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A Review of Metacognition: Implications for Teaching and Learning

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A review of metacognition: implications for teaching and learning

Ab Kadir & Tay

Highlights of this Working Paper Brief

- Introduces key definitions of metacognition.
- Presents research that shows the importance of metacognition in education.
- Shares classroom strategies that can promote student metacognition.

Keywords

Student metacognition, teaching strategies

Metacognition: Components and Related Notions

Metacognition can be defined as “one's knowledge about one's own cognitive processes or anything related to them” (Flavell, 1979, p. 906), or simply 'thinking about one's thinking'. The notion of metacognition was subsequently expanded to include *awareness and management of one's own thought* through monitoring and self-regulation (Schneider & Lockl, 2002). It is also conceptualised as learners' awareness and knowledge, including their abilities and tendencies to control learning processes (Derry, 1990).

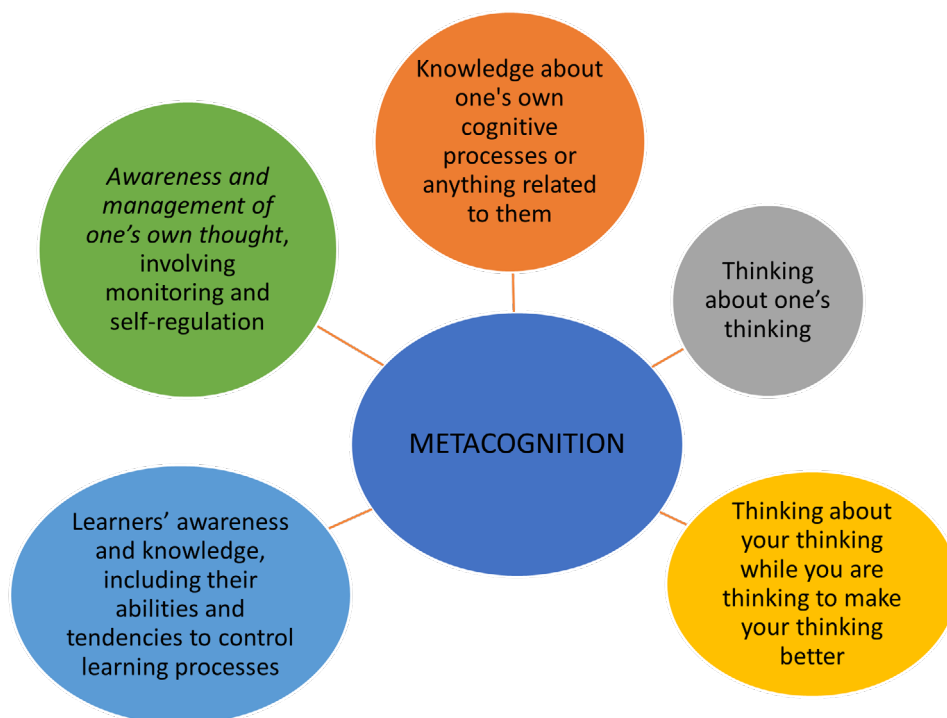


Figure 1. Key ideas and definitions of metacognition.

While there are some differences among its various definitions as illustrated in Figure 1, all notions of metacognition emphasise metacognition as a higher-order thinking skill that enables one to plan, monitor and regulate the cognitive processes. Thus, metacognition is relevant in the educational context, particularly in promoting analytical and critical thinking skills. In classroom practice, metacognition can be seen as a key tool to help students

become self-regulated learners and achieve deep learning. In the Singapore educational landscape, metacognition has a central role in the Mathematics and English Language curricula, with the emphasis on explicit teaching and learning in their 2020 syllabuses.

How Metacognition is Linked to Self-regulation and Motivation

Metacognition and Self-regulated Learning

Metacognition is key in self-regulated learning. The process of self-regulation is often viewed as the motivational equivalent of metacognition (Zimmerman, 2008). Individuals are self-regulated when they are active participants in their own learning process. Self-regulated learners use specific strategies (e.g., organising and translating information, seeking information and rehearsing or using memory aids), which are metacognitive in nature, to achieve their learning goals. They are also more aware of their knowledge, beliefs, motivation and cognitive processes, and are able to modify strategies to meet their goals (Cleary & Zimmerman, 2012).

