SUMMARY & IMPLICATIONS

Cognitive Science Approaches in the Classroom: A Review of the Evidence (EEF 2021)

THIS REPORT SUMMARISES THE CONTENTS OF A LONGER SYSTEMATIC, EVIDENCE AND PRACTICE REVIEW PRODUCED BY A TEAM FROM THE UNIVERSITY OF BIRMINGHAM, ENGLAND. THE REPORT IS AN EVIDENCE SUMMARY 'ON THE IMPACT OF COGNITIVE SCIENCE APPROACHES WHEN APPLIED IN THE CLASSROOM...FINDINGS FROM TWO AREAS OF COGNITIVE SCIENCE HAVE BEEN ESPECIALLY INFLUENTIAL: COGNITIVE PSYCHOLOGY, WHICH IS UNDERPINNED BY INTERPRETIVE, BEHAVIOURAL, AND OBSERVATIONAL METHODS, AND COGNITIVE NEUROSCIENCE, WHICH IS UNDERPINNED BY BRAIN IMAGING TECHNOLOGIES. '

'THE KEY MESSAGE HERE IS THE IMPORTANCE OF NUANCE. PRINCIPLES FROM COGNITIVE SCIENCE ARE NEITHER MYTHS TO BE DISCOUNTED, NOR SILVER BULLETS THAT DIRECTLY TRANSLATE INTO ACCELERATED PROGRESS. ' PROFESSOR BECKY FRANCIS (CHIEF EXECUTIVE, EEF)

KEY QUOTES & HEADLINES

Theories of effective learning have been derived from both cognitive science and cognitive neuroscience. These include:

1) Spaced learning - distributing learning and retrieval opportunities over a longer period of time rather than concentrating them in 'massed' practice;

2) Interleaving- switching between different types of problem or different ideas within the same lesson or study session;

3) Retrieval practice-using a variety of strategies to recall information from memory, for example flash cards, practice tests or quizzing, or mind-mapping

4) Strategies-to manage cognitive load—focusing students on key information without overloading them, for example, by breaking down or 'chunking' subject content or using worked examples, exemplars, or 'scaffolds';

5) Dual Coding -using both verbal and non-verbal information (such as words and pictures) to teach concepts; dual coding forms one part of a wider theory known as the cognitive theory of multimedia learning (CTML).

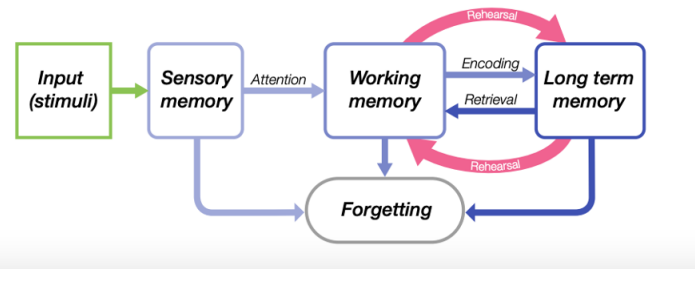
Key Terms

'Basic' cognitive science—seeks fundamental understanding of learning, memory, and the brain. It typically uses experiments in controlled conditions to establish knowledge that is likely to have wide applicability.

'Applied' cognitive science—seeks to apply knowledge from basic cognitive science to solve practical problems. Here we are focused on cognitive science that is applied in the classroom that aims to improve learning of children and young people aged 3–18.

SENIOR LEADER IMPLICATIONS

- Ensuring staff have a sound understanding of the theory, are equipped to deliver the theory, can target the theory effectively through their teaching and have the time and space to evaluate the effectiveness of the theory when applied to the classroom. (see below)
-Creating adequate time and space for professional development linked to these findings.
-Ensuring these approaches are embedded more widely as part of whole-school initiatives as opposed to ad-hoc. E.g. what is the interplay between assessment and retrieval practice?



Lost in translation: how to lose the power of a good theory

1. Misunderstanding an important part of the theory

Mr Bell has heard a lot about dual coding—and that learning can be enhanced by pictorial representations alongside information. He fills all of his classroom slides with quirky illustrations that he hopes will make the learning memorable. Unfortunately, the images end up distracting his pupils and increasing their cognitive load meaning that they struggle to remember the content itself.

2. Failing to equip teachers to deliver the theory

The Ofsted inspection framework prompts senior leadership to book some staff training on cognitive science. While the twilight session covers some of the principles behind spaced learning, staff are given no guidance on how to apply the approach. Senior leadership are not keen on any changes to school timetabling or the curriculum. No follow-up training is provided.

3. Failing to target the theory effectively

Mrs Rushby has heard that worked examples with incorrect information in them has been shown to be an effective way of teaching information while managing cognitive load. When she uses the examples in her Year 7 maths class, most pupils struggle to identify any errors—many of them end up reinforcing rather than addressing misconceptions and only a few of the top attaining pupils in the class respond positively to the task.

4. Or... the theory doesn't actually work in schools?

It might be that none or all of these factors are in play and that the theory itself has only ever been shown to work in highly controlled laboratory settings or for particular age ranges or subject areas. In medicine, treatments are often shown to reduce in efficacy as they move from lab-testing, to larger trials, to the real world.

MIDDLE LEADER IMPLICATIONS

-Having a sound understanding of how their particular subject or area is affected by the impact of cog-sci techniques. (see below)
-Supporting teachers to map out learning material in a way that incorporates some of these principles e.g. spaced learning
-Considering where a particular approach may support learning in a purposeful way e.g. how can the impact of interleaving be leveraged?
-How can middle leaders support colleagues in preparing high-quality lesson resources e.g. worked examples?
-Ensuring best practice is disseminated and shared

Activity, topic, and subject

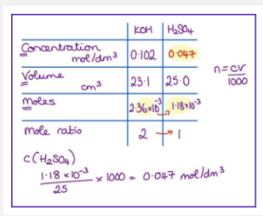
- Subject or curriculum area (e.g., general differences in the nature of subject content and pedagogy)
- Nature of specific learning content (e.g., complexity/ element interactivity, novelty, connection with other learning)
- Nature of specific learning activity (e.g., student-led, length, structure, resources)

TEACHER IMPLICATIONS

-Considering how to embed approaches such as worked examples into lesson planning and preparation in a purposeful way.
-Taking time to evaluate the effectiveness of these approaches 'on the ground' and considering their individual cohort and pupils.

An example approach

When teaching her class about titration calculations, Dr Turner demonstrates how to organise the information in a question within a grid format. This breaks down the steps involved in the overall calculation, helping to ensure pupils complete each step in the correct order. Dr Turner always models how to use the grid correctly when teaching it to pupils.



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REFLECTION QUESTIONS

1) How can teachers be supported in having a working knowledge of cognitive science principles?
2) How can teachers be supported in applying these principles and bridging the gap between the knowledge of these and their day-to-day teaching and learning?
3) How can professionals leading teaching consider the interplay between the different approaches and embed these into pedagogical practices, in turn supporting teachers to do the above?
4) How can teachers be facilitated to regularly evaluate the impact of these principles?