

Memorable Teaching

Distributing the same amount of time over several sessions is better than a single session.

By Daniel T. Willingham

How much practice do students need to learn a given body of knowledge or group of facts? What strategies for learning different kinds of material work best? What's the most efficient way to allocate practice time?

Cognitive science offers insights that can help answer these questions and thus help teachers shape their instruction in especially effective ways.

In this article, we will consider one aspect of this broad topic for which the findings are especially consistent: how the 'massing' or 'distributing' of students' practice time influences students' long-term retention of factual knowledge.

This is an important issue for an obvious reason: knowing important factual information should be a residual effect of good schooling. In addition, in many cases, students' more advanced learning depends on their retention of previously-learned material.

Suppose a student is going to spend one hour learning a group of multiplication facts. How should that hour be allocated? Should the teacher schedule a single, one-hour session? Ten minutes each day for six days? Ten minutes each week for six weeks?

The straightforward answer that we can draw from research evidence is that distributing study time over several sessions generally leads to better memory of the information than conducting a single study session. This phenomenon is called the spacing effect.

The spacing effect was noted by Hermann Ebbinghaus, the psychologist usually credited with the first scientific study of memory in 1885. In a super-human feat of patience and endurance, Ebbinghaus tested his ability to learn hundreds of lists of meaningless syllables (e.g., 'lum') under different conditions.

Ebbinghaus noted that if he studied a 12-syllable list 68 times, he

could remember the list perfectly the next day if he allowed himself a 'refresher' of seven repetitions before the test.

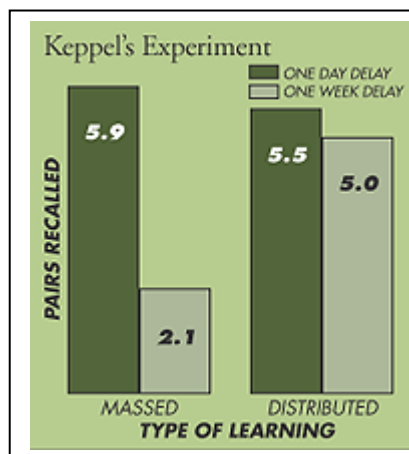
However, if he distributed his study over three days (and again allowed seven repetitions as a refresher before the test), he needed to study the list just 38 times — meaning he could cut study time nearly in half, with the same result, by distributing the practice.

The spacing effect has held up remarkably well over the better than 100 years that researchers have examined it. Here's another example, published about 80 years after Ebbinghaus' work.

In 1967, Geoffrey Keppel had college students learn pairs of nonsense syllables and adjectives (e.g., 'lum-happy'). They were to learn the list so that when they saw the syllable, they could provide the matching adjective.

All subjects studied the list eight times, but for half of the subjects, all eight trials occurred on the same day (massed practice) and the other subjects studied the list two times on each of four successive days (distributed practice).

Keppel then tested their memory of the list either 24 hours after the final study session, or a week later. The results are shown on the chart



below.

The upshot is that the massed practice subjects do slightly better the next day but considerably worse a week later. The distributed practice subjects, on the other hand, show very little forgetting, even after a week.

Massed practice is obviously very similar to what is commonly and derisively called 'cramming.' These results make it look as though cramming might allow you to remember things for a test the next day, but not for the long haul.

The spacing effect seems to apply equally to school-age children as well as college students, and to the sorts of materials students learn, not just nonsense words like 'lum.' Spacing appears to have the biggest effect on the learning of simple motor skills (such as typing), but it is also present when subjects learn new facts.

The effect size for the spacing effect is estimated at $d = .42$. This means that the average person getting distributed training remembers better than about 67% of the people getting massed training. To put this effect size in perspective, consider the fact that people who have had a heart attack are often encouraged to take an aspirin each day to help prevent future heart attacks. The effect size associated with this treatment is $d = .03$.

Most studies used timeframes that were not all that distributed — a matter of minutes or perhaps a day. But the few experiments that have used longer delays between practice sessions, and very long delays (years) before testing for retention, indicate that the spacing effect holds — and perhaps is even more robust after these long delays.

(Adapted with permission from the summer 2002 issue of American Educator, the quarterly journal of the American Federation of Teachers. Dr. Willingham is associate professor of cognitive psychology and neuroscience at the University of Virginia.)