Making The Abstract Explicit: The Role Of Metacognition In Teaching And Learning

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RESEARCH BRIEF

This policy paper presents findings from a wide range of literature on metacognition in primary and secondary education. To help make the abstract explicit for school leaders and teachers, we focus on three aspects of metacognition commonly studied in the literature , metacognitive knowledge, metacognitive skills, and metacognitive experiences. Part 1 describes key insights from research on metacognition. Part 2 presents promising practices to improving students' metacognitive abilities. Finally, Part 3 provides recommendations for IB stakeholders meant to strengthen and reinforce the potential of IB programmes to develop students with metacognitive strengths for lifelong learning. This Research Brief provides a brief overview of metacognition in education and summarizes the main findings and recommendations from the full policy paper.

WHAT IS SO IMPORTANT ABOUT REFLECTING ON OUR THINKING?

When we do purposeful thinking about our thinking we engage in *metacognition*. Metacognition is an essential part of teaching and learning and the main driver for self-regulation. In the metacognitive process, learners tap into their prior experiences to develop a plan, achieve a goal, select strategies, monitor progress, and reflect on what and how they learned. Imagine yourself as a student. You just received a challenging social studies assignment to present on the history of global pandemics. The task will require research, note-taking, presentation skills, critical and creative thinking, organizational skills, and self-monitoring to gauge your progress, motivation, and overall success. At every stage from start to finish, your metacognition is at work helping you grow through the learning experience.

WHAT ROLE DO TEACHERS PLAY?

Teachers are important models and facilitators of the metacognitive process. Teachers make their own thinking and the thinking of students explicit using techniques, such as questioning, reflecting, think-alouds, and feedback. Not surprisingly, research has established a positive link between metacognition and academic performance. Despite its critical importance, students rarely receive explicit instruction on metacognition across all levels of education. Making thinking visible and reflecting on the learning process can be difficult and abstract for students. Thankfully, research and innovations in education from around the world can provide schools, educators, and parents with tools to support students.

WHAT DOES THE RESEARCH TELL US?

We systematically collected research published between 2000 and 2020 as a starting place for generating the main research insights presented in Part 1 and to identify the promising approaches presented in Part 2. Here are some of the key findings from Part 1:

- Metacognitive strategies are among the most influential factors in student learning.
- Interventions that improve metacognitive knowledge and skills can be effective.
- Metacognitive knowledge increases with age, but all learners, especially primary-aged students, need explicit instruction to build metacognitive knowledge and skills.
- Parents and families play an integral role in providing metacognitive experiences and developing students' metacognitive knowledge and skills.
- Students' motivation, growth mindset, self-efficacy, and emotions all influence their use of metacognitive learning strategies, which supports students' academic resilience.
- Beliefs about knowledge and learning influence how teachers and students use metacognition and approach self-regulated learning.

In summary, research shows that metacognition is essential for students to effectively self-regulate their learning. Interventions that aim to enhance students' metacognitive abilities are associated with improved academic performance, especially if they combine instruction in metacognitive knowledge and skills and address motivation, growth mindset, self-efficacy, and emotion. Teachers should use explicit metacognitive language and instruction, ask questions rather than give answers, provide illustrative examples of metacognitive thinking, model for students, and prompt students to connect their learning within and across subjects.

WHAT DOES METACOGNITION DEVELOPMENT LOOK LIKE IN PRACTICE?

Approaches to fostering metacognitive knowledge and skills vary widely from large-scale government policies and international education programs to discrete classroom practices. This policy paper presents illustrative examples and unpacks specific classroom practices for metacognition within each phase of the *self-regulated learning process*: goal-setting and planning, monitoring and control, and self-evaluation and reflection. Highlighted classroom practices include: (a) using mnemonic devices to build students' metacognitive knowledge, (b) metacognitive questioning to help students develop plans and achieve goals, (c) Reciprocal Teaching to encourage students to develop their monitoring skills, and (d) reflective journaling for tying the self-regulated learning process together and for self-evaluating. We dissect one widely adopted and successful program to improve metacognition and other skills, called *Cognitive Acceleration*, to demonstrate the level of commitment needed to create learning environments that support students' metacognition growth.

HOW DO GROWTH MINDSET, METACOGNITION, AND ACADEMIC RESILIENCE WORK TOGETHER?

Given the recent increase in attention around social and emotional learning in education, the IB commissioned three policy papers focused on key interrelated social and emotional learning topics that are most closely aligned to the work of IB: metacognition, growth mindset, and academic resilience. Research illustrates how these three factors work together in teaching and learning. Failure, setbacks, and mistakes are a natural and inevitable aspect of school and academic learning. Adaptive responses to the stress of setbacks draw on growth mindset thinking about ability, the metacognitive knowledge and skills to make adjustments and be strategic, and the academic resilience to persevere with confidence, composure, and control. Metacognition skills may be critical for learners to implement a growth mindset when stressed and to manage emotions when failure makes them want to quit.

