Using evidence in practice

In search of the information literacy training 'half-life'

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Introduction

There is an increasing concern with the effectiveness of information literacy (the activity formerly known as information skills) training. How do we know that it is effective? Are we wasting our time? In a previous column I introduced the learning 'half life', the period of time over which course participants forget half of what they have been taught.[1] This led me to explore the wider evidence base located outside library and information practice. What is the likely period for this degradation of knowledge? Can this research inform our approach to information literacy training? This investigation is framed within the following realistic scenario.

Scenario

For some years your library has contributed a 1-h training session to a junior doctor's induction programme. Various staff members have participated over the years, but there is a general perception that this session is not effective. Typically it comprises a 50-min lecture but you are wondering if it could be more interactive. As lead for information skills training you decide to examine what the psychological and educational literature has to say about memory retention.

A few caveats

Memory attention research is populated by considerable myth and folklore. Vested interests exist around memory and recall learning systems and make spuriously precise claims. You have probably encountered the 'Average Learning Retention Rates' pyramid. This says that 'Of what we learn we retain approximately 10% of what we Read, 20% of what we Hear, 30% of what we See, 50% of what we Hear And See, 70% of what we Say, 90% of what we Say As We Do ...' Impressive, isn't it? The origin of this myth appears to be Edgar Dale's famous 'Cone of Experience' diagram from a 1946 textbook called *Audio Visual Methods in Teaching*.[2] Dale used the Cone to illustrate his classification of different types of mediated learning experiences. Fine so far! However. 'at some point someone conflated Dale's Cone with a spurious chart that purports to show what percentage of information people remember under different learning conditions'.[3] In recent years these percentages have been superimposed over Dale's Cone, replacing or supplementing Dale's original categories. Therefore, unfortunately for many of us who have used this diagram, there is no scientific basis for these often-quoted retention percentages. In fact, we could probably spot that this is at least an over-simplification if not completely erroneous—have you ever managed to read something (10%) without seeing it (30%)?

Secondly, because this is essentially a populist area of science it is difficult to establish the rigour of methods used to derive the evidence base. For example, popular books on mind mapping are one source for claims on memory retention. Such works are prone to oversimplification. How can we capture what a course participant has learnt? How can we establish that they have not, in fact, remembered more of a lecture but not what we specifically deemed important enough to ask them? Similarly, we do not simply wish to achieve recall—more importantly we want them to acquire understanding.

Finally, we should acknowledge that within an educational context there is already a well-established 'half-life'. This is the time within which a professional's skills and knowledge become obsolete:

'The half-life of professional competency is defined as the time after completion of professional training when because of new developments, practicing professionals become roughly half as competent as they were upon graduation.'

Obviously this characterizes the volatility of a domain not our learning about it. An estimated 50% of a professional's knowledge and skills deteriorate or become obsolete within 10–12 years of receiving training.[4,5] Similar studies have been conducted in medicine.[6] Even if we could miraculously assist course participants to retain 100% of what we teach this knowledge is subject to the speed of decay of knowledge within their specific area. In this column, we focus on individual knowledge retention, not on the wider properties of the subject domain.

This proves a complex topic for desk-based research. The concept of the 'half-life' is by no means common in the literature. Relevant articles were found under 'trace decay', the 'curve of forgetting', and 'performance decrement'. Many cross-referenced the same key studies, although frequently identical statistics were attributed to secondary sources rather than to the primary research literature.

Memory retention studies

During a lecture

Even while the lecture is taking place we are performing at less than optimum effectiveness. Students are not attentive to lecture content about 40% of the time.[7(p. 11)] Adult learners can keep tuned in to a lecture for no more than 15–20 min at a time—at the beginning of a class. Johnstone and Percival observed that, after 3–5 min of 'settling down' at the start of class:

'[T]he next lapse of attention usually occurred some 10–18 min later, and as the lecture proceeded the attention span became shorter and often fell to three or four minutes towards the end of a standard lecture.'[8(pp. 49–50)]

Burns (1985) asked students to write summaries of presentations and tallied their reports by the 'half-minute segment of the presentation' in which they occurred. Students recalled most information from the first 5 min of the presentation:

'Impact declined, but was relatively constant for the next two 5-minute portions, and dropped to the lowest level during the 15- to 20-minute interval.'[9]

This 15–20 min point is apparently critical. Student attention levels continue to drop throughout a lecture.[10(pp. 90–91)] Attention is linked to retention with students retaining 70% of the first 10 min of a lecture but only 20% of the last 10 min.[11(p. 72)] When delivering didactic sessions, we need to recognize the existence of this 'performance decrement'.[12]

Following a lecture (short-term)

Many key memory studies are noted for their longevity. An often-cited work by Ebbinghaus in 1885 showed we forget about 75% of what we learn after 48 h.[13] When subjects memorized a list of nonsense syllables (hopefully not directly equatable to your information literacy lectures!) and were tested repeatedly, they had forgotten 47% within 20 min. After 1 day, 62% were forgotten and this rose to 69% after 2 days. At the end of 31 days in excess of 78% were forgotten. Most forgetting takes place within minutes after we have delivered our didactic sessions.

Another seminal study examined student notebooks following lectures and found that 'students carry away in their heads and in their notebooks not more than 42% of the lecture content'.[14(p. 9)] While this is demoralizing enough, when students were examined 1 week later without reference to their notes, they could recall only 17% of the lecture material.

Following a lecture (long-term)

Studying long-term retention of knowledge is even more complex. However, this topic was considered by a team from the Open University who found that 'rapid forgetting occurs in the first 2 years after learning'.[15] After this time, memory seemed to stabilize for up to 12 years. They concluded that knowledge which is still retained after approximately 2 years appears to remain intact indefinitely. Interestingly, in our context they found two exceptions

Table 1

Number of half-lives elapsed	Fraction remaining	Time period (% remembered; Author–Date)
0	1/1 (100%)	
1	1/2 (50%)	After 20 min (53%; Ebbinghaus, 1885) Post lecture (42%; McLeish, 1968)
2	1/4 (25%)	1 day later (38%; Ebbinghaus, 1885) 2 days later (31%; Ebbinghaus, 1885) 48 h later (25%; Ebbinghaus, 1885) 15 days later (25%; Ebbinghaus, 1885) 31 days later (22%; Ebbinghaus, 1885)
3	1/8 (12.5%)	1 week later (17%; McLeish, 1968)
4	1/16 (6.25%)	
5	1/32 (3.12%)	
6	1/64 (1.56%)	
7	1/128 (0.78%)	

to this pattern of forgetting. Although memory for details and highly specific facts declined rapidly (e.g. a fact from our teaching sessions would be 'how many records are covered by the MEDLINE database?'), memory for general principles (e.g. 'what does the Boolean "AND" mean?') was extremely stable and showed no forgetting over the 12-year period.

Lectures vs. study of textbooks

We should not be too harsh on lectures. A famous study on retention of textbook materials[16] also compared the percentage of material remembered after different intervals of time. After 1 day students had forgotten 46% of material read from a textbook. After 28 days this had risen to 81% and after 3 months, the typical period assessed by end of semester examinations, this had reached 83%.

Responding to the evidence

It is not enough to record this evidence. This would be analogous to making a diagnosis but leaving a condition untreated. What strategies might we propose to address this performance decrement, to arrest the decline to half-life?

Note-taking

Many students record too few notes to benefit fully from note-taking and review.[17] Instructors should explicitly structure and signpost their presentations, reduce their lecture rate, pause for note-taking, emphasize key ideas and encourage alternate frameworks for note-taking and review to suit students cognitive preferences.[17]

For notes to be truly beneficial they must be complete *and* accurate. Unfortunately, student notes typically contain little more than 35% of the presented material and are sometimes incorrect.[18] In fact, students reviewing a good set of notes (but never attending the lecture) outperformed a group who attended the lecture, took their own notes, and then reviewed their own notes![19] Don't tell that one to your boss!

Providing students with a skeleton outline of the lecture can also improve the quality of notes taken.[20] Armbruster (2000) supports the skeletal outline or partial notes, arguing that 'taking notes is such a cognitively demanding task, there is limited opportunity for generative processing at the time of encoding'.[21(p. 179)] Students are thus encouraged to make connections between what they have learnt rather than simply recording statements from the projector screen.