Metacognition and Motivation

Motivation is also closely linked to metacognition and self-regulated learning, as illustrated in Figure 2. Often, learners need motivation to direct their thought processes and actions (i.e., behaviours) to complete a learning task. Learners also need to believe that effort is required to apply strategies and that effort can produce results and success. This attributional belief is what motivates learners to take on learning challenges without undue fear of failure (Borkowski, Johnston & Reid, 1987).

Metacognition and Beliefs

Metacognition and motivation can be influenced by self-perceptions and beliefs because they are all mental evaluations of self, task

*A Review of Metacognition: Implications
for Teaching and Learning*

and strategies (Flavell, 1979) . For instance, a student might think about her own thinking and conclude that she is incapable of learning how to do a certain task, or that the task requires more effort than what she is able to put in. Such ideas can become personal beliefs that will negatively impact students' effort and persistence.

Students' behaviours are likely to depend on the interplay between specific strategy knowledge, self-regulation and motivational beliefs. For instance, if a student believes that she is not good in a certain subject and is unlikely to get a decent grade, she will probably not put in much effort or activate any learning strategies even if she is aware and knows how to use them. This suggests that it is more important to ensure a conducive and supportive learning culture which encourages students to explore metacognitive strategies, instead of just teaching metacognitive strategies.

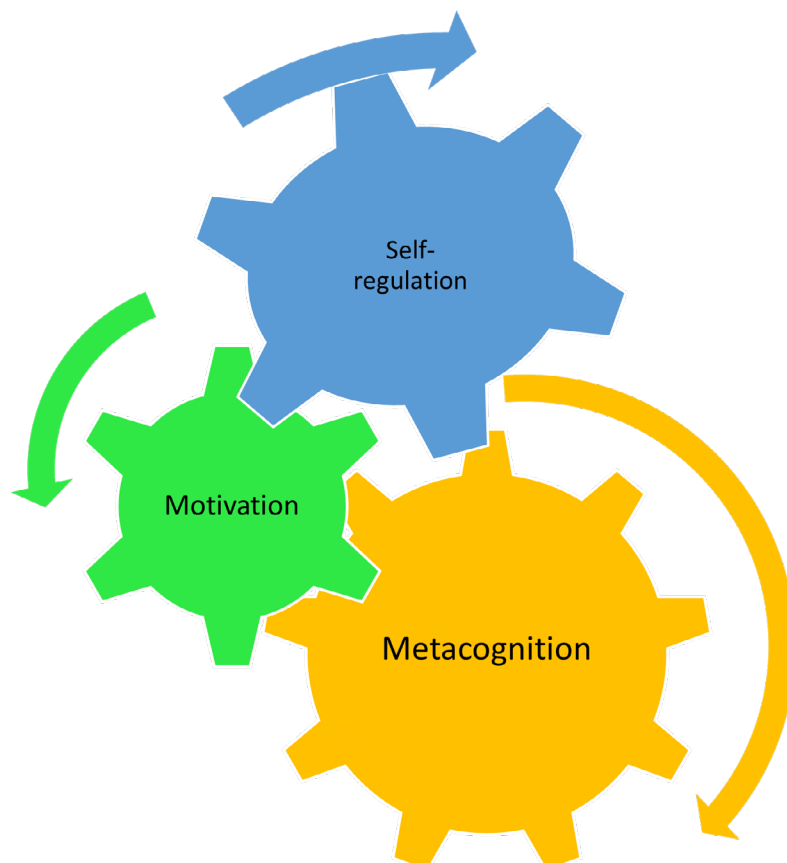


Figure 2. The relationship among metacognition, self-regulation and motivation.