When teachers message and model a growth mindset in the face of setbacks in their own learning, they illustrate a self-regulatory process that underpins the academic resilience students need in their own lives. Recognizing one's fixed mindset dialogue and adjusting to make room for growth mindset thinking is a metacognitive process that sets the stage for academic resilience. Goal-setting and consistent reflection on progress toward those goals are also important metacognitive processes that influence growth mindset and, in turn, academic resilience. Goals emphasize the link between effort, strategy, and progress in learning. Reciprocally, mindset beliefs and thinking will influence how teachers and students use metacognitive knowledge and skills. It is important to understand how these three factors of growth mindset, metacognition, and academic resilience interact in typical academic experiences across grade levels and content areas. They do not function in isolation.

WHAT DO WE RECOMMEND FOR INTERNATIONAL BACCALAUREATE (IB) STAKEHOLDERS?

Our recommendations build from research and promising practices to strengthen and reinforce IB's existing supports for metacognitive development in students.

1. Make Metacognition Valued and Explicit

IB already provides students with explicit metacognitive experiences, such as the Theory of Knowledge course in the Diploma Programme. IB can further demonstrate the value of metacognition by defining the concept clearly in curriculum standards, assessments, and each aspect of IB's system of professional learning. School leaders, teachers, students, and parents should recognize the role of metacognition in developing internationally-minded students, have resources and training on how to use metacognition, and understand how metacognition can be assessed and evaluated in different ways.

2. *Ensure Students Use Their Reflections*

Reflection within IB programmes should be explicitly connected to the other phases of the self-regulated learning process (i.e., goal-setting, planning, monitoring) in IB's approaches to teaching and learning. Self-evaluations and reflections are most useful when the formative information generated is used to make self-regulated learning strategies more effective.

3. *Create Learning Environments That Foster Metacognition*

IB's programme standards and practices specific to teaching and learning strongly align with self-regulated learning and metacognition. Schools and teachers should consider two additional principles that will further enable self-regulated learning and enhance students' motivation. First, teachers should present students with consistent opportunities to set and plan long-term, proximal, and personally meaningful goals. Second, teachers should emphasize student choice and personal relevance to improve motivation and engagement.

4. *Assess Metacognitive Knowledge And Strategy Use Regularly*

We recommend schools take a holistic approach that includes occasional schoolwide use of self-report measures, ongoing classroom-based formative assessments, and informal teacher observations. This type of approach can lead to the development of a well-rounded, nuanced evaluation of students' metacognitive abilities and lead to more effective planning for teachers and school leaders.

5. *Evaluate Teachers' Beliefs And Provide Needed Support*

School leaders should use prior knowledge, teacher interviews, and classroom assessments to evaluate whether teachers' beliefs and actions lead to student-centered learning environments where students are given the support, guidance, and autonomy to own their learning process. Teachers can use developmental frameworks, approaches for cultural expression, and research-based examples as models to follow.

6. *Align Curriculum, Assessment, And Professional Learning*

Curriculum, assessment, and professional learning must all be coherent and aligned. School leaders are well-positioned to ensure these core components of teaching and learning are aligned to IB's principles and practices while also balancing the external demands from national and regional governments, local education agencies, parents, and the general public.

7. *Parents Can Model Metacognitive Thinking and Behavior*

Most promising teaching practices presented in this policy paper have one thing in common—teachers modeled metacognitive thinking and behavior, especially for younger children, to provide explicit examples that could be adapted to individual strengths. Metacognitive behaviors taught in school can be reinforced at home to enhance student ownership of learning across environments. Parents are important models in student learning.

8. *All Students Can Own Their Learning*

A deep base of metacognitive knowledge and strong metacognitive skills provide students with the necessary tools for effectively regulating and owning their learning. The promising practices presented in this policy paper, although directed at teachers, can be adapted and used by students to improve their metacognitive skills for goal-setting, planning, monitoring, and reflection. Students who exhibit strong ownership over their learning also know to seek help when they are struggling with a task. Seeking help can introduce students to new learning strategies and avoid unnecessary frustration and stress. Finally, all students, regardless of how well they currently use metacognition, should have the confidence to know that with continued practice and support from teachers, peers, and parents they will develop the skills that allow them to become lifelong learners.

CONCLUSION

Promoting metacognition is less about finding the perfect policy, practice, or program and more about creating a culture of teaching and learning that produces thoughtful and reflective students who are prepared and motivated to engage in independent, lifelong learning. The insights and lessons learned from the research provided in this policy paper can help teachers and school leaders take small steps toward creating a school culture and learning environments that cultivate metacognition for all learners.

