BERA October 2020

Education Futures:
Neuroscience, Climate change and Learning

Paper 1. The Learning Sciences in the Initial Teacher Education Curriculum

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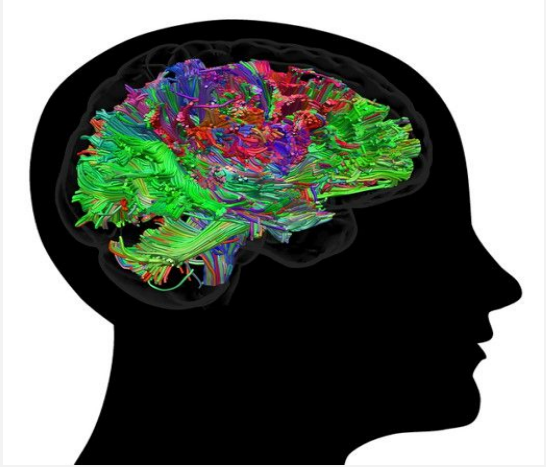


Henrietta Howells, NatBrainLab. CC BY

The ‘problem’

- Burgeoning field of cognitive neuroscience, international interest in implications for education
- A cognitive psychology model of learning as working memory- long term memory is in English policy documents: Early Career Framework (DfE 2019a); Core Content Framework for ITE (DfE 2019b) and is unfamiliar to many ITE tutors.
- Concerns that new CCF for ITE takes a partial view of cognitive neuroscience research, need for more nuanced view (e.g. Turvey et al 2019) BERA blog)
- Wider concerns about scientific frameworks being applied to education: learning conceptualised as acquisition not participation; ‘Evidence Informed Practice’ positions teachers as recipients of technical knowledge; professional action by teachers requires contextual value-based judgements (e.g. Biesta 2007; Hordern 2018, 2019)

Our response

- Locate cognitive psychology within the broader ‘Science of Learning’, and the even broader ‘Learning Sciences’ and reference to existing educational ideas.

- Develop open-access material that supports a ‘compliant yet critical’ approach to ITE curriculum development.

- Embrace the possibilities of new lenses on learning.

Locate cognitive psychology within the broader 'Science of Learning', and the even broader 'Learning Sciences'.

Science of Learning (SoL) – educational neuroscience and psychology

The Learning Sciences

- Interdisciplinary: education, cognitive psychology, neuroscience, linguistics, artificial intelligence, computer and information science, anthropology
- Broad conception of learning
- Empirical, 'real world' design-based research, integrating research and practice

The 'New Science' of Education

- characterised by RCTs and systematic reviews

Furlong & Whitty (2017)

Value of Multidisciplinary project team

McMahon and Etchells (2018)

Emma Arblaster - PGCE tutor English, SEN
Emma Asprey - PGCE tutor ICT
Pat Black - Head of ITE
Pete Etchells - Biological psychology
Alison Lee - Clinical social neuropsychology
Kate Humphreys - Educational neuroscience
Lisa Howarth, PGCE tutor - Educational neuroscience
Darren McKay PGCE tutor - science, professional studies
Kendra McMahon - Science education
Lynn Salter - PGCE tutor Maths

Collaboration with Paul Howard-Jones & Annette Garrett-Cox, University of Bristol

Develop open-access material that supports a ‘compliant yet critical’ approach to ITE curriculum development.

Cognitive psychologist Willingham (2017:70): ‘Practitioners need one theory’

“Ideally, prospective teachers would learn a single theory that captures all empirical generalizations,...This claim obviously invites the question “Which theory?”

“Providers should ensure their curricula encompass the full entitlement described in the ITT Core Content Framework, as well as integrating additional analysis and critique of theory, research and expert practice as they deem appropriate.” (DfE 2019: 4)

Some ITE tutor views

‘..it seems that there is a bigger body of research where we are learning what we can find out about learning from that kind of research.’