What Research Says about Metacognition in Education

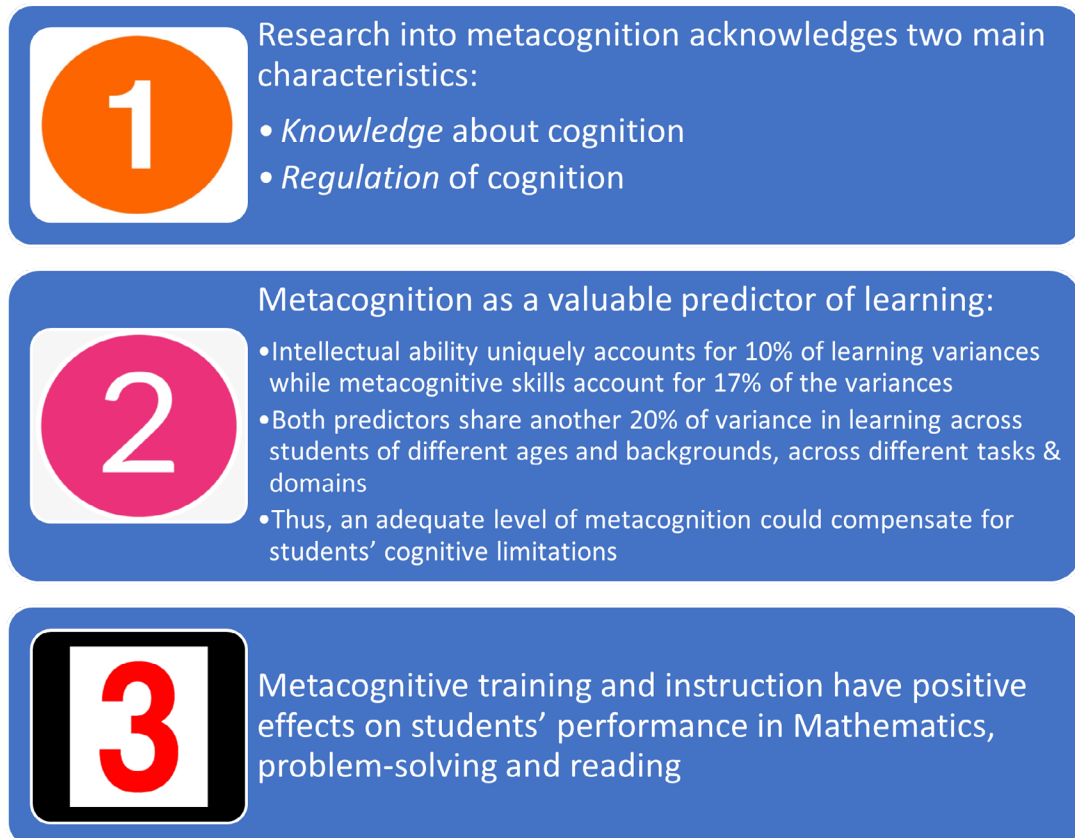


Figure 3. A summary of research findings on metacognition in education.

Based on research findings, Figure 3 summarises the three main points for the application of metacognition in education: (1) acknowledgement of two main characteristics; (2) metacognition as a valuable predictor of learning; and (3) positive effects on students' performance.

Four general approaches can be used to help increase metacognition for teaching and learning in schools, as illustrated in Figure 4: (1) promoting the general awareness of metacognition;

*A Review of Metacognition: Implications
for Teaching and Learning*

(2) improving knowledge of metacognition; (3) improving regulation of cognition; and (4) fostering environments that promote metacognitive awareness (Hartman & Sternberg, 1992).

