a musical instrument was done early in life. But there is no brain function benefit to listening to classical music (120).

8. We think more clearly when under pressure

No, and if frightened or anxious, we perform more poorly. Stress creates a fight-or-flight response that releases adrenaline and focuses the mind, but repeated exposure to high levels of stress can result in brain damage (122).

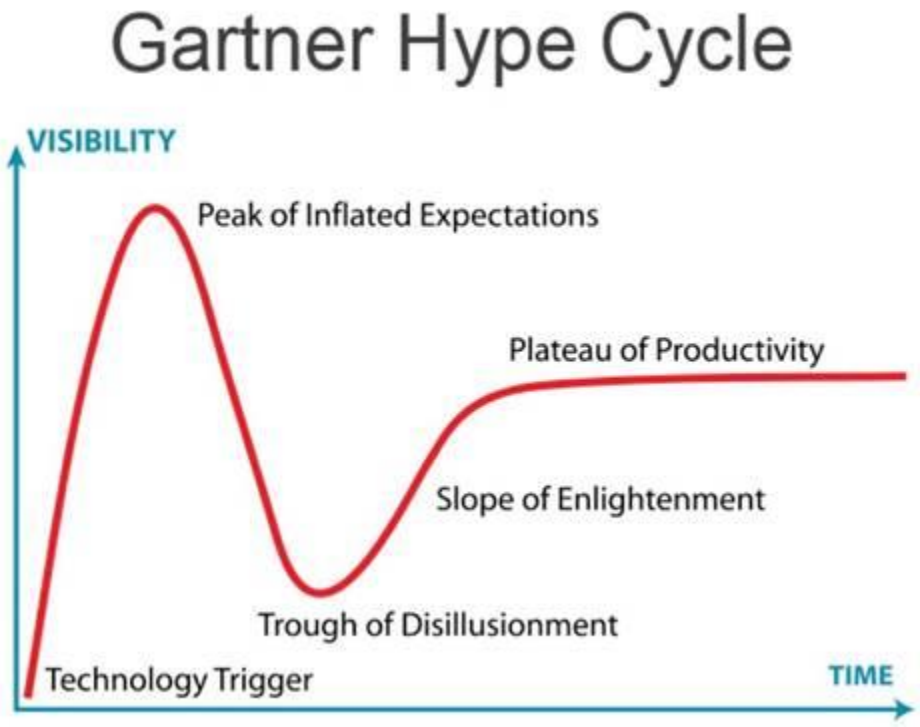
9. Does it help to have a correct knowledge of how the brain works?

Learning is hard and requires effort. If it can be done by tricks that avoid effort, learning will be ineffective 124. All the effortless learning tricks are based on myths.

Myths about Technology in Education

1. New Technology is causing a revolution in education

60 years of comparative studies about teaching methods and resources all confirm that it is not the medium that decides how effectively people learn. The way the medium is used and the quality of instruction associated with that use are the critical factors (the "method not the media" hypothesis) (130).



Originated in 1995 and has not changed shape since.

Few studies on media effectiveness in learning have control and experimental groups and useful data collection. Studies that have shown increases in student performance due to the educational use of technology usually attribute it to accommodation of more learning styles, where learning styles is a myth, or that it facilitates discovery learning, which has also been debunked as a myth. Or, by giving students autonomy and control over learning. Only a small percentage of students benefit from this autonomy and control, studies show 134.

2. The internet belongs in the classroom because it is part of the personal world experienced by children

Canadian Higher Education Strategy Associates study involving 1380 students showed that the more technology is used to teach a course, the less students think they get out of it. Their preference was for

human interaction rather than e-learning. However, more than half the respondents said they would skip a lecture if more information or a comparable video we available online (135). More than half also said they would like more electronic content-specifically, more course notes and recording of lessons made available online (136). There is little evidence that students expect the use of new technologies at university (different study-literature review). Students prefer moderate use of ICT in courses. Students do not demand the use of the newest technologies, although they don't object. Multimedia courses may be more attractive to students so they choose them when offered, but student interest does not mean improved performance, and often result in less learning (136). Students must see the ICT as a value-add (more efficient, effective or enjoyable) or they lose interest (138).

3. Today's digital natives are a new generation who want a new style of education

There is no evidence than any of the digital natives claims (they have new ways of knowing and being; they are driving a digital revolution transforming society; they are inherently tech-savvy; they are multitasking, team oriented collaborators; speak the native language of technology; embrace gaming, interaction and simulation; demand immediate gratification; are reflecting and responding to the knowledge economy) are true (140-141) or that a generation of digital natives even exists (142). A new phenomenon of Attention Deficit Hyperlink Disorder has been found that leads to a "butterfly effect" (never staying long on any one source) and results in a fragile knowledge network (141).

Students are not literate in using technology to support their learning or to create content for academic purposes (142).

4. The internet makes us dumber

There is no evidence one way or the other. We know more now, and use our brains for more important tasks than memorizing, treating Google as an external memory device (146-7).

5. Young people don't read anymore

Several studies show that young people still read daily for pleasure, although the proportion is declining in most countries, but is increasing in some. Young people in high socioeconomic families read more than others (150). There seems to be little difference in speed and comprehension of reading on e-book readers vs. paper, although paper has an advantage for intensive reading of long expanses of text only (151). Students are still as capable of reading long texts, but less likely to if they find it boring because of so many ready alternatives and distractions (152).

