Sabbatical Mini-Report #8
Telling, Explaining, and Learning

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Imagine this …

Student (C) walks in to a room, where two other students (A and B, naturally) are already working on some problems. Since C has struggled with math, he asks A and B how to do this problem …

A person with an income of $24,000 per year pays about 15% federal tax and 3.9% Michigan tax. What is the overall tax rate for these?

B says "That's easy enough, as long as you don't panic …you just add the percents."

C exclaims "Really? The answer is 18.9%?"

A says "Sure is!"

C turns in his math book to this problem …

A person needs 24,000 gallons of a mixture. Part will be 15% acid, and the other will be 3.9% acid. What is the possible percent acid?

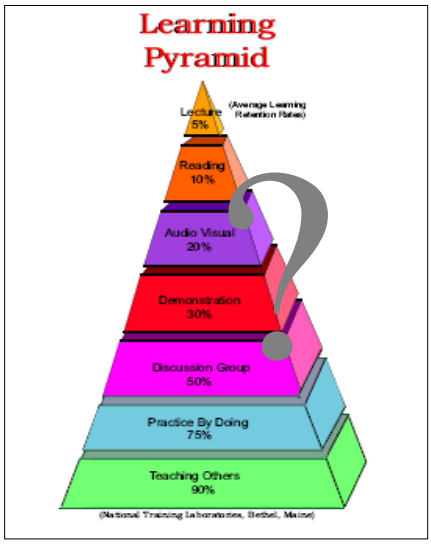
With a confidence never felt before, C writes down 18.9%, and goes on to the next problem.

Clearly, the purpose of this scenario is that the telling of information sometimes does not match the situations where it will be applied. If there is a mis-match, students will need to un-learn; if students do not understand the situations in the 'telling', there will also need to be some un-learning. For this purpose, it does not matter WHO is doing the telling – a student or a teacher.

Telling … What's the Deal with That?

Prior to 1991, "telling" (or "not telling") was not an explicit issue for most teachers. However, the NCTM Professional Standards advised teachers not to tell … and to focus on other students telling (Lobato, pg 106). Some of this, certainly, was due to a constructivist viewpoint held by the authors of the Standards. Another factor is the "Learning Pyramid" shown here:

Note the added "?" to the pyramid and cone.

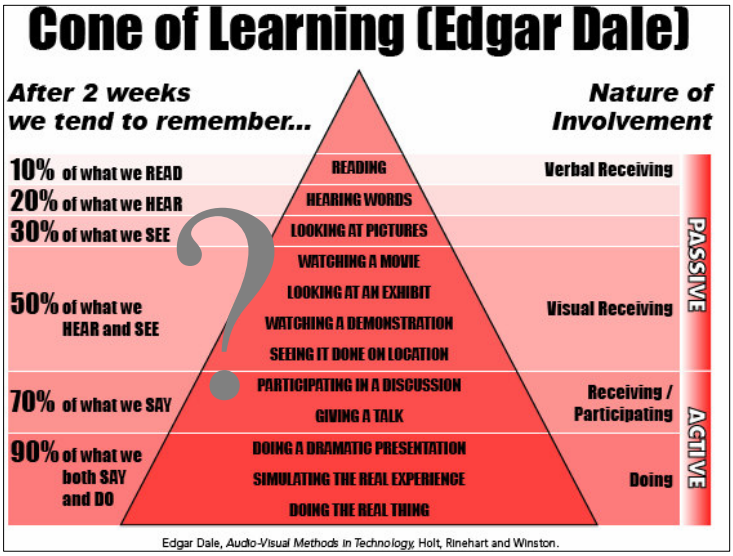


The learning pyramid [downloaded from http://www.tcde.tehama.k12.ca.us/pyramid.pdf on December 8, 2006; ?" added] was apparently started by the National Training Laboratories (Bethel, Maine) (NTL), and frequently adapted. The learning pyramid itself was based on the research of Edgar Dale, and "Dale's Cone". The original research behind Dale's Cone was interested in the learning and two-week retention

under “passive” and “active” conditions. In other words, if a learner ONLY listens, they will remember 5% (if you believe the NTL version) or 20% (if we go back to the “original source”).

Dale’s Cone is also shown here:

(downloaded from http://www.intech.com/education/pdf/ConeOfLearning-Flyer.pdf on December 8, 2006)
[“?” added”]



There are two basic problems with using these images to encourage teachers to “not tell”:

First, Dale’s research did not use “lecture” – it used “passively hearing words” … like a student who sits in class and never takes notes.

Second, Dale’s own original research did not have the numbers (percentages) … they appeared later. There is no basis for the numbers shown. [It certainly is true that learning is increased when a student is active in some way.]
These are the reasons for the “?” additions to the images shown.

Therefore, the “not telling” guideline came from a philosophical viewpoint (bias) and cited “research” that did not conclude “not telling”. The actual research of others seems to be a lot more consistent with the conclusion of Bruning (below).