PART 1.
METACOGNITION IN EDUCATION: A LITERATURE REVIEW

1.1. INTRODUCTION

Metacognition is widely recognized as an essential skill for 21st century learning (Horvathova, 2019) and the main driver of students' self-regulated learning behaviors (Winne & Perry, 2000). Despite its critical importance in the learning process, and a strong evidence base showing metacognitive abilities are positively associated with academic performance (Donker, de Boer, Kostons, van Ewijk, & van der Werf, 2014), **metacognition is rarely explicitly taught to students at any level of education** (Annevirta & Vauras, 2001; Perry, Phillips, & Dowler, 2004). The purpose of this policy paper is to help make the abstract explicit by providing school leaders and teachers with insights from research and practical guidance on improving students' metacognitive abilities.

In Part 1, findings from a literature review provide a broad overview of metacognition in primary and secondary education. The aim is to describe the evidence base for metacognition, the role of metacognition in teaching and learning, and ways for schools and teachers to measure metacognition. Part 2 presents promising policy, programmatic, and instructional approaches to improving students' metacognitive abilities. We systematically collected research from 2000-2020 as a starting place for generating the main research insights presented in Part 1 and to identify the promising approaches presented in Part 2 (see the Appendix for details on our methodological approach). Finally, Part 3 presents recommendations for International Baccalaureate (IB) stakeholders. IB is a non-profit educational foundation that offers four programmes to more than a million students aged 3–18 across 151 countries. IB programmes aim to develop thoughtful, internationally-minded students committed to creating a better and more peaceful world. **This policy paper provides some insights into the role metacognition can play to equip IB students with the knowledge, skills, and reflective capacity necessary to be internationally-minded, lifelong learners**. Metacognition can enhance international-mindedness by providing students with learning strategies for developing intercultural understanding, as well as thinking skills, such as reflection, that prompt students to continuously compare their view of the world to other cultural perspectives.

1.2. WHAT IS METACOGNITION?

Numerous definitions and models of metacognition exist in the literature (Gascoine, Higgins, & Wall, 2017; Panadero, 2017). For example, cognitive psychologists often define and study metacognition in the context of

executive functions. For example, executive functions play an important role in promoting metacognition in learning, including the ability to sustain attention and switch focus from one task to another (cognitive flexibility), the ability to retain and recall information (working memory), and the ability to recognize and control impulses that distract from the learning process (inhibitory control; Center on the Developing Child, 2020; Howard & Vasseleu, 2020). Though executive functions relate to metacognition, it is beyond the scope of this policy paper to cover that important topic, fully. Instead, we focus on the role of metacognition within the self-regulated learning process, a concept that has been studied extensively in primary and secondary education.

In education, metacognition is most often studied in the context of self-regulated learning, a common skill among high achieving students (Karlen, 2016). When applied to the learning process, self-regulation entails developing a plan to achieve a task-specific goal, monitoring and controlling one's ongoing performance, and self-reflection (Panadero, 2017). Self-regulated learning is an overarching construct that takes into consideration the influence of environmental factors and is comprised of several psychological concepts, such as motivation, emotion, and metacognition. **Metacognition—broadly defined as purposeful thinking about thinking—has been described as "the gateway to self-regulating one's learning"** (Winne & Perry, 2000, p. 540). Figure 1 below illustrates the role metacognition plays in self-regulated learning.

