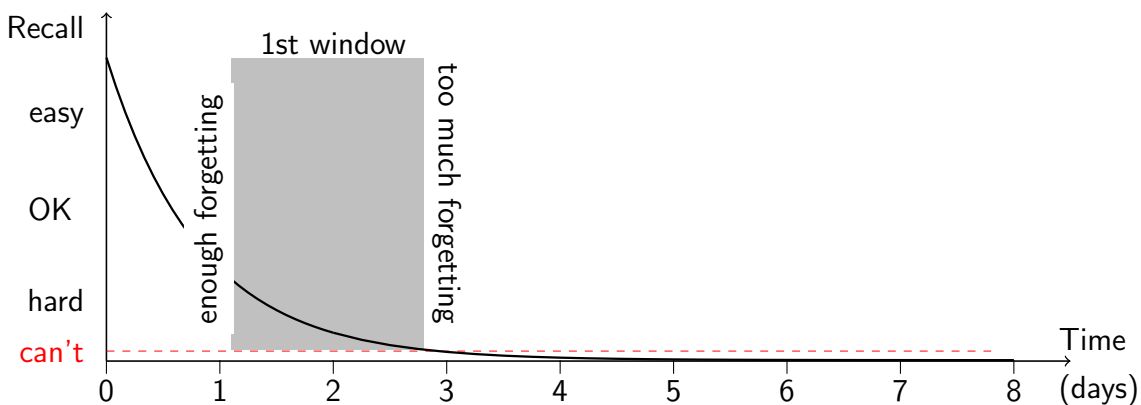


In “the problems” document I looked at a number of the reasons why embedding learning is so hard for low attaining learners.

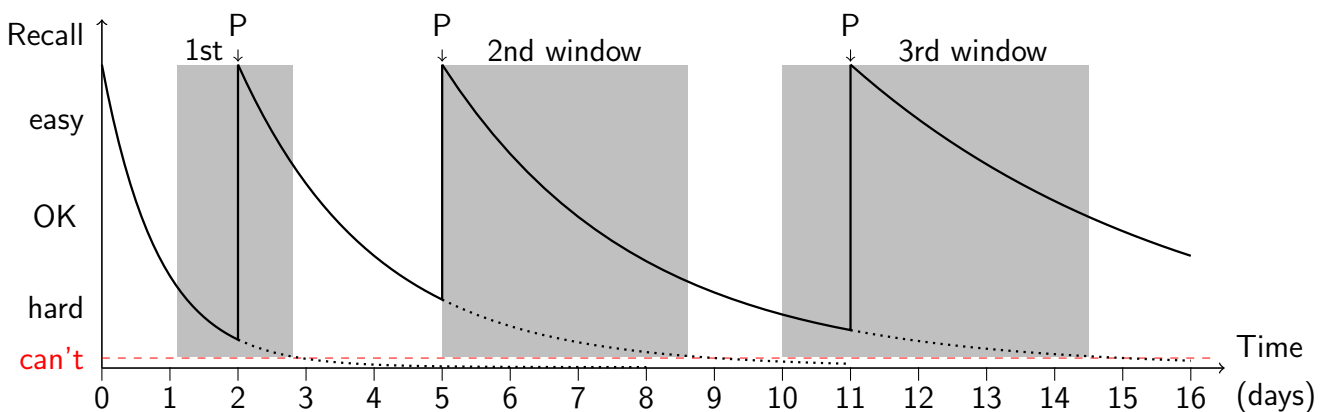
In this, the first of two solutions documents, I look at how, when teachers “think outside the lesson box”, they can ensure more learning becomes embedded learning; in the second one I look at how to increase the pace of learning by using a more tightly spiralled curriculum.

- First we’ll study forgetting, how forgetting can help embed learning and why overlearning is far less efficient than retrieval practice in embedding learning.
- Then we’ll look at why doing retrieval practice is considerably more beneficial for low attaining learners than their peers.
- Finally we’ll look at what teachers need to do differently and how timely practice makes retrieval practice easier for groups of low attaining students.

