

The Learning Sciences in Initial Teacher Education

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Overview

- What do we mean by the 'Learning Sciences'?
- What are people saying?
- The Bath Spa Project – Enhancing the Learning Sciences in Primary ITE
 - Overview of the project
 - Open access resource - we'll have a look!
 - Findings
- What do we think we should do in ITE?

What comes to mind
when you think of the
'Learning Sciences'?

What do we mean by the Learning Sciences?

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)

Science of Learning (SoL) - often used interchangeably with Learning Sciences, but emphasis on cognitive psychology and neuroscience

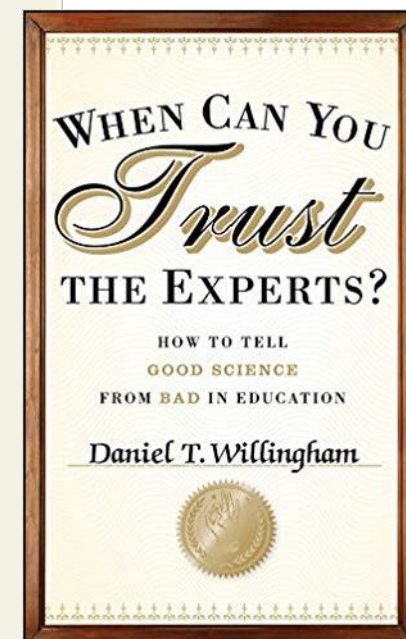
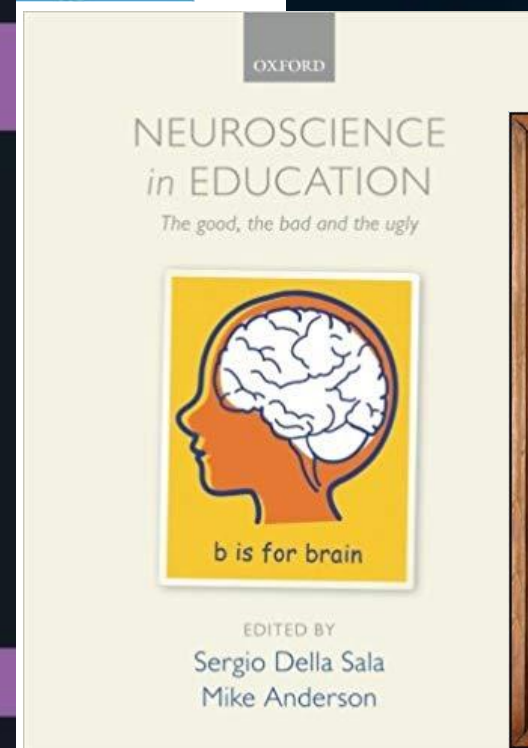
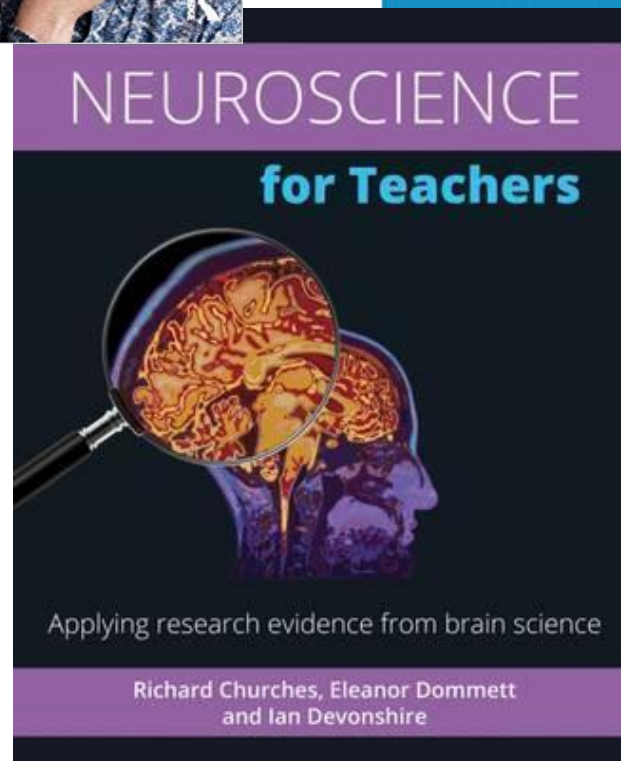
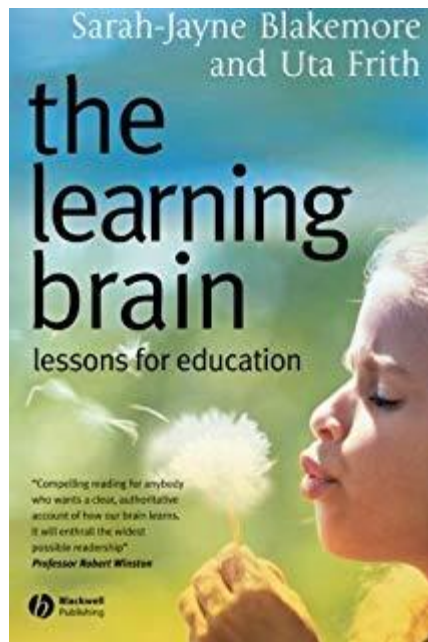
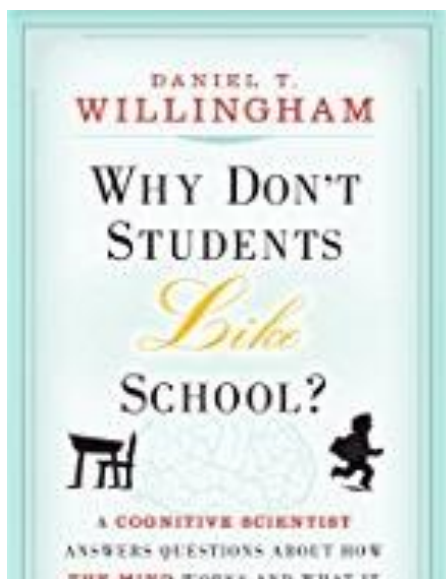
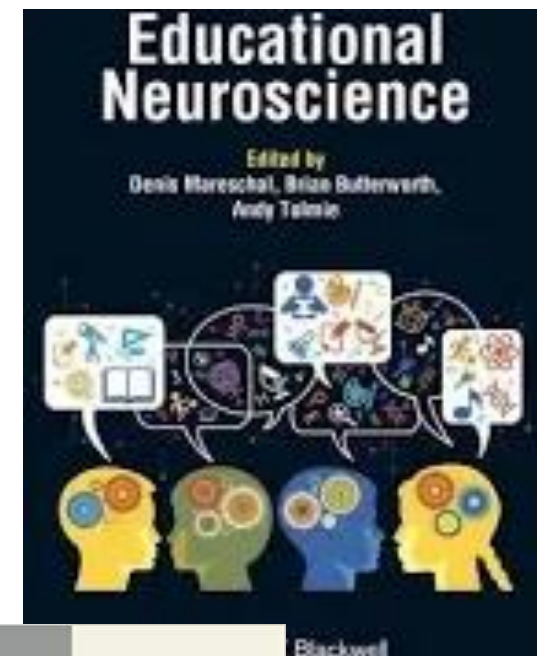
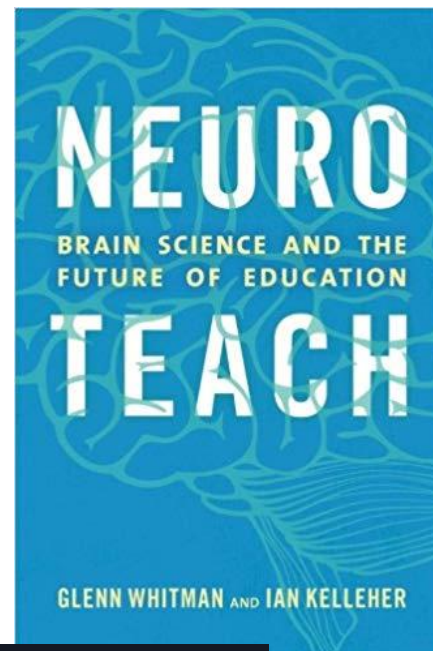
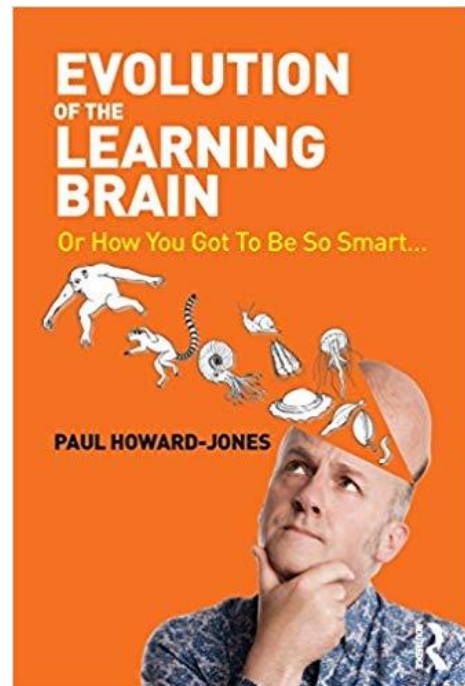
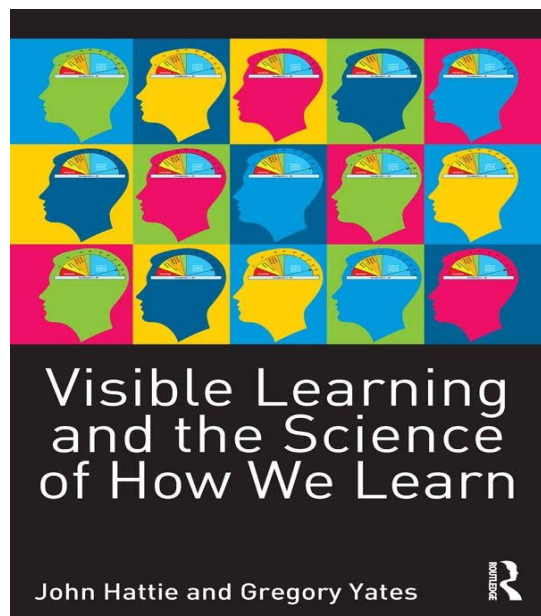
We need to address the Learning Sciences in Teacher Education because:

- The biological sciences are becoming increasingly prominent and powerful.
- Parents, teachers, politicians, policymakers, education consultants, bloggers and tweeters are interested in the brain and are making 'brain-based' claims about how teaching should be.
- A interdisciplinary approach may benefit the development of educational theory of teaching and learning and might benefit practice

There's a lot of it about...

“Professor Dan Willingham - a cognitive scientist who has greatly influenced my thinking - said that “memory is the residue of thought” and that it is this accumulation of factual knowledge in long-term memory that enables people to be creative and critical thinkers.”... **Nick Gibb (2017)**

<https://www.gov.uk/government/speeches/nick-gibb-the-importance-of-an-evidence-informed-profession>



Learning Scientists - 'strategies for effective learning'

(inform Teach First 'Cognitive Science' sessions.)

Spaced Practice

Retrieval Practice

Elaboration

Interleaving

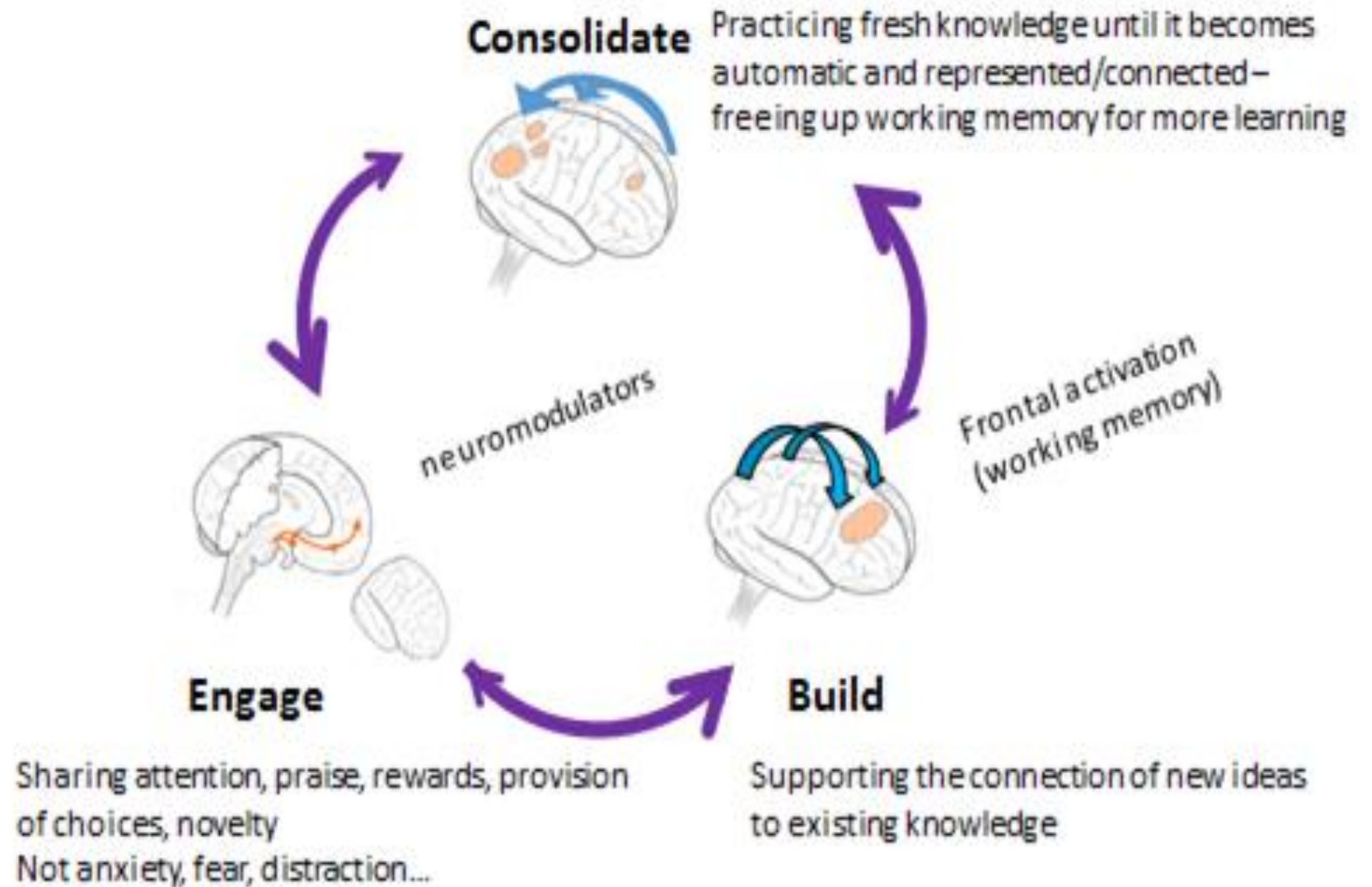
Concrete Examples

Dual Coding

<http://www.learningscientists.org/downloadable-materials>

Paul Howard-Jones and Bristol University colleagues

<https://www.futurelearn.com/courses/science-of-learning/0/steps/40532>



Research based pedagogy

- Cognitive load theory
- Retrieval practice
- Spaced learning
- Interleaving
- Knowledge organisation
- Guided practice