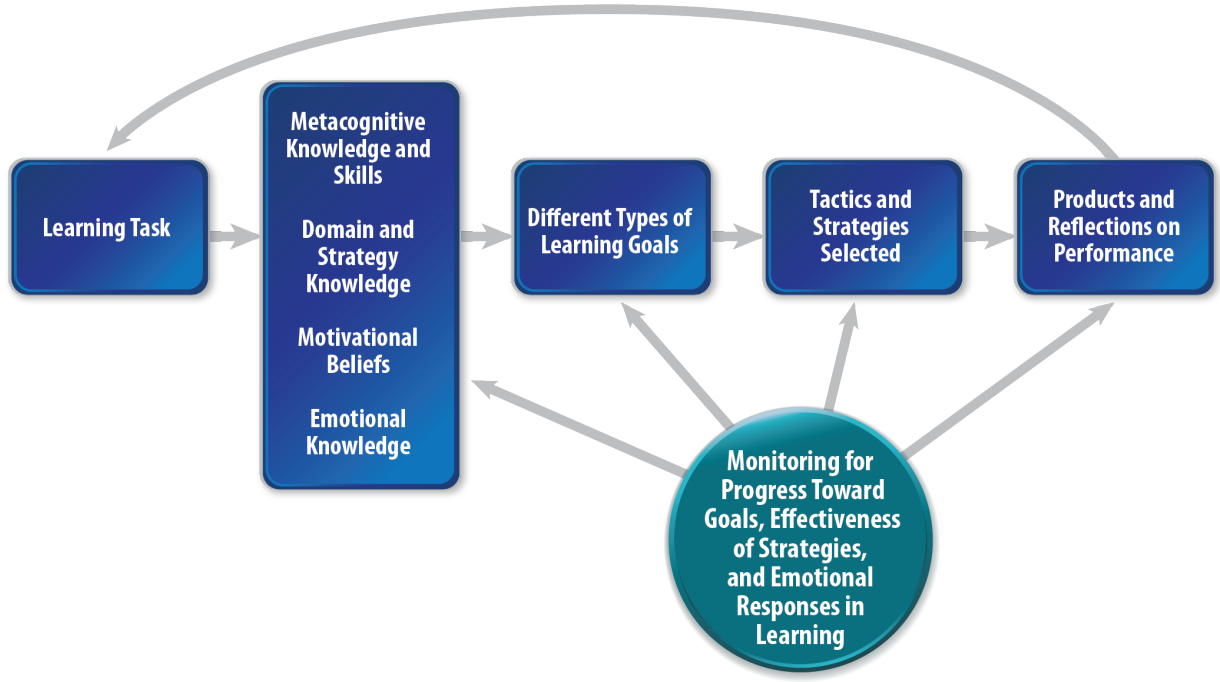


Figure 1: The Role of Metacognition in Self-Regulated Learning

During the self-regulated learning process, metacognitive learners select a task-specific goal that their prior experience suggests is appropriate and realistic. While working on a task, metacognitive learners select from an array of learning strategies based on the applicability to the task, their strengths and weaknesses, and relevant

past experiences. The emotional knowledge and regulation skills they bring to the learning task support their use of metacognition and the academic resilience to persist through setbacks. Finally, during the self-reflection phase, metacognitive learners determine whether they achieved their goal and attained greater conceptual understanding of the material. They compare their product to a set of standards and their own past performances and evaluate their use of learning strategies. They also evaluate how well their strategies worked and their emotional experience across the learning process. As this process unfolds across different settings, metacognitive skills become habituated.

In this research review, **we focus on three aspects of metacognition that are commonly studied and equally important to the self-regulated learning process: metacognitive knowledge, skills, and experiences.** Researchers commonly describe three types of metacognitive knowledge: declarative, procedural, and conditional (Schraw, Crippen, & Hartley, 2006). Declarative knowledge refers to students' knowledge of themselves as learners and what factors are likely to influence their learning. Procedural knowledge focuses on students' understanding of various learning strategies, such as note-taking methods and reading comprehension techniques. Conditional knowledge is necessary for students to know when and why to use certain learning strategies based on the demands of specific tasks, the characteristics of the broader learning environment, and their own strengths and weaknesses.

Metacognitive skills or *skillfulness* refers to the capacity to actively monitor and control one's own thinking and behavior using specific learning strategies such as goal setting, progress monitoring, and deliberate reflection. Metacognitive skills are closely related to executive functioning (Roebers, 2017). Executive functions are self-regulatory processes that help facilitate metacognition. For example, students need executive functions, such as impulse control, to avoid reverting to a learning strategy that they metacognitively know will not work based on past experiences (Roebers, 2017). Finally, students need consistent access to *metacognitive experiences*—explicit learning opportunities that activate metacognitive knowledge and require use of metacognitive skills. Metacognitive experiences include everything from formal classroom tasks and reflections to informal opportunities to learn at home or during extracurricular activities. We use these three aspects of metacognition to frame the literature review findings and practical guidance to school leaders and teachers.

1.3. WHY SHOULD METACOGNITION MATTER TO STAKEHOLDERS?

Since psychologists introduced the construct in the 1970s to study memory (Flavell, 1971, 1976), metacognition has been studied extensively in the social sciences, including in primary and secondary education. Below is a summary of the evidence base supporting metacognitive learning and the role schools, teachers, and parents play in developing students' metacognitive abilities.

EVIDENCE-BASED BENEFITS FOR STUDENTS

Finding 1. Teaching metacognitive strategies are among the top ten most influential factors in student learning and success.

Several meta-analyses stretching back to the 1980s have found a positive link between metacognition and students' academic performance (Dignath, Buettner, & Langfeldt, 2008; Donker et al., 2014; Haller, Child, & Walberg, 1988; Hattie, 2009; Hattie, Biggs, & Purdie, 1996; Ohtani & Hisasaka, 2018). Perhaps the most well-known of these is Hattie's (2009) synthesis of more than 800 meta-analyses focused on factors predicting academic achievement, which found teaching metacognitive strategies as one of the top ten most influential factors in student learning and success. A more recent meta-analysis found metacognition predicts academic performance from primary school students through adults, in both classroom and laboratory settings, and when controlling for intelligence (Ohtani & Hisasaka, 2018).