‘Its a bit of a non-negotiable - its in the core content framework so we have to do it and we have to do it properly.’

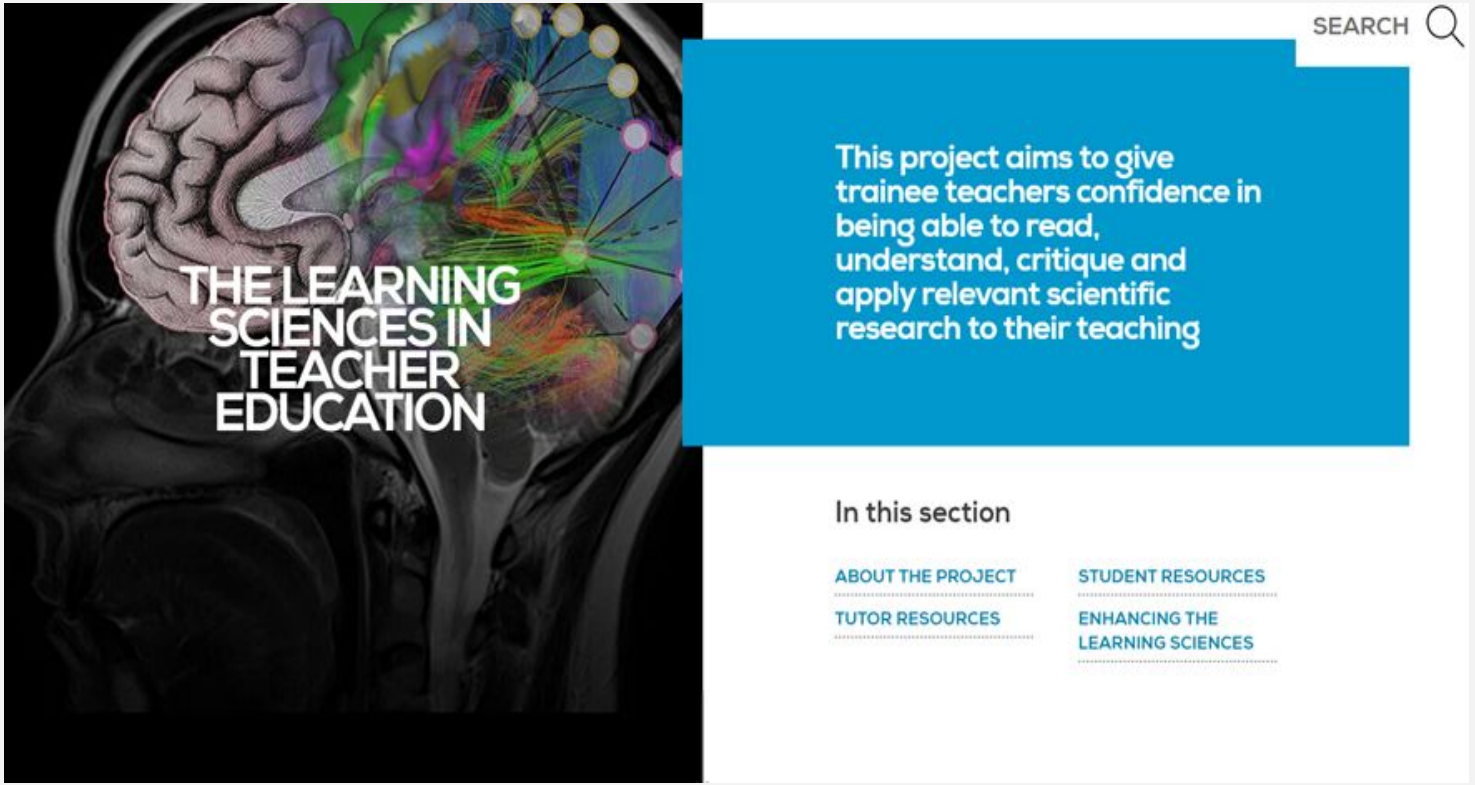
‘...if I had an issue with that, [] is that it is compartmentalising this framework of learning into a scientific domain.’