6. You learn nothing from games other than violence

Research shows that learning from games is effective in languages, history and movement (if you have a Wii console). Not so for math or sciences. Its still early days (154). Action games (Call of Duty 2 and Unreal Tournament) greatly decrease action time compared to relaxed games, and may assist in literacy because significant proportions of gamers read game-related texts regularly, especially multiplayer online gamers. Reading is part of the culture of videogame play (155). Increased violent behaviour in children is more likely with boys, and children who already have a violent nature, live in a difficult home, or have low empathy (156).

7. You can help poor children learn just by giving them computers

Sugat Mitra's experiment where large numbers of computers were put in slums in large cities, mostly in India, showed that learning anything other than basic computer skills requires guidance, even if it is only someone asking questions that learners need to solve. Negroponte's One Laptop Per Child program

showed that it dramatically increased access to computers but there was no evidence it increased learning in math or languages. It did have some beneficial effects on cognitive skills (160).

Here's what the research supports:
Images with text work better than images alone.
Interactive Computer Training (ICT) generally has too much text and learning may be improved by more images that clarify and enhance the content (162).

For videos, performance and learning decreases with (163):

- Subtitles and regular text summaries
- Showing interesting but irrelevant information
- Brightening up the video lesson with fun images and amusing text
- Large amounts of text rather than narration for instructional images

For video and also online lessons, learning is improved with:

- Smaller chunks of content (4 videos of 5 minutes length are more effective than on 20-minute video)
- Roughly the same number of practical practice opportunities as a classroom lesson
- Giving learner-controlled navigation in video (pause, replay, move to specific parts, chaptering)

Education Policy Myths

(mostly about K-12)

1. You can justifiably compare the school results of different countries

Contextual information is vital in determining the likelihood that one country's high scores on Program for International Student Assessment (PISA) or Trends in International Mathematics and Science Study (TIMSS) or Progress in International Reading Literacy Study (PIRLS), even thought they have high levels of quality control. For example, a Pearson comparative report found that Finland and South Korea are fist and second internationally, but the two countries' education systems could not be more different: Finland's is progressive and focuses on equality, creativity and healthy living, whereas South Korea's approach is traditional, with standardized tests, and high valuing of technical skills and concrete results (166-68).

2. Class size doesn't matter

Some studies support this contention. However, research has shown small classes are better because students pay more attention, if the teacher is of high quality. The quality of the teacher is more important that class size. There is evidence that "small class size" being effective is for classes of 16 or under. Its better to choose a good teacher than a small class (171). A 2014 Northwestern report showed that all things being equal, increasing class size will harm student outcomes; money saved today by increasing class size will result in greater educational and social costs in the future; increasing class sizes impacts low income and minority children more (172). Luxembourg invested in smaller class sizes, and South Korea invested in teacher training and keeping class size large. South Korea outperformed Luxembourg, but in South Korea, students' parents hire expensive tutors after class to help their children (173). A Swedish study showed that students who scored high in small classes in early years consistently scored higher than those who had always been in large classes (174).

3. Larger schools are better than smaller ones

Schools need to be large enough for professionalization but small enough to avoid anonymity and to encourage people to take responsibility. That seems to be 600-900 for secondary and no more than 800 for elementary. For more diversity in the student population, smaller is better (176).

4. Separate education for boys and girls is more effective than mixed education

No reliable study supports this contention (178). There is no cognitive benefit for either boys or girls taught in gender-specific classes. Better pupils benefit from mixed classes. Boys prefer mixed classes (179). Research in multiple countries shows that mixed classes lets girls limit their lag behind boys in math (179). Performance of both boys and girls suffers at the same rate when they lack motivation to learn and confidence in themselves. Boys tend to study for performance and girls to learn the material. The latter usually results in higher scores. Girls generally perform better than boys throughout mandatory schooling (180). School elements that affect outcomes positively are structure, rules, clarity, safe teaching spaces, adequate personal attention for individual pupils and a good guidance and care structure (181).

5. Boys benefit if they have lessons from men more regularly

There is almost no proof that boys do better or worse with male or female teachers. One Flemish study showed some social differences: boys taught primarily by female teachers had a less traditional view of role models and have higher level of wellbeing at school on the one hand but lower self-esteem, a less strong work ethic and a more negative view of the future (183, 184).

6. Grade retention-being held back-has a positive effect on learning

Early on in the repeated year it seems to, as students are better at reprocessing what they got previously, but quickly diminishes when the material they didn't get is covered. Overall, it has a negative effect on achievement, and hurts boys more than girls and poor more than middle class (187). Social promotion is a failed policy as well. What works is sufficient guidance and follow-up when needed.

7. More money means better education

There is no correlation between what countries spend on education and student performance. Spending more money on students who come to school with the fewest resources improves student performance. So does spending on resources that assist the use of research-based effective teaching methods (189).

8. Education never changes

Changes do filter down from national or regional educational administrative layers to school boards to principals to teachers. At the local level, they are adapted to the practices that people there are used to. So education changes, but slowly (192). The authors see only two revolutions in education so far: the printing press, which made books available to students and not just to teachers; and the blackboard, which made it possible for teachers to present their own writing and demonstrations to students. The authors see PowerPoint and Learning Management Systems as extensions of this latter revolution.