“If we learn something and don’t use it, over time we will forget it”. This is shown by Ebbinghaus’ forgetting curve. Retrieval practice requires us to allow “quite a lot, but not too much” forgetting to happen before we practice another similar question. When learners practice in this “window”, they will increase the duration before they would otherwise forget.



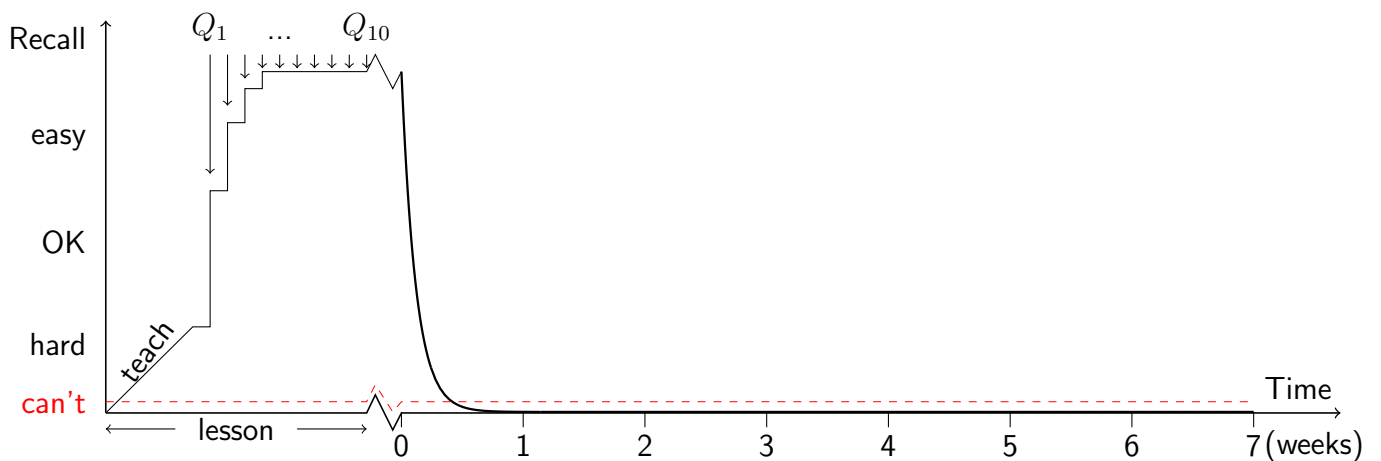
Repeated retrieval practice requires we practice another question within the next window ...



... and so on. Each practice extends the duration the learning can be recalled for. Even if we leave the practice “too late” and the learner can’t remember, provided we give feedback - show the

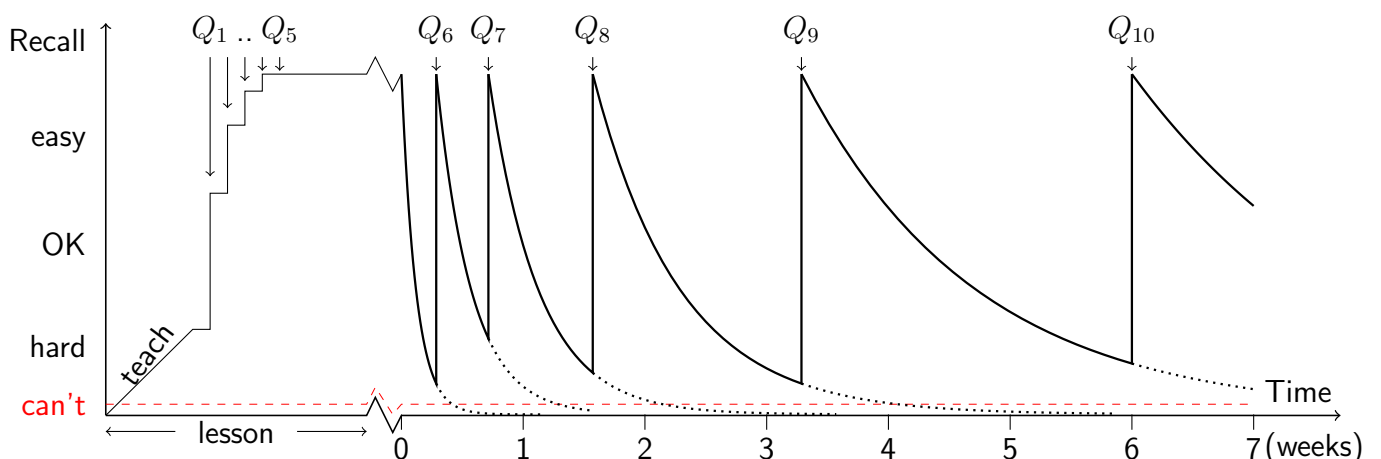
learner what they can't remember, whether that is part or all of the "learning" - the duration of learning is increased.<sup>1</sup> Ideally, to reduce teacher workload, we'd like to time the practice so that we increase the depth of learning significantly, without needing to give feedback - hence the name of our app "timely practice".

