The Self-Testing Toolkit

1.   Pre-Tests

What are…Pre-tests?

David Ausubel famously said, "The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly". Clearly, the prior knowledge of our students is essential feedback to guide our teaching. The problem? Students already know about 40 to 50% of what we are going to teach them, but that prior knowledge differs between students (Nuthall, 2001).

Getting an accurate measure of students' prior knowledge and skills is challenging. Furthermore, providing them with clear and actionable feedback can be particularly difficult during class time. In David Carless' study, 'Differing Perceptions in the Feedback Process' (2006), he noted that 70% of teachers claimed that the feedback that they gave was detailed enough for students to use, but only 45% of students agreed that feedback was of this standard.

Pre-tests are an objective test designed to provide teachers with a gauge on the topic students are about to study. They provide a more accurate and reliable snapshot of a student's prior knowledge than what we may assume they already know. They may vary in form, from short, closed questioning, to more long-format answers judged against specific levelling criteria, depending upon the topic.

Why use…Pre-tests?

Topic based Pre-tests, based on the essential knowledge and skills from a topic to be studied, provides an objective mode of feedback on students' prior knowledge. Even when a student struggles on a Pre-test, the evidence shows that it helps to prime students to learn in future.

How can you best use…Pre-tests?

The planning for Pre-tests should identify what the essential knowledge and skills from a given topic in Geography and Science is and design a test accordingly. This may be in the form of a short-answer response, or a long-format response, ultimately mimicking the form of the post-topic assessment. To enhance the accuracy of the Pre-test, it may be pre-planned between teaching teams, or taken from the examination board materials directly. Teacher moderation could then take place after the test has been sat (given that we would seek to avoid adding to teacher workload, considering how students can self or peer assess should be explored).

Students need to be supported so that they don't lose motivation if they struggle on a Pre-test, which is often a likely outcome. They need to understand the purpose of such assessment and why failure may prove productive. They also need prompt feedback on incorrect responses.

Relevant Research Evidence:

•   'The Pretesting Effect: Do Unsuccessful Retrieval Attempts Enhance Learning?' Lindsey E. Richland et al.: http://bit.ly/1QFjcui.

•   'When Does Feedback Facilitate Learning of Words?' Harold Pashler et al. http://bit.ly/2hFjaIW.

The Self-Testing Toolkit

2.   Cumulative Quizzes

What are…Cumulative Quizzes?

Quizzes are a very common assessment strategy deployed across a range of curriculum areas for decades. Typically they are focused around factual recall of subject knowledge, but there is also developing understanding of how multiple-choice quizzes and quiz applications can support learning.

Cumulative quizzes test knowledge not only from the most recently studied topic, but also across a number of topics studied in the past so that the student is guided to revise content in a regular way over the course of a term, school year, or even a key stage.

Why use…Cumulative Quizzes?

The 'cumulative' aspect of Cumulative quizzes is crucial to their effectiveness. The principle draws upon the cognitive science that attends learning and the memory, particularly the concepts of spacing and interleaving. Cumulative quizzes take a planned approach to repeating core knowledge questions so that they become better stored in our students' long term memory. Such an approach proves particularly useful in subjects where there is a lot of complex knowledge and terminology to be learnt.

By doing such quizzes over a planned period of time, teachers can induce just the right amount of forgetting from students. For example, a teacher may look at the specific content learned, decide an appropriate length of time to allow for forgetting to occur and space the quizzing accordingly, so that these repeated answers are increasingly retained over time

How can you best use…Cumulative Quizzes?

Ideally, Cumulative quizzes are co-planned and they are part of a strategic curriculum planning model. By centralising question banks and tests it helps reduce the planning burden on teachers. Multiple choice quizzes can prove effective, but they require a good deal of planning; short answer recall questions can prove more straight forward, but lack the structured support inherent in a multiple-choice model.

Applications like Quizlet have a lot of existing quizzes, but you can also design your own and use them more flexibly. Other apps, like Socrative and Google Forms, can perform a similar function and provide instant feedback to students to help highlight misconceptions etc.

Relevant Research Evidence:

•   'Test-Enhanced Learning in a Middle School Science Classroom: The Effects of Quiz Frequency and Placement', Mark A. McDaniel et al.: https://bit.ly/2DvwItM

•   'Spacing and Interleaving of Study and Practice', Shana K. Carpenter: http://bit.ly/2hsEqCB

•   'Interleaving Helps Students Distinguish among Similar Concepts', Doug Rohrer: http://bit.ly/2hA0nTf

The Self-Testing Toolkit

3.   Flashcards

What are…flashcards?