Mnemonic techniques

Basic training in mnemonic techniques can help to overcome difficulties in retention. Examples include the mnemonic PICO for remembering the elements of a well-formulated question[22] or RAAAMBO for recalling the important characteristics of a well-designed study.[23]

Review

'Encoding' can help to counter the brain's tendency to forget. In a study by Spitzer, some subjects merely read materials while others recited the information in their own words immediately after reading it.[16] Seven days later, those who had recited the information remembered 83% of what they had read. Those simply reading it could only remember 33%.

Repetition and reinforcement

Repetition increases the optimum interval before the next repetition is needed. That is why instructors commonly repeat material, or re-present it in a different form. Spaced repetition uses increasing intervals of time between subsequent reviews. Populist works on study skills consequently recommend that within 24 h of receiving information a course participant should spend 10 min reviewing what they have learnt. Then a week later it only takes 5 min to 'reactivate' the same material, and again address the decline in retention. By day 30, they only need 2–4 min to cover their review. This investment of time compares favourably with spending 40–50 min re-learning each hour of material. Rather than simply repeating phrases, such repetition emphasizes active recall and uses questioning and other mnemonic triggers or cues.

Interaction

Interactive lecturing involves a three-part exchange between the facilitator, the student and the lecture content.[24] Active learning aims to heighten attention and motivation, providing frequent feedback for teacher and student, thereby increasing their satisfaction with the learning process. Such interactive learning is embodied in the 90/20/8 rule.[25] This rule is based on *Using Both Sides of Your Brain*, which estimates that the average adult can listen with understanding for 90 min, but with retention for only 20 min.[26] The 90/20/8 rule states that no module should run more than 90 min; the pace of instruction should change every 20 min, and we should involve participants in content application every 8 min.[25] Applying this rule to teaching and training can move us from a passive learning environment to an interactive one. Given that students have an attention span of around 15–20 min[27] and we have a 50-min teaching slot we must punctuate such lectures with periodic activities. Lecturers who

'deliberately and consistently interspersed their lectures with illustrative models or experiments. short problem solving sessions, or some other form of deliberate break. usually commanded a better attention span from the class, and these deliberate variations had the effect of postponing or even eliminating the occurrence of an attention break.'[8(p. 50)]

Of course mini lecture breaks should not be performed mechanically at 20-min intervals. Instead you, the facilitator, should ensure that such activities are inserted where students will pay most attention to points singled out for special emphasis.

Problem-based learning

Although problem-based learning is not a panacea—in some circumstances it performs no better or worse than traditional lecture methods—it can be beneficial for long-term knowledge retention.[28] This involves selection or creation of realistic scenarios, identification of learning needs within the group and then a mechanism to satisfy these needs. Ideally participants should satisfy their own learning needs with the facilitator acting as a resource, suggesting routes or tools to be used in the quest for answers. Learning by doing has been found to be effective in aiding retention. It is also important for participants to spend time reviewing the effectiveness of the process so that they can identify missed learning opportunities and 'salvage' strategies.

Conclusion

This column has concentrated on the individual's role in remembering—either the participant in reviewing material or the trainer in reinforcing learning. The environment too has a bearing on attention and retention. In a warm room, for example, participants find it correspondingly more difficult to remain alert. It is simplistic, too, to assume that listeners can absorb information of different levels of complexity with equal facility. Indeed the lecture method is considered inappropriate when:

1 the material is complex, detailed or abstract;
2 students need to analyse, synthesize, or integrate knowledge; or
3 long-term retention is desired.[29]

We have found plenty of justification for defining a lecture as:

'The process by which the notes of the lecturer become the notes of the student without passing through the mind of either.' (Anon.)

So what will you do with your new found knowledge about the 'training half-life'? Act now to address the 'trace decay' of knowledge during your didactic teaching and training sessions? Alternatively put this article to one side and forget it? After all if you do not encode it or put it into your own words the moment you finish reading it, you will have forgotten almost half of it by the time you reach this evening!

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