Overlearning is defined as any practice after the first success. Usually overlearning happens in the same lesson as the teaching of any "new learning" - the vast majority of practice questions done in maths lessons are overlearning. A little overlearning embeds learning, but with each extra practice the learner embeds that learning progressively less, until soon there is no further improvement. This is because we aren't waiting for forgetting to happen.



Despite the optimistic name, overlearning is not very successful at embedding learning, it doesn't ensure the learning will be remembered for a long duration of time.<sup>2</sup>

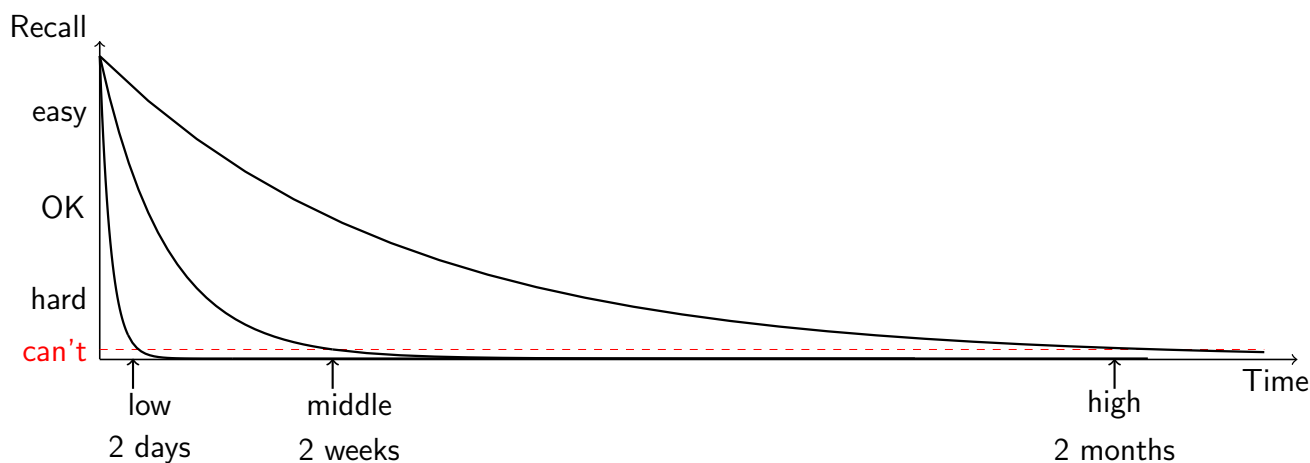
If we begin retrieval practice once overlearning becomes less effective; normally this is after a few successful practice questions in the lesson, we will get maximum embedded learning for minimum lesson time.