- Dialogic teaching
- Executive function
- Self regulation
- Deliberate practice
- Revealing misconceptions



Slide in presentation
by
Alison Peacock ,
Chartered College of
Teaching, at BSU
launch April 2018

Chartered College of Teaching

Professional Principles

“3.4 Has up-to-date knowledge of theories and research from the field of cognitive science and understands how these can be used to inform practice in education”

<https://chartered.college/chartered-teacher/professional-principles>

Accessed 16/10/18

Ofsted Sept 2018

“Knowledge acquisition, therefore, is the aim of this type of curriculum
....

This often led leaders to focus on in-depth understanding of fewer topic areas rather than surface-level understanding of more content, as part of this mastery approach. **These leaders also referred frequently to developments in cognitive psychology and theories of working memory as guides for their curriculum design.”**

Spielman, A. (2018) HMCI commentary: curriculum and the new education inspection framework.
Retrieved from: <https://www.gov.uk/government/speeches/hmci-commentary-curriculum-and-the-new-education-inspection-framework> accessed 14/10/2018



Daniel Willingham

@DTWillingham

Follow



Understanding the mind helps education.
Sometimes.

William S. Cossen @WilliamCossen

Challenge for #academia tweeters:

Write a #sixwordstory summarizing your current research. Here's mine...