‘Anything that’s new, that could impact on education, needs to be interrogated’

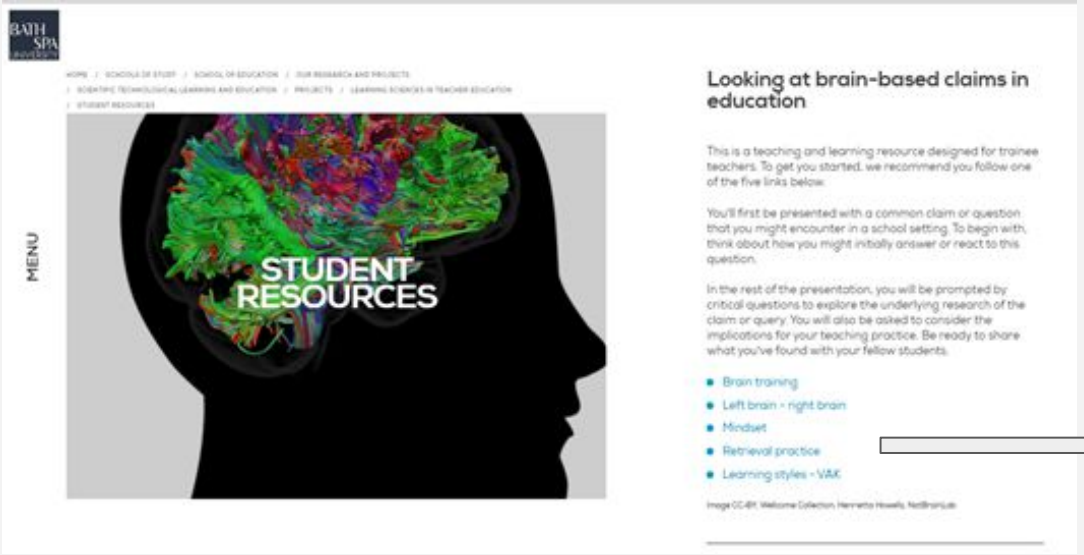
‘I see the ideas as a way of weaving, making meaning, with the content we are already delivering.’

Interactive - word cloud

Please give a word or short phrase that expresses your thoughts about the learning sciences in ITE.



https://www.bathspa.ac.uk/learning-sciences McMahon, Yeh and Etchells (2019)



https://www.bathspa.ac.uk/learning-sciences

Retrieval Practice

If you give children frequent tests and quizzes it really helps them to remember the facts.

HEADTEACHER

For Trainees!

Retrieval Practice – an introduction

The claim is that the process of testing itself contributes to learning - so that regular, low stakes tests, or 'quizzes' help children learn. This has been called 'retrieval practice.'

The research claim is that low stakes testing leads to better recall than practice that is rereading the information.

For cognitive scientists learning and memory are the same thing.

This strategy is related to a cognitive psychology model of memory in which ideas are held in the 'working memory' while they are being used consciously in the current moment, but for these to become the kind of memories that last, they have to become part of the 'long term memory'. The capacity of working memory is limited.

A neuroscience view of this would be that there is activation of brain cells/pathways in the moment, but it is the traces this activity leaves in the form of changes to connections between brain cells that is the basis for the long term memory. Repetition of the same activity strengthens the connections. The effort required for retrieval, (rather than just looking at it again) is important - linking motivation and attention - people are complicated!

Critical questions

- Has the research been done on (primary) children?
- Has the research been conducted in schools or in a lab?
- What kind of learning is being researched and valued here?

- How does retrieval practice fit in with your views of knowledge and of learning?

First source

Sumeracki, M.A and Weinstein, Y. (2018) Optimising Learning Using Retrieval Practice, Impact 2

Open Access link:
https://impact.chartered.college/article/sumeracki-weinstein-optimising-learning-retrieval-practice/

open-access material to support ITE tutors

Unpacking and expanding on the ITE Core Content Framework especially section 2 How pupils learn e.g.