<sup>1</sup> Unsuccessful Retrieval Attempts Enhance Subsequent Learning Nate Kornell, Matthew Jensen Hays, and Robert A. Bjork Journal of Experimental Psychology Vol. 35, No. 4, 989-998

<sup>2</sup> Rohrer, D., and Taylor, K. (2006). The effects of overlearning and distributed practice on the retention of mathematics knowledge. Applied Cognitive Psychology, 20, 1209-1224.

Before looking at the changes the teacher needs to make, in order for retrieval practice work for low attaining learners, let's look at why retrieval practice is so much more necessary for low attaining learners than their peers.



High attaining learners tend to remember “new learning” for much longer longer than their low attaining peers. High attaining learners generally remember “new learning” for “a few weeks”, so they tend to get “well enough” timed retrieval practice through homework, end of unit, mid year and end of year tests. When they have forgotten some “new learning”, they can often recall it by having their memory jogged or can quickly relearn it because it is only just forgotten - they often experience that “I remember I’ve learned this before feeling”.

Retrieval practice websites suggest middle attaining learners remember “new learning” for about a fortnight. Most middle attaining learners usually can and will revise for tests. An end of unit test is usually 1 to 5 weeks after the lesson, so although some learning may have been forgotten - the learning usually won’t have been forgotten so much that the learner feels “as if they have never learned it”. Revision although not enjoyable is possible. The end of unit, mid year and end of year tests won’t be so well aligned for them as their high attaining peers, but they can revise to fill these gaps. (Of course schools could introduce more frequent, low stakes retrieval practice, timed so that middle attaining learners can recall their learning without revision.)

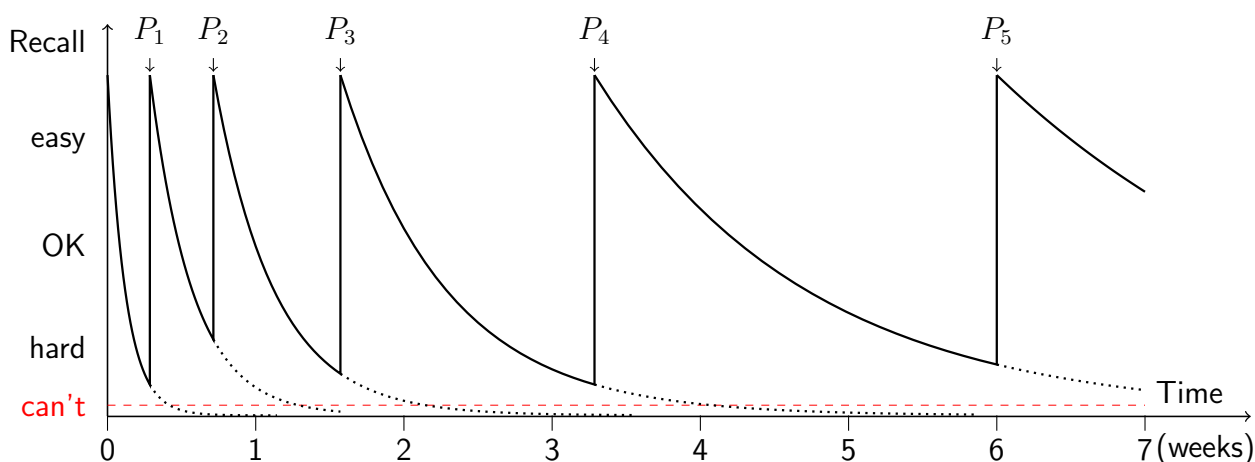
For low attaining learners, our “testing” is badly timed. Revision isn’t revision if you “can’t remember at all” - it is self teaching; not easy for any learner, let alone low attaining learners. Testing can be stressful for all learners, but the less successful you are and expect to be, the more stressful the process is. My experience of low attaining learners in tests is that copying is endemic unless one goes for strict “exam conditions”. Exam conditions are counterproductive and difficult to achieve in a classroom with disaffected and distressed learners.

So the first and most important thing the teacher should do when beginning “retrieval practice” is to make it “low stakes” and never call it “testing”.