Typically, Flashcards are A6 pieces of card with a key term, concept or question on one side of the flashcard and the definition or answer on the back. Although flashcards can vary in authorship (student or expert generated), size and format (physical vs virtual), the concept remains the same; students test their knowledge by hiding the answer from sight before attempting to recall it as accurately as possible. They then check to see how accurate they were in their recollection of the answer. In doing so, students test their ability for factual recall and/or their understanding of key concepts.

Why use…flash cards?

Each time we recall information without seeing it in front of us, we re-consolidate prior learning. Repeating this process reinforces our memory of the content of that learning. Flash cards are a simple and effective tool for allowing students to engage in active recall, a process that has been demonstrated to strengthen the neuronal connections that underpin our memories.

The forgetting curve is a data-driven phenomenon in Psychology that was originally demonstrated by Hermann Ebbinghaus as far back as 1885! Although his research may not have been as secure as the methods used by researchers today, it has been replicated in many subsequent studies. There are now hundreds of studies that support what was once a revolutionary approach to improving memory over time, namely 'repetition based on active recall'.

How can you best use…flash-cards?

Flash cards are most effective when they are learner generated and used over time. Re-visiting the full stack of the cards on a weekly basis provides students with the spaced practice needed to strengthen the memory traces required for long term recall.

When a flashcard relates to a concept such as 'democracy' that requires more than a closed or one-word answer, evidence suggests that a written or spoken aloud process as opposed to students answering internally is most beneficial for learning. Dunlosky, who has contributed to much of the research on flashcards, recommends students writing out the definition and then turning over the flashcard to check the accuracy of their response.

In a single sitting, students can take a more diagnostic approach to the use of flashcards, 'dropping' cards from the stack that have already been memorised. However, flashcards should be used as part of a model of distributed practice as well as returning previously 'learned' cards into the rotation to improve long term recall.

Karpicke and Roediger found that students who whose 'learned' cards were taken out of the stack got 30% correct answers in tests compared with 70% achieved by students whose cards were returned to the stack in order to revisit, retest and re-consolidate on a weekly basis. This offers further support for the view that testing is learning.

Relevant Research Evidence:

•   'The critical importance of retrieval for learning.' Karpicke, Jeffrey D. and Roedinger, Henry L. III http://bit.ly/2hC7F8O

•   'Improving Students' Learning.' Dunlosky et al http://bit.ly/10VR4Re

The Self-Testing Toolkit

4.   Structured Note-Taking

What is structured note-taking?

Structured note-taking requires students to ensure carefully spaced areas around their notes are left blank ready to be populated with cues or questions that will later be answered when the learning is revisited as part of a model of spaced practice over time.

Cues take the form of key words, which students then utilise in self-testing by covering up the main body of notes to which the cues relate before testing their recall of the information.

Questions in the area preserved for self-testing may simply be 'closed' or could be more complex and demanding, mirroring the higher order thinking skills required by high value assessment/examination questions.

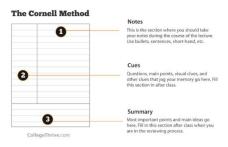**Why use…structured note-taking?**

Re-reading notes is not very hard. And therein lies the issue. We know that an appropriate level of challenge supports learning as well as students ability to self-regulate and approach tasks more metacognitive. Just as the relative passivity of using highlighters to highlight text is what underpins its ineffectiveness, so to the passivity of re-reading one's notes is what renders this approach relatively ineffectual when compared with the structured note-taking that builds in the opportunity for review, diagnosis and self-testing over time.

Structured note-taking helps to convert a record of key ideas taken at the time that students are first introduced to them and turn this into a permanent part of their knowledge (Pauk and Ross 2010).

In addition to the benefits in learning generated by the self-testing element of this strategy, the process of producing structured-notes may also contribute to enhanced learning. It is quite conceivable that the process of cue and question generation itself when creating notes engages students more in the content to be learned.

How can you best use…structured note-taking?

The Cornell structured note-taking system involves leaving a blank column when taking notes in class. Students then

enter key terms (cues) or questions in this space, usually to the left or right of the notes, shortly after the content has been recorded. Cues and questions then form the bases for self-testing when reviewing notes over a period of time as part of a frequent diet of spaced practice.

It is important to ensure that cues and questions relating to the notes are revisited after in a model of distributed practice approx. weekly, as with all of the methods of spaced practice explored in the toolkit.