Finding 2. Interventions designed to increase academic performance by improving metacognitive knowledge and skills have been consistently effective.

In a meta-analysis of various learning strategy interventions, those that included a focus on developing students' metacognitive knowledge by teaching "which strategies to use and how to apply them (declarative knowledge) but also when and why to use them (procedural and conditional knowledge)" had the strongest effects on students' writing, science, math, and reading performance (Donker et al., 2014, p. 15). That effect held across different groups of students (e.g., students from socioeconomic challenged backgrounds, students with learning disabilities, and gifted children) and developmental periods (Donker et al., 2014). Interventions that combine instruction on metacognitive knowledge and strategies (Dignath et al., 2008) and those aimed at enhancing students' motivation by addressing task value seem to be most effective (Donker et al., 2014). Even interventions where metacognition is not the focal point also showed positive effects. For example, a meta-analysis on writing-to-learn interventions found the most effective interventions were ones that provided students with metacognitive prompts (Bangert-Drowns, Hurley, & Wilkinson, 2004).

THE ROLE OF TEACHERS AND SCHOOL LEADERS

Finding 3. Students need explicit instruction to build their metacognitive knowledge base and repertoire of learning strategies.

Teachers have an essential role to play in developing competent metacognitive learners and are responsible for creating a learning environment suitable for metacognitive growth. Learning environments conducive to metacognitive learning emphasize student choice and personal relevance, challenge students beyond their comfort zone, and encourage independence while also enabling peer and teacher support (Perry, Hutchinson, & Thauberger, 2008). Additionally, when teachers embed these core instructional practices into existing curriculum it can help provide students with consistent metacognitive experiences (Veenman & Beishuizen, 2004). When these conditions are in place, the core instructional practices presented in Box 1, adapted from Perry et al., are most likely to promote students' metacognition.

Box 1: Core instruction practices that promote students' metacognition

- Using explicit language to describe metacognition and self-regulation.
- Asking probing questions rather than giving answers.
- Providing specific, rather than general, examples and suggestions.
- Modeling metacognitive behavior and highlighting exemplary student behaviors.
- Prompting students to transfer and connect their learning to other topics and experiences.

Finding 4. School leaders are responsible for ensuring teachers have the necessary training and support for developing students' metacognitive abilities.

Research shows teachers need knowledge and training on incorporating metacognition into everyday teaching and learning (Askell-Williams, Lawson, & Skrzypiec, 2012). Teachers may lack the necessary time to read and digest research on best practices in metacognitive learning and identifying different tactics for ensuring instruction is developmentally appropriate (Li, 2012). One potentially powerful tactic school leaders can use to promote metacognitive learning is to integrate metacognition throughout a school's approach to learning (Veenman & Beishuizen, 2004). School leaders can include metacognitive knowledge and skills as core cross-disciplinary standards and components of common assessment rubrics used to evaluate student work (Li, 2012). This type of integrative tactic can help ensure students are provided with consistent metacognitive experiences.

THE ROLE OF FAMILIES

Finding 5. Parents and families have an integral role to play in providing metacognitive experiences and in developing students' metacognitive knowledge and skills.

Pino-Pasternak and Whitebread (2010) used a systematic review of 22 studies to develop a model for describing the relationship between parenting behaviors and students' self-regulated learning. Box 2 presents the six categories of parenting behaviors described by the authors' model. These behaviors are seen as beneficial to improving students' metacognitive knowledge and skills, their motivation to learn and succeed, and their self-

Box 2: Parenting behaviors that promote children's metacognition.

- Encouraging the use of metacognitive language to describe learning experiences.
- Creating a challenging and autonomous learning environment.
- Generating confidence in students' sense of agency through low levels of control.
- Gradually shifting the responsibility for learning from parent to student.
- Being responsive to emotional reactions during the learning process.
- Approaching learning failures with more support and successes with less control.

efficacy. Parents can also provide consistent learning opportunities at home to reinforce metacognitive learning at school. A significant limitation of existing literature on the role of parents in the metacognitive process is the preponderance of studies on highly educated, middle class Caucasian families from Western societies. More research is needed to determine how different cultural values in non-Western societies and non-white contexts influence parenting norms and the metacognitive support students receive at home. More research is also needed for examining how parents provide metacognitive support to vulnerable groups of students (Pino-Pasternak and Whitebread, 2010).

1.4. HOW DOES METACOGNITION DEVELOP AND AFFECT LEARNING?

The following section briefly describes the development of metacognition across grade levels, the role of metacognition in the learning process, and differences across global contexts.

THE DEVELOPMENT OF METACOGNITION ACROSS GRADE LEVELS

Finding 6. Very young, primary-aged students possess metacognitive abilities, but they need consistent and explicit instruction and modeling from teachers to further develop their skills.

