The theory behind evidence-based practice – going beyond the surface level

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When preparing teachers for practice, there are various options regarding the level of theoretical depth that teacher-educators provide. In this article, I will argue that developing a theoretical understanding of human cognition can help teachers to make better decisions about which strategy to use, and when. My view differs from that held by researchers such as Willingham (2017), who argued that teacher-educators "should stick to basic empirical findings" (p. 171) and eschew theory, which, he believes, is hard to understand and likely to be misapplied.

Research in cognitive psychology has uncovered a number of promising techniques that stand to improve classroom attainment (e.g. Dunlosky et al., 2013). For example, *the spacing effect* is where practice is distributed over a longer period of time rather than being intensive, and *interleaving* is where diverse examples are contrasted rather than examples presented in blocks of the same type.

Both of these techniques are founded on a strong body of evidence, and are associated with large effect sizes in comparison with alternatives (Cepeda et. al., 2006; Firth et. al., 2021). And while it can be argued that both focus on memory, neither is confined to rote memorisation. Applications of the techniques include helping students distinguish between easily-confused concepts, and boosting higher-order skills such as evaluation. However, they are sometimes called 'desirable difficulties' because they can make the learning process harder and more error-prone, while improving long-term retention and transfer of what has been learned.

The spacing effect and interleaving are becoming more commonly recommended in popular books about evidence-based teaching practice (e.g. Agarwal & Bain, 2019), as well as on blogs and social media. And it certainly makes sense to tell teachers about these techniques directly; not only do most report little or no prior knowledge of them, the majority do not appear to make a good intuitive judgement about the benefits of the techniques when presented with hypothetical classroom scenarios (Halamish, 2018).

The underlying reason for such misjudgements is that memory is fundamentally counterintuitive in its workings (Bjork, 2011). Learners and teachers are typically unaware that rapid and error-free performance in class does not always indicate secure new learning, and is in fact often negatively correlated with learning (Soderstrom & Bjork, 2015). They may therefore assume that desirable difficulties are best avoided. This is a fundamental and widespread metacognitive error in terms of how classroom techniques are judged.

To address this, I would argue that teachers need a theoretical understanding of human cognition. Teachers need to know what is going on beneath the surface if they are to select classroom techniques appropriately and use them flexibly, and must not be misled into thinking that learner mistakes or difficulty indicate that learning is going badly.

Willingham (2017) argues that while teachers do need a mental model of the learner, this should be a simplified 'modal model' (similar to the model presented by Atkinson & Shiffrin, 1968), should stick to basic empirical findings, and should present these in terms of "folk constructs" (p. 171) rather than scientific terminology. Willingham (one of the co-authors of the Dunlosky et al paper cited above) would probably support telling teachers about techniques such as the spacing effect, but believes that telling teachers about scientific theories of cognition would lead to their misapplying those theories (p. 169).

The problem with this argument is that there is a lot of nuance as to how and when pedagogical techniques should be used. Interleaving, for example, can make differences between examples more salient to learners, but this advantage disappears when differences are so obvious that no learner would mix them up. The optimal spacing of practice depends on both the subject matter and the learners' prior knowledge, and teachers need to understand forgetting in order to judge the optimal time to engage in practice (Firth, 2021). The theory that underpins such techniques is both specific and highly generative across different situations; understanding it is likely to help teachers make better classroom decisions.

In my view, then, teacher education should aim to develop an accurate understanding of the underlying theory among teachers. Without such a foundation, their judgements of techniques such as the spacing effect and interleaving are likely to be informed by flawed assumptions due to the fundamentally counterintuitive nature of human memory.

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