4:29 AM - 12 Nov 2018

12 Retweets 66 Likes



12



66

Write a #sixwordstory summarizing your current research. Here's mine...

Responses?



Enhancing the Learning Sciences in Primary Initial Teacher Education



- Aims for **primary** teachers to become **critical consumers** of learning sciences, including challenging 'neuromyths', through **ITE curriculum development**
- **Multidisciplinary team** of teacher educators, education researchers, cognitive psychologists, neuropsychologist
(Kendra McMahon, Pete Etchells, Chloe Shu-Hua Ye, Alan Howe, Sarah Earle & Alison Lee)
- Iterative **Design-Based Research** processes of design, trial, feedback and reflection

Design-based Research

Addresses issues of theory and practice together (Cobb et al. 2003; Anderson and Shattuck, 2012).

Iterative cycles of design, trial, feedback, reflection

Data sources and analysis:

- Pre survey- quantitative and qualitative analysis (n= 298) neuromyth element based on Dekker et al (2012)
- Pre and Post survey comparison - quantitative analysis (n=154)
- Post survey qualitative analysis (n=61)
- Trainee (n=281) and tutor (n=9) feedback on critical consumer workshop (8 iterations trialled with 12 groups)
- Trainee feedback on Science Workshop (n= 209)
- Trainee focus Group analysis (participants n=25)
- Analysis of trainee essays on Learning (n=277)

Trainee ideas at the start of the project (survey n= 298)

I find it very intriguing to learn about how the brain functions and what the different parts do.

What is happening on a cellular level when we learn new things? How is information stored in our memories?

If I learn by visual methods how can I help a child who does not learn in this way?

The difference between right and left brain dominance - how much this has an effect on whether people are creative etc or logically minded.

How 'plastic' the brain is and whether we can 'miss the boat' on different stages of developing our intellect.

how people learn differently and why some people find it easier to remember things than others.

I don't feel like I know anything about the brain and learning.

Primary trainee teachers' ideas

- Trainee were somewhat interested in learning about the brain (M=4.9, max 7 Likert) and saw it as quite valuable (M=5.6 max 7 Likert)
- Prior experience of Learning Styles/VAK (38%), Brain Gym (19%), left brain/right brain 35%. Often encountered as pupils.
- Held common neuromyths (esp. Learning styles/VAK, fish oils, left brain /right brain.)
- Would like to know more about: how different learners might have different brains: "How the brain works with SEN child and whether it is different."
- Focus groups - wide ranging ideas from 'recipe based on brain print-out' to critical discussion of observing 'brain breaks' in school.

The Bath Spa University designed product:

- ❖ Science workshop – science literacy; fish oils neuromyth, human body systems
- ❖ SEND sessions – limits of working memory, every brain is different
- ❖ Learning Theories lecture and seminar – developed to include neuroplasticity
- ❖ ‘Pre-Learning’ – intro to the brain structure
- ❖ Workshop: Neuroscience for teachers, critical thinking for critical consumers

Resource will be freely available - Leave your email for link!

Frontal lobe

Prefrontal cortex: executive functioning

Primary Motor Cortex: motor control

Parietal lobe

Somatosensory (eg touch), spatial awareness/navigation, integrate sensory information

Occipital lobe

Primary visual cortex: map of visual space, colour, movement, and form

Temporal lobe

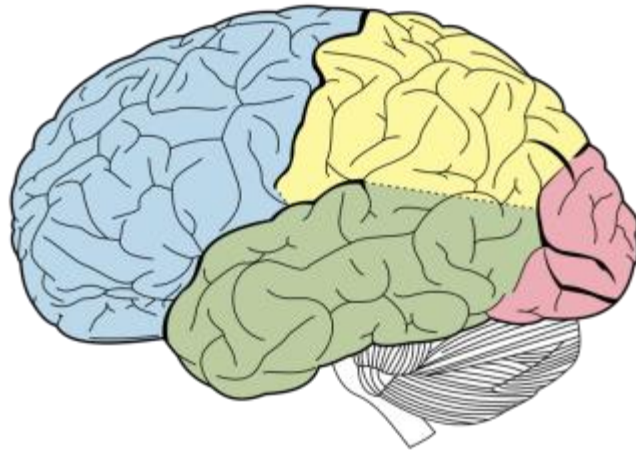
Auditory cortex: hearing, language areas, comprehension, some vision eg face perception