Metacognition appears at an early age with a marked increase in ability at the transition between early childhood and adolescence (Schneider, 2008) and continues to grow into adulthood (Schraw & Moshman, 1995). For very young students, building executive functioning skills (i.e., working memory, cognitive flexibility, inhibitory control) is a prerequisite for effectively using metacognition to enhance learning (Howard & Vasseleu, 2020). For example, the ability of students to store metacognitive knowledge in their memory begins developing in preschool and steadily increases throughout primary school (Schneider, 2008). Primary-age students possess the ability to use learning strategies as well, but the developmental trajectory is less clear than is their ability to store metacognitive knowledge (Schneider, 2008).

Although metacognition appears at an early age, students in the early grades need explicit instruction and modeling to apply their nascent metacognitive skills (Schneider, 2008). Younger students may not recognize metacognitive experiences as readily as their older peers. Therefore, younger students likely need help

identifying and interpreting their meaning and modeling from teachers (Georghiades, 2004; Schneider, 2008). Younger students also need feedback on the accuracy of their self-evaluations. There is evidence that very young students tend to overestimate what they have learned and how easy it was to learn, though these perceptions can become more accurate by the end of primary school (Schneider, 2008).

In general, individuals develop strong metacognitive abilities across time (Schneider, 2008), but how they employ their skills in the classroom may be culturally dependent and influenced by personal characteristics (Li, 2012). In one study, researchers surveyed nearly 9,000 students in Hong Kong across eight grade levels to determine students' perceptions of their metacognitive knowledge and use of learning strategies (Mok, Fan, & Pang, 2007). The authors found a clear downward trend in metacognitive strategy use with the sharpest decline at the transition between primary and secondary school (Mok et al., 2007). The frequency of self-reported metacognitive strategy use appeared to flatten in the secondary grade levels (Mok et al., 2007), a result that is supported by research conducted in Switzerland (Leutwyler, 2009).

The decline in self-reported metacognitive strategy use could be due to a decline in students' self-efficacy for self-regulated learning across time (Pajares & Valiante, 2002). Several other explanations may also be responsible for the decline in self-reported strategy use. For example, the intellectual and self-regulatory demands placed on students may accelerate faster than their knowledge of metacognitive strategies (Mok et al., 2007). That explanation is plausible considering how rarely metacognitive knowledge is explicitly taught (Annevirta & Vauras, 2001; Perry et al., 2004). Teachers themselves may lack the knowledge or necessary training to incorporate metacognition into everyday teaching and learning (Askell-Williams et al., 2012). It is also possible that as metacognitive skills become habituated over time, students' explicit awareness about their use of these skills decreases.

Even within grades, students are likely to show developmental differences. For example, four types of self-regulated learners were found among students preparing for university entrance in Switzerland when examining differing levels of metacognitive strategy use, motivation, self-efficacy, and self-concept (Karlen, 2016). Box 3 presents a brief description of each type of

Box 3: Karlen's (2016) four types of self-regulated learners.

- **Maximal learners** exhibited the highest levels of motivation, self-efficacy, self-concept, metacognitive strategy use, and were the most academically successful students among the four types of self-regulated learners.
- **Strategic learners** exhibited high levels of metacognitive strategy use, but had lower levels of motivation, self-efficacy, and self-concept than maximal learners.
- **Confident learners** had higher levels of motivation, self-efficacy, and self-concept than strategic learners, but low levels of metacognitive strategy use.
- **Unmotivated learners** had the lowest levels of motivation, self-efficacy, self-concept, and metacognitive strategy use among the four types.

self-regulated learner. Interestingly, some students displayed a different profile when measured nine months later, suggesting some students may have stable self-regulated learning profiles while others vary across time. These findings also suggest efforts aimed at improving students' metacognitive abilities should address other factors, such as students' motivation, self-efficacy, and self-concept.

METACOGNITION IN THE LEARNING PROCESS

Finding 7. Developing metacognitive knowledge and skills generally occurs through the process of completing a specific cognitive task.

Metacognition is most often studied in the context of specific cognitive tasks (Veenman, Bernadette, Van Hout-Wolters, & Afflerbach, 2006), such as writing an essay, studying for an exam, or building a desk. Metacognitive experiences entail the period of time where learners become aware of a specific cognitive task through its completion and the period of reflection that follows (Efklides, 2006). Completing cognitive tasks requires various forms of metacognitive knowledge, including knowledge about one's own abilities, knowledge about the specific task, and procedural knowledge of different learning strategies. Students activate these forms of knowledge by applying specific learning strategies to complete a task (Kuhn, 2000). At the end of the metacognitive process, students use internal reflection and external feedback to evaluate their performance and determine what they learned about their specific approach (Efklides, 2006). The insights a student acquires from a metacognitive experience are then applied to the next cognitive task (Panadero, 2017).