It's worth noting an observation by Bahrick and Hall whose study showed that testing students on the content of unstructured note-taking in the immediate moments after taking the notes creates a significant risk that students who recall something from memory immediately after notetaking may be misled by the ease of the task. This in turn leads to students believing that they know the material better than they do. Such false confidence is easily shattered when a student is tested in examination conditions and is unable to recall key information. Structured note-taking not only avoids this but builds in the necessary recall process to deepen learning over time.

Relevant Research Evidence:

•'How to study in college' (10th ed.), Pauk, W., & Ross, J. Q. http://bit.ly/2hjjb8n

•'The importance of retrieval failures to long-term retention: A metacognitive explanation of the spacing effect.' Bahrick, H. P., & Hall, L. K. http://bit.ly/2hqv0tP

•   'Improving Students' Learning.' Dunlosky et al http://bit.ly/10VR4Re

The Self-Testing Toolkit

5. **Blind Mindmapping**

What is Mindmapping?

A mindmap is a visual way of structuring information, ideas and concepts. As well as aiding factual recall, it allows learners to make links between ideas via connecting branches and engage in higher-order thinking skills such as analysis, synthesis and evaluation.

Why use…mindmaps?

Studies have shown that mindmaps are an effective strategy for helping to maximise germane load, a learner's way of processing, organising and automating schemas (see Sweller's Cogntive Load Theory). Applying the principle of self-testing to mindmapping in a process of 'blindmapping', students can begin to move from creating 'paper maps' to storing 'mind maps' in their long-term memory, available for recall at a later date. Given the complex neuronal connections required for the synoptic thinking associated with mindmaps, if students are able to memorise the connections between concepts as well as the concepts themselves, they may have a greater level of reflexivity when it comes to addressing questions involving higher order thinking tasks. For example, writing that requires the linking of specific themes to key characters in a play or answering an unseen essay question on a theory in Psychology underpinned by multiple case studies.

How can you best use…mind mapping?

Mindmapping is something that could first be introduced with low-stakes learning. For example, students may begin by creating a mindmap based on a written resource outlining the work that takes place at Disneyland. Students use this information to create a mindmap linking the various aspects of the running of the park, from the business model through to the experience of children meeting their favourite characters. Having created a mindmap, students then begin to self-test for diagnostic as well as enhanced learning. This will allow students to gain a sense of the struggle required to recall larger quantities of interconnected information but in a low-stress situation that ultimately results in a sense of the success that follows challenge. It could also aid their metacognition by improving their understanding of how this method works and secure greater buy-in to the process when it comes to the content that they will need to learn as part of their actual studies.

The 'blindmapping' process that forms part of this toolkit combines the process of mindmapping with the principle of enhanced learning through frequent self-testing distributed over time. Combining the self-testing element of this tool with the simple principle found in game-based learning theory that learners tend to be more motivated by in-game feedback such as scores than by process alone, blindmapping assigns a set number of 'lives' to the first attempt at recreating the mindmap. Having photocopied multiple structure-only templates of the mindmap, students allow themselves a set number of lives (5 is a good starting point, represented by heart symbols down the side of the mindmap) and must lose (strike-out) a life each time they peek at the original fully populated mind map.[1] If they succeed at recreating the mindmap within five lives, they begin again with a new template and just four lives and so on until they are recreating the mindmap fully from memory using no lives. If students are struggling with the initial five lives then additional lives can be added to adjust the challenge to a suitable level for each child depending on their starting point. Crucially, this challenge should be repeated over time, with students recording the fewest number of lives they used on previous attempts and picking up at this point the next time they attempt the self-testing process.

Peeking can be time limited or not, depending on the breadth and depth of the mindmap. Mindmaps with more ideas may be better suited to unlimited time for each 'peek' but no-writing is allowed whilst peeking. With smaller mindmaps, there is a risk that longer periods of time spent re-studying the mindmap mid-game may allow students to store the information in their immediate or even visual memory in order to recreate the information with little challenge. In turn, they gain a false sense of being secure in their knowledge.

Relevant Research Evidence:

- 'The efficacy of the mindmap study technique' Farrand, Hussain, Hennessey http://bit.ly/2htsSBx

- 'Bloom's Taxonomy', Bloom http://bit.ly/1CiMWeK

- 'What the Best College Professors Do', Bain http://bit.ly/1NboqPT

- 'Theory and Research-based Principles of Learning.' Carnegie Mellon Eberly Center for Teaching Excellence http://bit.ly/1eIN0Uw