Brain stem

keeps you alive
e.g. heart rate,
breathing

Cerebellum

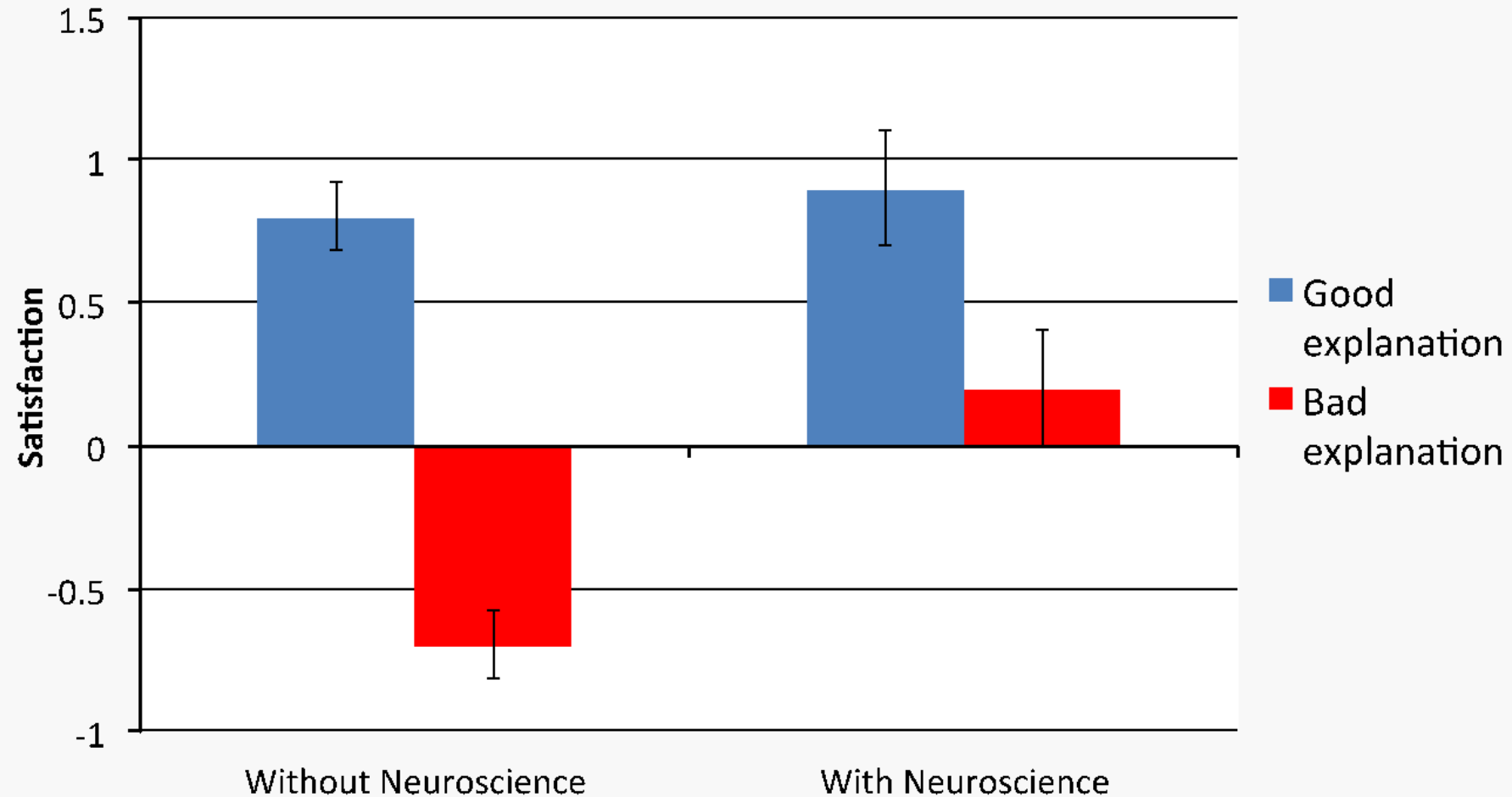
Balance,
coordination, learnt
movements
And more!