GENERAL AND DOMAIN-SPECIFIC METACOGNITION

Finding 8. Students typically use general and domain-specific metacognitive knowledge and skills to complete cognitive tasks.

A key question debated among scholars is the degree to which learning strategies gleaned from metacognitive experiences in one domain or subject are transferable to another (Veenman et al., 2006). Domain-specific metacognitive knowledge and skills are necessary for near transfer (e.g., different tasks within the same domain) whereas general metacognitive knowledge and skills are needed for far transfer (e.g., applying learning strategies across domains; Conley, 2014). For example, writing an essay and building a desk both require general planning strategies, such as developing a timeline for completion and identifying what information is needed, as well as 21st century skills such as creative problem-solving. However, writing a paper also requires an understanding of outlining methods, grammar and punctation, the use of linguistic devices, and various other domain-specific knowledge and skills. Similarly, building a desk requires an understanding of geometry, cutting and finishing techniques, and knowledge of carpentry materials and equipment. Research suggests students need both general and domain-specific metacognitive knowledge and skills to be successful academically and

that transferring metacognitive skills across domains is possible, but limited (Neuenhaus, Artelt, Lingel, & Schneider, 2011; Zohar & David, 2009).

THE ROLE OF MOTIVATION, SELF-EFFICACY, AND EMOTIONS

Finding 9. Students' motivation and how much value they find in completing a task is strongly associated with their use of metacognitive learning strategies.

Schools and teachers should also be aware of other psychological constructs that have been shown to influence and interact with the metacognitive process (Zimmerman & Moylan, 2009). For example, students who are motivated to complete a task are more likely to use metacognitive learning strategies (Shannon, Salisbury-Glennon, & Shores, 2012). Conversely, when use of metacognitive skills leads to greater academic success it can increase a student's motivation to learn (National Academies of Sciences, Engineering, and Medicine, 2018). In a meta-analysis of learning strategy interventions, programs that included metacognitive knowledge and skill instruction and also enhanced motivation had the strongest relationship with improved academic performance (Donker at al., 2014). Additionally, goals that promote mastery learning or conceptual understanding have a positive association with the use of metacognitive knowledge and skills (Gafoor & Kurukkan, 2016). Goal orientation plays an important role. Mastery-oriented goals focus on developing a deep, conceptual understanding of a topic. Performance-based goals indicate a focus on external expectations and validation (e.g. a high test score), including competition with others.

Finding 10. Students with a growth mindset and high levels of self-efficacy are more likely to believe metacognitive learning strategies can work for them.

In addition to being motivated, successful metacognitive learners also have confidence in their ability to leverage their thinking skills and apply learning strategies to achieve their goals (Cera, Mancini, & Antonietti, 2013). Research shows students with a growth mindset and high levels of self-efficacy are more consistent with metacognitive learning strategies (Berger & Karabenick, 2011). As students gain confidence in their ability to successfully use metacognitive learning strategies they begin using them more often and develop more accurate evaluations of their performance (Bouffard-Bouchard, Parent, & Larivèe, 1991). Problematically, some research suggests students' self-efficacy beliefs may decline as they progress though primary and secondary education, and as a result, their use of self-regulated learning strategies also declines (Mok et al, 2014; Pajares & Valiante, 2002). This trend is counterintuitive given the metacognitive strengths students develop with age.

Finding 11. Students' emotional response determines whether they employ metacognitive strategies to overcome learning challenges.

How students react emotionally when confronting challenges while completing a task and reflecting on their performance is also part of the metacognitive process (Efklides, 2006). When students experience problems overcoming a challenging aspect of a difficult task it can affect students' perceptions of their cognitive abilities and their self-efficacy (Efklides, 2006). Students with high self-efficacy respond positively to challenges, believing they can succeed with the right strategy. Students with low self-efficacy may be overwhelmed with feelings of frustration and stress and are less sure that learning strategies can work, decreasing their academic resilience when facing setbacks (Conley, 2014). These same emotional dynamics arise when students appraise their own work or when they are evaluated by others (Efklides, 2006).

DIFFERENCES ACROSS GLOBAL CONTEXTS

Finding 12. Epistemological beliefs influence how teachers and students use metacognition and approach self-regulated learning.

Although research on metacognition has been conducted across the world there is surprisingly little research that leverages cross-country samples of students. However, research shows students' epistemological beliefs about the nature of knowledge and learning predict their use of metacognitive learning strategies. For example, a study on Grade 8 and 9 Greek students found those that viewed learning as a quick process were less motivated to use self-regulated learning strategies (Metallidou, 2012). A similar study of Grade 9 Turkish students found those that believed learning would be challenging and involve struggle were more likely to use self-regulated learning strategies than those that believed their fixed intelligence dictated learning outcomes (Koksal & Yaman, 2012). Importantly, epistemological beliefs vary widely between and within countries (Felbrich, Kaiser, & Schmotz, 2012), suggesting significant differences in how metacognition affects the learning process across global contexts. Teachers' beliefs about how people learn also influence what type of learning environment they create and how they approach teaching metacognition to students. Section 2.2 discusses teachers' beliefs in more detail.