Research on learning, as usual, is more complex. Bruning (pg 119) concludes that learning is best when there is a combination of expert (usually teacher) and inexpert (usually students) modeling. Without the expert ‘telling’, students are often unsure what the eventual ‘target’ is (what they are supposed to learn); without the inexpert ‘telling’, students may be perceiving different information than the teacher intended. From what I have seen in the research, a priority

should be placed on the teacher telling; the peer telling seems to work best as a enhancement. (See the Norton and Carmine reviews of Project Follow Through, and Direct Instruction in particular; Direct Instruction focuses on the teacher telling.)

When peers are doing the telling, a number of additional factors become involved. Solomon reported that minority students in particular had a preference for expert telling – for the teacher being explicit (Solomon, page 252). There are identified issues with race and culture that affect classroom 'telling' relationships; those will be explored in a separate report.

One of the specific reasons cited for "not telling" was to not inhibit the student's own mathematics. Lobato (pg 104-106) concludes that "not telling" underestimates the students ability and thinking skills, and that telling did not suppress the students' mathematics.

There are also authors who advocate "not telling" for political reasons, where they see an equivalence between the mathematics classroom and a democratic society (see Gates, pg 62). From this viewpoint, the mathematics classroom must be run in a democratic manner … because the society is democratic. I wonder if these authors would suggest that hospitals and restaurants be run democratically for the same reasons.

From a learning standpoint, the critical issue is not 'telling' or 'not-telling' – the issue is what does the learner do with the information that was received? Practice is the single largest determinant of long-term learning; see the separate report ("Life in the Grey Zone"). Current research on working memory indicates that sound (phonological) is processed in to verbal (semantic) long-term memory by a compilation process that is based on error reduction and efficiency. See the texts by Bruning, Goldstein, and Speelman for more information. "Explaining" is also a strong factor; see the discussion below.

There is a need to balance expert and inexpert telling; a dependence on inexpert telling can lead to a number of learning problems, including over-generalized rules.

Explaining

To use peer telling (inexpert generally), we need to understand the role of explaining. By "explaining", we will mean the stating or elaborating of the rationale for either the method(s) used or some specific elements of the application of those methods. In the starting scenario, explaining could look like this:

Student (C) walks in to a room, where two other students (A and B, naturally) are already working on some problems. Since C has struggled with math, he asks A and B how to do this problem …

A person with an income of $24,000 per year pays about 15% federal tax and 3.9% Michigan tax. What is the overall tax rate for these?

B says "That's easy enough, as long as you don't panic … in this problem, you can just add the percents because both percents are based on the income."
C exclaims "Really? The answer is 18.9%?"
A says "Sure is! It would be different if this wasn't about taxes; it doesn't always work for percents, but it does on this one."
C turns in his math book to this problem …

A person needs 24,000 gallons of a mixture. Part will be 15% acid, and the other will be 3.9% acid. What is the possible percent acid?

With a confidence never felt before, C writes down 18.9%, and was about to go on to the next problem. However, C then realizes that this is not about taxes, and wonders if the same rule applies. He concludes that they might not, so he decides to ask his instructor.

Explaining turns out to be a significant factor in learning, and it seems to help even if nobody is listening.

The type of explanations can be analyzed. A structure was found in Ploetzner et al (pg 104), given as a continuum:

"Explaining to oneself" (nobody else),
Explaining to Listener (either anonymous or just passive),
Constrained other (like teacher or tutor),
Mutual Explanation (fully engaged)

In their research, Ploetzner et al found that the benefits of explaining were found for both the explainer and the listener, even if the listener was just saying "ok" or "hmmm" as opposed to asking for clarification. [The researchers also found that students who were weak in problem-solving or learning abilities were often passive during instruction; classrooms need to build in participation for all, especially those most in need of improvement. Webb and Palincsar found that ethnicity and racial identity also have an impact, with minority students contributing fewer explanations; this finding is based on perceived power and other sociological factors.]

Slavin looked at research, and commented that cooperative learning does not create explanations; some structure is needed to focus on explanations about the content, in order to avoid an overly strong focus on a product (like an answer) (see pg 115). Students in groups that did not experience explanations did no better than students who had no group … there was no benefit without the explanation (Slavin, pg 114).

Even "explaining to oneself" shows promise in improving learning. Wong et al (online) found that self-explanations improved skills and procedures, when the explanations focused on knowledge of concepts. Similarly, Rittle-Johnson

(online) found that explaining why another student's work was right or wrong improved performance, even when the explaining was done to a passive listener.

Koedinger and Corbett (pg 72) tested self-explanations in a computer environment. Even if all the student had to do was select the proper reason from a list, the student learned the material better. The process even uncovered over-generalized rules, which is often a goal of explaining.

In some cases, the process becomes the focus on effort instead of the material. Sawyer (pg 196) reports that some learners focus on the quantity of interactions and the process, and lose the benefits of explanations.

Summary:

"Active Learning" is redundant. One can have a passive listener, but learning is an active state.

Telling is a valid pedagogical tool, and is often efficient.

"Discovering" is also valid, but is less efficient. (See Anderson et al, online.)

Explaining is a very active state, and tends to trigger strong learning.

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