The Brain



The seductive allure of neuroscience



Weisberg et al (2008)

A psychological experiment

- This is a quick version of a classic psychological experiment in order to see how evidence is collected by cognitive neuropsychology.
- You will get the chance to first experience the experiment from the perspective of a participant, and then later from the perspective of a researcher.
- The data collected here will only be used for demonstration purposes in this class; this is not an actual scientific experiment.

Instructions

- You will be given 4 descriptions of scientific studies.
- For each study, you will also be given an **explanation** of the phenomenon described.
- The explanations may not necessarily be real explanations of the phenomenon.
- ***Your task is to rate how satisfying you find each explanation on a scale from -3 to 3***

Collecting the data

- Before we explain the study, let's gather the data you've just produced...

On each table, 1 person to collect all the scores for explanation A..., B..., C..., D...

	A	B	C	D
Person 1				
2				
3				
4...				

How would you respond?

I've seen this brain training app to improve her maths, what do you think?

PARENT

We must praise children for their effort, not tell them they are clever, to foster a growth mindset.

Anyone can achieve anything if they believe in themselves!

CONSULTANT

She's like me - no good at maths, but more of a right brained creative thinker.

COLLEAGUE

He's a kinaesthetic learner – he only learns by doing. Have you done a VAK test with your class?

TEACHING ASSISTANT

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

HEADTEACHER



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.

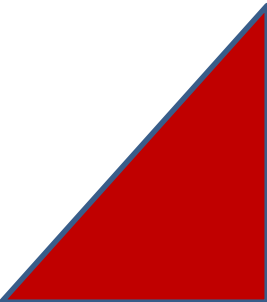
This strategy is related to a cognitive psychology model of memory in which ideas are held in the 'working memory' while they are being used consciously in the current moment, but for these to become the kind of memories that last, they have to become part of the 'long term memory'. The capacity of working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

A red triangle graphic is located in the bottom right corner of the slide, pointing towards the top right.

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?

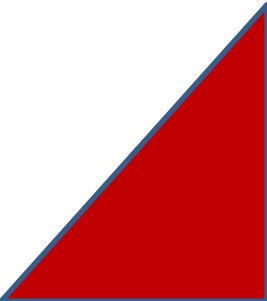


First source

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/>



Second source

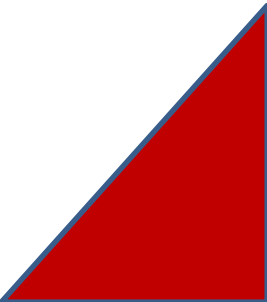
Ritchie SJ, Della Sala S, McIntosh RD (2013) Retrieval practice, with or without mind mapping, boosts fact learning in primary school children. *PLoS ONE* 8(11): e78976.

- Open access link:

https://www.research.ed.ac.uk/portal/files/14216085/retrieval_practice_with_or_without_mind_mapping_boosts_fact_learning_in

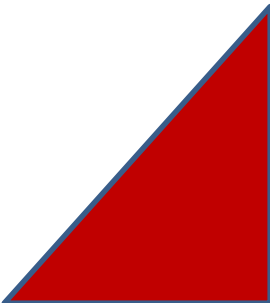
Implications for Practice

- Would you apply these ideas in your teaching?
- If so, how?



Further links

- <http://www.learningscientists.org/blog/2016/6/23-1>
- <https://www.ncbi.nlm.nih.gov/pubmed/26173288>
- This blog post includes a great example of a how a child builds their knowledge of dinosaurs;
<http://www.learningscientists.org/blog/2018/6/7-1>.
-



Tutor notes to support discussion:

Interact during their feedback if needed to elicit the following points for each claim:

Retrieval Practice

- Not just lab tested. Here psychology lab findings have been trialled with classes of children.
- What is being tested? The kind of knowledge being tested in the example is recall of vocabulary. This is quite a limited kind of learning. What kinds of knowledge and learning do the trainees value?

Have a look at the materials!

https://drive.google.com/drive/folders/1RwofOovY9lhvyKF_tKN7CF1JafmIxo2E?usp=sharing

What we did we learn from the
Bath Spa Project?