**How to Promote Student Metacognition:
Four Generic Approaches**

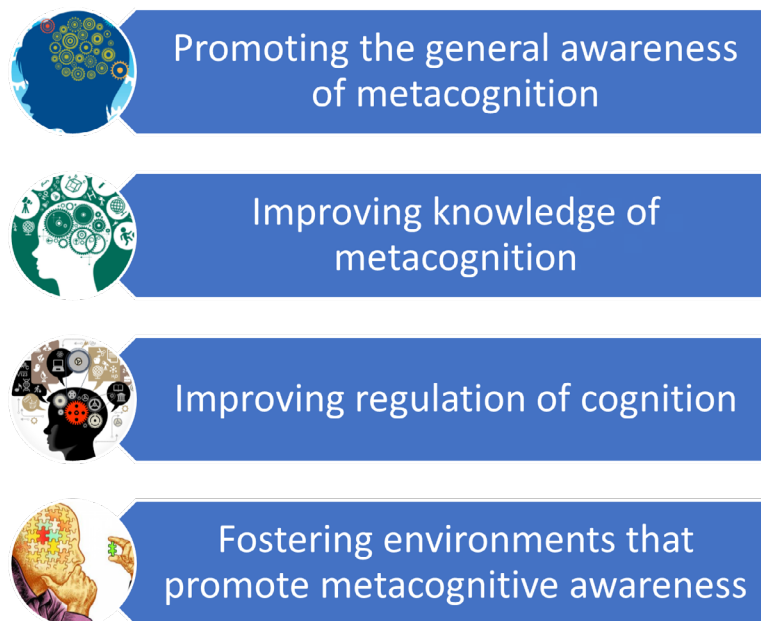


Figure 4. Generic approaches to foster metacognition.

Promoting General Awareness

Teachers need to provide opportunities for students to understand the difference between cognition and metacognition and enhance their metacognitive thinking, to help them become more self-regulated learners (Schraw, 1998). This can be achieved with practice and reflection over a period of time and is best done as a whole-school approach. In this regard, teachers:

- Need to take time to explicitly discuss and talk about the importance of metacognitive knowledge and regulation.
- Should explicitly model their metacognition—in particular, what and how they think about a concept or how they go about answering questions and monitoring their own performance. Often, teachers tend to show how they solve a question instead of describing their thought processes on how to solve the question. Verbalising teachers' thought process (i.e., thinking aloud) will make this process visible to students who can then follow this process.
- Should allocate dedicated time for group discussion and reflection.

Improving Knowledge of Cognition

The development of general thinking capacities and higher-order thinking require basic curricular knowledge to be learnt in a way that is meaningful and relevant for future problem solving. This is because higher-processing abilities build on the prerequisite learning of certain core skills and subskills. Hence, learning strategies could be used to facilitate the learning of two kinds of knowledge:

1. Declarative (facts and concepts)
2. Procedural (how) knowledge

While different subjects often emphasise the importance of one knowledge form over the other, expertise in most subject-matter domains requires access to both declarative and procedural knowledge. Table 1 shows some strategies that can be used to help students acquire declarative and procedural knowledge.

*A Review of Metacognition: Implications
for Teaching and Learning*

Table 1

Strategies that can be used to acquire declarative and procedural knowledge.

Declarative Knowledge	Procedural Knowledge
<ul style="list-style-type: none"> a) Simple attention focusing, such as highlighting and underlining b) Structured focusing, such as looking for headings c) Schema building, such as story grammar and schema training (e.g., generalisation, enumeration, sequence, classification and compare/contrast) d) Elaboration techniques, such as self-questioning, imaging and analogies 	<ul style="list-style-type: none"> a) Hypothesising b) Seeking reasons for actions c) Using examples and non-examples d) Algorithms e) Reflective self-instruction (i.e., to monitor, adjust and be aware of one's own ways of learning and studying) f) Part practice (e.g., drills on one specific aspect of performance) g) Whole practice (i.e., student practises full performance)

Note. Extracted from Derry (1990).

The use of an instructional aid, such as the strategy evaluation matrix (refer to Table 2), is another strategy which teachers have found useful in promoting students' cognitive skills, metacognitive awareness

and active construction of knowledge about how, when and where to use the strategies. The matrix consists of five strategies with suggestions and questions on how, when and why to use specific strategies like skimming or activating prior knowledge. Students can follow the matrix individually or as a group. Continuous practice of the strategies with reflection and discussion with the teacher and classmates can help students to use the strategies more effectively.

Table 2

Strategy evaluation matrix.

Strategy	How to Use	When to Use	Why to Use
Skim	Search for headings, highlighted words, previews, summaries	Prior to reading an extended text	Provides conceptual overview, helps to focus one's attention
Slow down	Stop, read and think about information	When information seems especially important	Enhances focus of one's attention
Activate prior knowledge	Pause and think about what you already know. Ask about what you do not know.	Prior to reading or an unfamiliar task	Makes new information easier to learn and remember

*A Review of Metacognition: Implications
for Teaching and Learning*

Mental integration of knowledge (prior and new)	Pause and think about what you already know. Question what you don't know. Try to relate what you do not know to what you already know: e.g., relating to the main ideas. Use these to construct a theme or conclusion.	When encountering an unfamiliar task or learning complex information or when a deeper understanding of a certain concept is needed.	Reduces memory load by making new information easier to learn and remember. Strengthens one's understanding of prior knowledge and promotes a deeper level of understanding.
Diagrams	Identify main ideas, connect them, list supporting details under main ideas, and connect supporting details.	When there is a lot of interrelated factual information	Helps identify main ideas, organise them into categories. Reduces memory load.

