Desirable difficulties in learning

What are they and how can they help students learn?

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“Desirable difficulties” is the term given to a set of educational practices that make learning more challenging but also more effective. These approaches may feel hard, but evidence shows that they can lead to efficient learning.

Students are under great pressure to perform well in exams, and to do that, they need to learn vast amounts of information. To help the learning process, the temptation for teachers may be to make learning activities as easy as possible, to reduce the effort required by the learner. But research shows that this can be counterproductive. The term ‘desirable difficulties’ was coined by cognitive psychologist Robert Bjork, and describes the counterintuitive concept that there are ways of learning that may feel less effective and lead to more errors during the learning process, but that lead to better performance in the long term.

Spacing is one such desirable difficulty that aims to increase the amount of information that is learnt. Rather than revisiting the same material in succession, spacing involves spreading out learning over time. For example, rather than studying information on a topic three times in a row, under a spaced approach this information would be studied for the same amount of time overall, but with intervals in between.

A recent small-scale RCT compared the effectiveness of intervals of 10 minutes, 24 hours, and a combination of both 10 minutes and 24 hours between learning sessions in science. The study found that combining spaced intervals of 10 minutes and 24 hours was the most effective of these: students whose learning was spaced in this manner performed better on a later test of the learnt material.

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A similar concept is interleaving, which is the practice of switching between topics, rather than studying one topic at once. One example would be to study some maths, then switch to geography, then switch to French, before going back to maths again later. Another example would be to interleave different problem-types within a subject. For example, one study either interleaved or blocked types of maths problems. During practice, blocked learning led to higher accuracy, but during the test, interleaved practice led to higher accuracy.

This is an example of how desirable difficulties may not feel like they are being effective, with learners not seeing as much improvement, but in the long run they perform better.

Perhaps the most unexpected desirable difficulty is the testing effect, whereby the act of testing can improve memory of the information being tested. Even if a learner is unable to answer the questions on a test, the act of trying to remember can improve later learning of that material.

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Multiple-choice testing has recently been explored as a particular way of exploiting the testing effect. This type of testing encourages learners to think not only about the right answer, but about all the possible answers and whether or not they are correct, which seems to help recall of untested but related information.

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These are just a few examples of the ways in which ostensibly making learning difficult, and requiring more effort from the learner, can lead to enhanced performance in the future.

**Aiming for the sweet spot**

Of course, it is not simply the case that the more difficult a task is, the better the learning outcomes. Content should still be at the right level for students, and if a learning scenario is too challenging, there could be unwanted outcomes.

Taking a desirable difficulties approach does make learning feel harder, and students may be disheartened, not realising the positive effect these techniques can have. This could lead to students feeling that they are learning very little, possibly leading to anxiety or reduced enjoyment of learning. As ever, there will be individual differences in how learners respond to these practices, with some enjoying the challenge more than others.

While educational tools that draw on desirable difficulties seem to be effective, there is still a lot more research to be done. For example, the optimum length of time between studying sessions is unknown, and it is likely that this will differ according to a host of factors such as the age of the learner, and the type of material being learnt.
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Multiple-choice tests may also have negative effects, potentially leading to false knowledge, so would need to be designed very carefully. It is also not clear how these different desirable difficulties practices might interact: would spacing, interleaving, and testing used together lead to even better performance than when just one technique is used, or would the difficulties be too great and reduce how much is learnt?

For now, these desirable difficulties can be used as guiding principles to help students structure their learning and revision. It might be a comfort to know that when things feel like they’re getting tough, it may well be that that is when the real learning is happening!

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