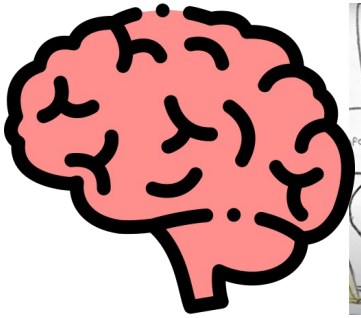
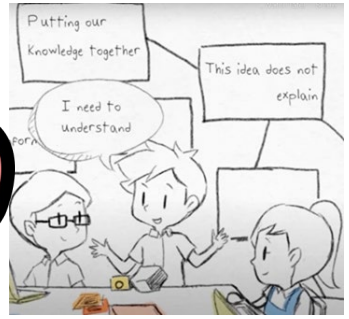
The Psychology and Neuroscience of Knowledge Building





Much of our cognition and learning is underpinned by three executive functions (EFs) – **inhibitory control**, **working memory**, and **cognitive flexibility**. EFs are developing as the brain matures across the school years and are heavily involved as students learn in a Knowledge Building (KB) environment. Educators play a role in helping students negotiate their use of EFs as they engage in KB practices, helping them work effectively with their peers to advance knowledge for themselves and the community. Additionally, given the importance of **cognitive flexibility in KB**, research suggests that engaging in KB practices might improve students' cognitive flexibility. This is an area of upcoming research at the Centre for Lifelong Learning and Individualised Cognition (CLIC).

Protest, Memory, Brainstorm Icons made by Freepik from www.flaticon.com

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The Executive Functions

Inhibitory control refers to our capacity to suppress distracting behaviours, so we can focus on achieving what it is relevant for our goals. In KB environments, students' inhibitory control processes are engaged when they:

- Take turns instead of interrupting in discussions;
- Resist to confirmation bias, and evaluate the information fairly;
- Handle disagreements constructively;
- Ignore unrelated comments when trying to rise above.

Working Memory is our ability to temporarily maintain, manipulate, and update information in our brain. In KB environments, students' working memories are engaged when they:

- Account for previously made points when they answer a classmate or reply a discussion thread
- Consider several discussion threads to synthesise information in a rise above post

Cognitive Flexibility refers to our capacity to adapt to change and problem solve in new situations based on previous experience. It often involves learning the structure of a task/situation, and then switching one's actions to be appropriate to the relevant structure. In KB environments, students' cognitive flexibility is engaged when they:

- Switch between different modes of thinking (e.g., from forming opinions to evaluating sources)
- Switch from traditional classroom to a KB setting
- Engage in Metacognitive processes

Thinking in the Brain

Our brains have areas that process different kinds of information coming from our senses, like visual, sound, touch and taste. These signals are usually processed separately by distinct brain areas. However, our so-called **pre-frontal cortex** helps us to integrate the information coming from other places in the brain. This area in the brain is located near the front of our heads and it is heavily involved in advanced human thinking capabilities like the executive functions. The prefrontal cortex tends to develop alongside our executive functioning across the years of formal schooling, reaching maturity in early adulthood. Throughout this period, it forms denser connections and networks with other areas of the brain, which are believed to help us to learn and pick up new skills. The importance of executive functions to everyday behaviour, including learning through Knowledge Building, and their continual development over the school years suggests a role for teachers to help students negotiate their use of their executive functions as they learn.

What Teachers Can Do

- **Use the promising ideas tool on Knowledge Forum** to highlight the most important ideas, helping students to inhibit less relevant information and prevent their working memories' from being overwhelmed as they are engaged to manipulate and synthesise knowledge.
- **Set ground rules and practice for discussions** to help students feel comfortable contributing to a discussion instead of inhibiting their desire to contribute.
- **Introduce idea diversity** to help students inhibit their tendency towards confirmation bias and evaluate ideas fairly and critically.
- **Use various aids (e.g., KB scaffolds, KB cards, analytics feedback)** to nudge students towards applying cognitive flexibility to engage in modes of thinking they are less used to, such as evaluating authoritative sources.