Pre and post comparison

Neuromyth statement	Sum of percentages of 2 most incorrect responses	
	Pre-test	Post- test
Individuals learn better when they receive information in their preferred learning style (e.g., auditory, visual, kinaesthetic).	73.9	43.7
Environments that are rich in stimulus improve the brains of pre-school children.	66.3	50
Differences in hemispheric dominance (left brain, right brain) can help explain individual differences amongst learners.	43.5	23.4
Short bouts of co-ordination exercises can improve integration of left and right hemispheric brain function.	41.6	25.3
It has been scientifically proven that fatty acid supplements (omega-3 and omega-6) have a positive effect on academic achievement.	33.1	15.1
Children are less attentive after consuming sugary drinks and/or snacks.	34	25.9
Exercises that rehearse co-ordination of motor-perception skills can improve literacy skills.	32.1	27.8

Trainee responses to 'critical consumer' workshop

Got me thinking about the truth behind some of the claims.

Enjoyed learning about new parts of the brain and to find out how little we know. Also to learn how to recognise valid research and not just readily accept theories.

Really made me think about why I thought the way I did.

Interactive- shocking what we believe.

Very engaging. It is evidence heavy and relatable to teaching career.

[it could have] examples of how people have successfully included ideas from proven research to teach effectively.

Value of Interdisciplinary working

- Cognitive & neuro psychologists aware of limitations of their own fields and therefore more critical of its applications ‘Seductive allure’
- Each discipline is complex with contested knowledge and varied perspectives
e.g. choosing representations of the brain.
- Bring different priorities to evaluation of research
e.g. looking for replication in underlying research/educational aims and values

McMahon and Etchells (2018)

Summary of Findings

- Trainee belief in 'neuromyths' was significantly reduced by the project
- Ready acceptance of brain-based claims was significantly unsettled by the intervention
- Working as an Interdisciplinary team was very important in the development of the approach and resource
- Most ITE tutors were enthusiastic but cautious, and busy!

What do we think we
should do in ITE?

References and sources

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- Weisberg, D., Keil, F., Goodstein, J., Rawson, E. and Gray, J. (2008). The Seductive Allure of Neuroscience Explanations. *Journal of Cognitive Neuroscience*, 20(3), 470-477.

- Claims about the value of cognitive psychology and neuroscience in education are being made by many powerful and influential people (e.g. Nick Gibb, Chartered College of Teaching, education tweeters and bloggers and recently Ofsted). The project 'Enhancing Learning Sciences in ITE' with the Bath Spa University Primary and Early Years PGCE is developing teaching and learning approaches and open access resources to engage trainee teachers with ideas from the learning sciences.
- In this session for UCET I will share the teaching resources and the rationale for the approach we have taken. We will discuss some of the issues and tensions in finding a place for the learning sciences in ITE. The resources explore how many ideas from the learning sciences are of value to teachers, but may also become oversimplified or misinterpreted in the jump from science to pedagogy. We found that our trainees are encountering these ideas on school placements. We feel more strongly than ever that a critical, though not cynical, approach to the 'learning sciences' is needed and that ITE must play a key role in this.

One list of the key ideas from science of Learning:

1. New ideas are learned by reference to old ideas
2. Information transfer from working memory to long term memory, cognitive overload if tasks are too demanding
3. Cognitive development is not fixed to age stages
4. Think about meaning when encountering 'to be remembered' material
5. Spaced practice and low stakes retrieval tests aid memorising
6. Knowledge of key facts aids problem solving (and reduces cognitive load)
7. Feedback, focussed on improvement, and on task not student, is essential
8. The transfer of knowledge or skills to a novel problem requires both knowledge of the problem's context and a deep understanding of the problem's underlying structure.
9. We understand new ideas via examples, but it's often hard to see the unifying underlying concepts in different examples.
10. Beliefs about intelligence are important predictors of student behavior in school.
11. Self-determined motivation (a consequence of values or pure interest) leads to better long term outcomes than controlled motivation
12. The ability to monitor their own thinking can help students identify what they do and do not know, but people are often unable to accurately judge their own learning and understanding
13. Students will be more motivated and successful in academic environments when they believe that they belong and are accepted in those environments
14. Novices and experts cannot think in all the same ways.
15. Teachers should recognise and challenge myths (e.g left brain, right brain, VAK)

https://deansforimpact.org/wp-content/uploads/2016/12/The_Science_of_Learning.pdf