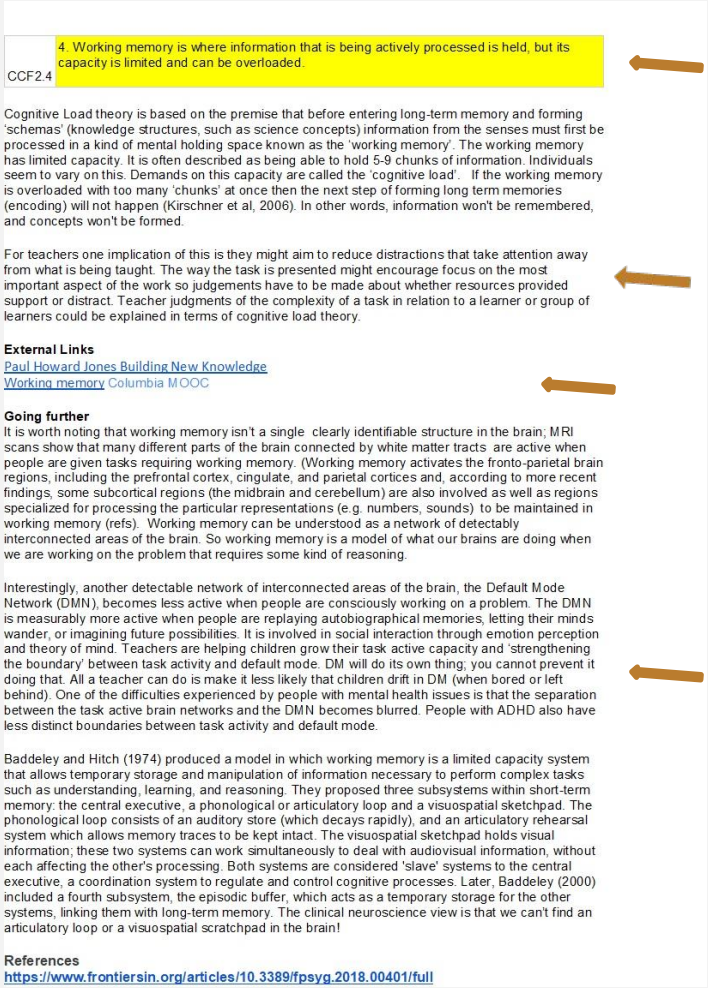
CCF 2.8 Requiring pupils to retrieve information from memory, and spacing practice so that pupils revisit ideas after a gap are also likely to strengthen recall.

Explain the cog psychology underpinning this and connect with the 'how to'

• *Observing how expert colleagues plan regular review and practice of key ideas and concepts over time (e.g. through carefully planned use of structured talk activities) and deconstructing this approach.*

Expand - *evaluate the cog psych evidence, the neuroscience perspective and locate in relation to educational ideas and research.*

Example page from guidance being developed



CCF2.4	4. Working memory is where information that is being actively processed is held, but its capacity is limited and can be overloaded.

Cognitive Load theory is based on the premise that before entering long-term memory and forming 'schemas' (knowledge structures, such as science concepts) information from the senses must first be processed in a kind of mental holding space known as the 'working memory'. The working memory has limited capacity. It is often described as being able to hold 5-9 chunks of information. Individuals seem to vary on this. Demands on this capacity are called the 'cognitive load'. If the working memory is overloaded with too many 'chunks' at once then the next step of forming long term memories (encoding) will not happen (Kirschner et al, 2006). In other words, information won't be remembered, and concepts won't be formed.

For teachers one implication of this is they might aim to reduce distractions that take attention away from what is being taught. The way the task is presented might encourage focus on the most important aspect of the work so judgements have to be made about whether resources provided support or distract. Teacher judgments of the complexity of a task in relation to a learner or group of learners could be explained in terms of cognitive load theory.