Secondly, the learners should do less overlearning practice questions in the lesson, than in a “business as usual” lesson. Unused practice questions should be retained for retrieval practice.

Thirdly, the teacher should begin retrieval practice.

Start by asking a (retrieval) practice question on what was learned, ideally within 3 days of the lesson. The teacher will need to experiment, some learners should ideally practice the next day. If all the learners could do their first retrieval practice question 2 days after the lesson, then the next practice question should be spaced 3 to 4 days<sup>3</sup> after that.<sup>4</sup>



If any learners can't do the retrieval practice question, then feedback should be given and the interval reduced to, at most, the last successful interval. If the retrieval interval is short enough, the learners will be able to remember the feedback when the next practice occurs. One final thing to bear in mind: every time feedback is required the teacher has "caught" learning which would otherwise have been "soon forgotten".

Retrieval practice works well for retaining learning - if the interval between practices can increase because all the learners are able to independently and accurately apply that learning, then we know that the learning of the lesson was appropriate ... but if the learners are forgetting often, need lots of feedback and the interval between practices is not increasing, then retrieval practice is letting the teacher know when they have tried to teach "too much" or "too hard".

The biggest change in outlook for teachers and learners is that we can no longer think that learning is confined to one lesson - we must think outside the "lesson box".

In "the solution part 2 - a more tightly spiralled curriculum" document I explain how returning to teach topics more than once per year enables teachers to increase the pace of learning for low attaining learners - that is we must think outside the "traditional scheme of learning box" too.

timely practice was created to deal with problems, which I encountered when using retrieval practice with classes of low attaining and underachieving learners.

<sup>3</sup> We have found that doubling the interval is too much for many low attaining learners. Multiplying the interval by between 1.6 to 1.8 is more successful.

<sup>4</sup> Clearly when we are doing retrieval practice in maths lessons, we can't always get the desired interval, because of weekends etc.

The problems I found were:-

- copying was endemic and meant I didn't know who had retained their learning and who had not;
- the wide spread of prior attainment of learners meant they needed different retrieval practice questions - to match the differentiation of my teaching;
- short attention spans of many learners meant that when I needed to feedback to only some learners, the ones who "knew already" wouldn't be able to "listen or work quietly" for long;
- learners needed more help than I had time to give, this seemed to me, to be because the spacing between one practice and the next was a not personalised. Too often learners had forgotten what was taught before the next practice question;
- place holding problems, which learners with poor working memory are prone to, meant - if I suggested the students did a single question from a number of different exercises from a text book - many would end up trying different questions by mistake.

The sum of all these factors meant that for effective classroom management I needed each learner to have personalised questions - so that they would not be forgetting unnecessarily. However just sourcing enough "one size fits all" retrieval practice questions for the class was already too time consuming. Especially so, when combined with

- a lack of sufficient practice questions. I could perhaps find a few in an exercise in a text book, but the text book soon started to "up their game" before my learners were ready.

timely practice was created to overcome all of these problems. It is a tool for use by teachers to embed significantly more learning than business as usual teaching. Teachers are initially quite shocked at just how little recent learning their learners retain without retrieval practice, they feel slightly embarrassed, "How could I have not known that so little of my teaching is remembered?" Teachers then go on to become excited about their learners' future learning possibilities; knowing that most learning in most lessons will go on to become embedded learning.

The favoured format, used by teachers to date, is that the teacher begins the lesson with each learner doing their personalised timely practice assignment for about 15 minutes as a "warm up". While the learners are engaged in independently and accurately answering the questions within their assignment, which results in progressively more deeply embedding the learning, the teacher circulates to give help or to give feedback on questions from the learner's previous assignment, which the teacher feels warrant feedback.

If you can do retrieval practice without timely practice, I would suggest that you do. However if you can imagine the list of problems above occurring with your classes of low attaining learners (if your classes are setted) or with the low attaining learners in your class (if your classes are mixed ability) then why not give timely practice a try?