Note. Extracted from Schraw (1998).

Improving Regulation of Cognition

Using the regulatory checklist (refer to Table 3) to complement the strategy evaluation matrix could further enhance student metacognition. The checklist provides explicit prompts to help students be more strategic and systematic in their problem solving. Teachers can use the checklist to explain and discuss with students how to plan, monitor, and evaluate their own learning.

Table 3

Regulatory checklist.

Type of questions	Planning	Monitoring	Evaluating
Goal-related	1. What is my goal?	1. Am I reaching my goals?	1. Have I reached my goal?
Strategies-related	1. What kind of information and strategies do I need? 2. How much time and resources will I need?	1. Do I need to make changes? 2. Do I have a clear understanding of what I am doing?	1. What worked? 2. What didn't work? 3. Would I do things differently next time?
Task-related	1. What is the nature of the task?	1. Does the task make sense?	-

Note. Extracted from Schraw (1998).

Fostering Conducive Environments: Creating a Classroom Culture of Thinking

Metacognitive knowledge and skills are often influenced by contextual and social factors. In some cases, students may possess the necessary metacognitive skills and knowledge but do not use them at all or effectively. If they do use them, students might not attribute their success to these skills and knowledge. In addition, the level of effort

A Review of Metacognition: Implications for Teaching and Learning

put in by the students may be influenced by their level of motivation. Research on metacognition and beliefs/motivation has shown that there is a link between students' beliefs and motivation. Students may not want to put in the extra effort when they perceive a low chance of success. Therefore, classrooms should facilitate a mastery of goal orientation to increase students' level of performance and reward effort and persistence (Schraw, 1998). This is another way to foster a conducive environment to increase metacognition for learning in classrooms.

Conclusion: Creating a Classroom Culture of Thinking

When considering the effectiveness of metacognitive thinking and strategies for teaching and learning, the motivation of students plays an important role. Students' metacognitive strategies can only be effectively activated if they believe in these strategies and that they are able to learn and solve problems more effectively with them. Thus, this would mean that teachers must explicitly demonstrate how such strategies are used (e.g., thinking aloud) and how they have benefited from them. Teaching students to successfully use these strategies will also increase students' confidence in them.

Furthermore, explicit and prolonged instruction and practice is necessary as this is an essential means to create a strong classroom culture of thinking practices and habits over time. Teachers also need to make the linkage between content specific metacognitive knowledge and metacognitive strategies or skills. It is also believed that a social constructivist approach (e.g., using inquiry-based learning, cooperative learning pedagogy) can be more successful in enabling students to acquire more high-order type of cognition with their fellow peers and teachers through in-depth discussions. Probing questions and prompts could be used by instructors and teachers to facilitate a more metacognitive type of thinking. Teacher thinking aloud and modelling of metacognitive thoughts and actions would also be helpful to students.

In addition to the considerations mentioned above, metacognition instruction needs to consider differences in the subject content.

There are similarities as well as differences in the ways that metacognition strategies are applied in different disciplines. For example, metacognition strategies students need to employ to solve problems in Mathematics will differ from strategies students need to employ to comprehend a written text.

For metacognitive training and learning to be effective, it is imperative for learners to be fluent with the fundamental knowledge and competence expected of the disciplines in question. A good grasp of number sense and arithmetic computational skills, for example, would help learners to maximise the benefits of metacognitive strategies specific to Mathematics and the concept of whole numbers.

Finally, it is also important to highlight the role of teachers in the metacognition–student learning equation. Continuous and persistent professional development efforts are necessary for teachers to understand the concept, components and sub-components of metacognition so that teachers can design instruction that facilitates this higher-order thinking among our students and effectively transfer their metacognitive knowledge and skills to their students.

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*A Review of Metacognition: Implications
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