External Links

Paul Howard Jones Building New Knowledge

Working memory Columbia MOOC

Going further

It is worth noting that working memory isn't a single clearly identifiable structure in the brain; MRI scans show that many different parts of the brain connected by white matter tracts are active when people are given tasks requiring working memory. (Working memory activates the fronto-parietal brain regions, including the prefrontal cortex, cingulate, and parietal cortices and, according to more recent findings, some subcortical regions (the midbrain and cerebellum) are also involved as well as regions specialized for processing the particular representations (e.g. numbers, sounds) to be maintained in working memory (refs). Working memory can be understood as a network of detectably interconnected areas of the brain. So working memory is a model of what our brains are doing when we are working on the problem that requires some kind of reasoning.

Interestingly, another detectable network of interconnected areas of the brain, the Default Mode Network (DMN), becomes less active when people are consciously working on a problem. The DMN is measurably more active when people are replaying autobiographical memories, letting their minds wander, or imagining future possibilities. It is involved in social interaction through emotion perception and theory of mind. Teachers are helping children grow their task active capacity and 'strengthening the boundary' between task activity and default mode. DM will do its own thing; you cannot prevent it doing that. All a teacher can do is make it less likely that children drift in DM (when bored or left behind). One of the difficulties experienced by people with mental health issues is that the separation between the task active brain networks and the DMN becomes blurred. People with ADHD also have less distinct boundaries between task activity and default mode.

Baddeley and Hitch (1974) produced a model in which working memory is a limited capacity system that allows temporary storage and manipulation of information necessary to perform complex tasks such as understanding, learning, and reasoning. They proposed three subsystems within short-term memory: the central executive, a phonological or articulatory loop and a visuospatial sketchpad. The phonological loop consists of an auditory store (which decays rapidly), and an articulatory rehearsal system which allows memory traces to be kept intact. The visuospatial sketchpad holds visual information; these two systems can work simultaneously to deal with audiovisual information, without each affecting the other's processing. Both systems are considered 'slave' systems to the central executive, a coordination system to regulate and control cognitive processes. Later, Baddeley (2000) included a fourth subsystem, the episodic buffer, which acts as a temporary storage for the other systems, linking them with long-term memory. The clinical neuroscience view is that we can't find an articulatory loop or a visuospatial scratchpad in the brain!

References

https://www.frontiersin.org/articles/10.3389/fpsyg.2018.00401/full

‘Know that’ Statement from ITE Core Content Framework

Explanation within CCF terms of reference (connect with practice ‘know how’ CCF statement)

External links such as video clips to develop the explanation

‘Going further’

Includes different perspectives within the Science of Learning and the Learning Sciences

Possibilities across the curriculum

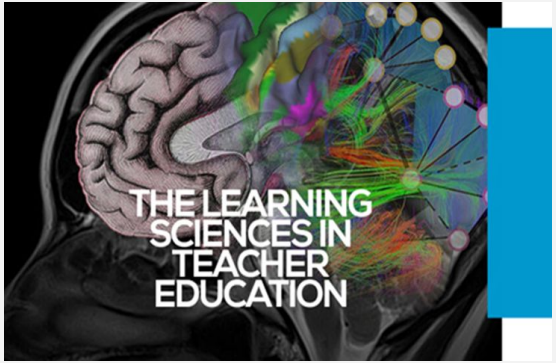
Maths possibilities:

Cognitive load theory, worked examples, Elaboration (connections) & a relational view of knowledge, maths and emotions (maths anxiety), finger gnosis

Science possibilities

elicitation and memory formation - connecting to existing ideas, brain within the whole body, embodiment - why hands-on matters

Any Comments or Questions?



Existing resources can be found at
https://www.bathspa.ac.uk/learning-sciences

For new resources - preview in exchange for feedback - please email me

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References

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