Teaching And Testing Our Students Better

Singapore has once again turned in a remarkable educational performance. Recently released results from the latest Programme for International Student Assessment (PISA) survey, the tests that are given to high school students in about 60 countries every three years, show the Republic ranking second globally in mathematics.

A proud accomplishment, without doubt, but how do we ensure that students retain and are able to use what they have learnt over the long run? This is a central question not only for Singapore, but many other high-achieving, advanced economies such as Hong Kong that must balance the immediate issues of ensuring academic performance with the long-term need for well-trained populations that possess strong quantitative and critical-thinking skills.

TWEAKING THE WAYS WE TEACH

Some tinkering with the way we teach and prepare students for tests may be in order. Educational research shows that when a little bit of difficulty and complexity is introduced into the learning process, learning improves and there is more retention of knowledge. One of the ways to increase difficulty is to space the time between learning sessions. The greater the interval length between repeating lessons, the longer the retention period. This spacing effect is vigorous in improving learning.

Another effective strategy is to intersperse different content or subjects. This has been shown to be effective in learning sports — for example, tennis coaches will alternate serving with volleying, backhand with forehand and so on.

Similarly, an efficient strategy for a student learning many subjects is to mix it up a bit: Study some science, then history followed by math, and go back again to science.

This appears to work particularly well in math. A number of classroom studies demonstrate that students learn more by alternating between studying problems they have already successfully worked out and solving comparable problems on their own than they do when given only new problems to solve.

Learning and performance in examinations improve when students face problems of differing levels of difficulty, and when they are asked to provide solutions to challenges, such as writing a computer program, that are posed in alternating levels of complexity.

This back and forth between easier and harder, familiar and new requires students to continually build understanding and test their knowledge. It improves memory and can allow students to extract and apply more general principles to the different contents that they are learning.

Each item that we learn is thought to have “storage strength” and “retrieval strength”. It is important not only that we know something, but that we can recall it when we need it. When we first learn, both storage and retrieval strength are weak, which leads to forgetting. Information that we use all the time has both strong storage and retrieval strength.

So if our job requires that we use calculus we will remember it, but if it does not, we will have trouble retrieving that knowledge from memory no matter how well we once learnt it for a test.

Cueing is another way to retrieve information stored deep in our memory. Things we have not thought about in a long time can be recollected easily once a cue is given. The name of a acquaintance known long ago can be brought to the forefront of our minds with a cue, such as the fact that you went to grammar school together.

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PERMANENT AND FLEXIBLE KNOWLEDGE

We want children to acquire knowledge and skills in ways that are permanent and flexible. More precisely, we want students to acquire a long-term capability to generalise and to apply their learning —that is, to use knowledge in circumstances that differ on dimensions from the particular context in which it was learnt.

One of the key insights that comes from the body of research on learning is that making it more difficult to acquire knowledge means that students actually retain more and may be able to generalise better.

This has implications for how we teach. If, on one hand, we wish to focus on near-term performance such as doing well on examinations, then teaching should concentrate on learning quickly, with clear cues to students about how to do well on tests with a lot of cramming.

The downside is that the information may not be retained and it may be more difficult to apply that knowledge to other situations.

If, on the other hand, the goal is long-term retention and continual learning, then variability in learning with increased spacing and interweaving will lead to better outcomes.

The paradox is that making learning easier leads to better memory in the short-term, thus leading to better performance in examinations. But without having some difficulties introduced into the learning process that require greater effort, the long-term retention is reduced and forgetting is increased.

When learning is challenging and students have to generate more effort, they may make more mistakes, but they learn better.

In the short-term, this type of learning is slower and the complications inhibit rapid learning performance, causing more errors to be made and more ostensible forgetting. But the relearning that this causes may be what leads to long-term retention.

Schools and students may have to tailor assignments, lessons and study strategies to emphasise long-term learning, but, at the same time, manage the short-term performance needs that today's system of education requires.

By

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