Metacognition appears to be important to the learning process across global contexts despite the potential for different approaches to teaching and learning the concept across various countries and cultures. For example, a study on the Programme for International Student Assessment (PISA) shows metacognitive knowledge is positively correlated with reading comprehension across the 34 Organisation for Economic Co-operation and Development (OECD) countries analyzed (Artelt & Schneider, 2015). The more metacognitive knowledge students possessed, the higher their reading comprehension scores. However, noteworthy variation exists between countries. For example, students in Switzerland and Belgium produced the strongest association between metacognitive knowledge and reading comprehension and Greece the weakest. The authors also found differences in the self-reported use of learning strategies (i.e., elaboration, memorization, and control). In

some countries, use of strategies or general metacognitive knowledge had a stronger relationship with reading comprehension than in others. Artelt and Schneider speculated that the differences observed across countries resulted from either cultural factors that influence how students interpret and respond to self-report questions or actual differences in the role metacognitive learning strategies plays in teaching and learning.

1.5. HOW CAN SCHOOLS MEASURE AND TRACK DEVELOPMENT OF METACOGNITION?

There is a wide range of tools for measuring students' metacognitive development (Gascoine et al., 2017). This section focuses primarily on student self-report surveys.

PREDICTIVE INDICATORS OF METACOGNITION

As discussed above, several psychological constructs influence students' use of metacognitive learning strategies, most notably, motivation and self-efficacy. Students with a strong motivation to learn are more likely to use metacognitive learning strategies (Shannon et al., 2012). The value students place on a cognitive task also influences their motivation to use metacognitive learning strategies (Donker at al., 2014). Students with high-levels of self-efficacy are more likely to believe using metacognitive learning strategies will lead to greater conceptual understanding (Cera et al., 2013; Sungur, 2007).

OUTCOME-BASED INDICATORS OF METACOGNITION

Academic achievement is perhaps the most common outcome indicator associated with metacognition. For example, research shows metacognitive knowledge and skills are positively associated with academic outcomes in writing, science, math, and reading (Bangert-Downs et al., 2004; Dignath, 2008; Donker et al., 2014), even when controlling for intelligence (Ohtani & Hisasaka, 2018). The use of motivational strategies is also considered an outcome of metacognitive learning (Dignath, 2008), though other researchers maintain that motivation should be considered a predictor rather than an outcome of metacognition (Sungur, 2007).

SELF-REPORT MEASURES

Finding 13. Educational leaders seeking to measure and track development of students' metacognition have an array of tools and surveys to choose from.

A systematic review of available metacognitive assessments for children between the ages of 4 and 16 produced 84 distinct assessments (Gascoine et al., 2017). Not all metacognitive assessments, however, have documented the necessary technical information for demonstrating the instrument is valid and reliable, sensitive to cultural

differences, or adequately measures the constructs being assessed. At 61%, the majority of measures are self-report questionnaires. Other types of measures include observational methods used primarily with children younger than 9 years old, think-aloud protocols where students are asked to verbalize their metacognitive thoughts, and various online tools and programs. Finally, several measures focus on domain-specific metacognitive knowledge and skills.

The following well-known self-report surveys illustrate the type of information these measures can provide schools and teachers. The Motivated Strategies for Learning Questionnaire (MSLQ) is a self-report survey that has demonstrated evidence of validity and reliability across different cultural settings and has been used widely in the scientific literature (Pintrich, Smith, García, & McKeachie, 1993; Duncan & McKeachie, 2005). The original MSLQ includes 81 items spread across six motivation and nine learning strategies subscales, which include cognitive, metacognitive, and resource management strategies (Pintrich et al., 1993). The subscales specific to cognitive and metacognitive strategies include (a) rehearsal, (b) elaboration, (c) organization, (d) critical thinking, and (e) metacognitive self-regulation. The subscale for metacognitive self-regulation focuses on planning, monitoring, and regulation skills rather than on students' metacognitive knowledge base. The MSLQ is appropriate for students near the end of secondary education and beginning of postsecondary education. The MSLQ has been translated into several different languages (Duncan & McKeachie, 2005) and is useful for its focus on motivation and metacognition—two closely related constructs.

Two other well-known and thoroughly studied self-report surveys, the Metacognitive Awareness Inventory (MAI) and the Junior Metacognitive Awareness Inventory (JMAI), focus more narrowly on metacognition. Similar to the MSLQ, the MAI is specific to students in the later secondary grades through the beginning of postsecondary education (Duncan & McKeachie, 2005). The MAI (Schraw & Dennison, 1994) and JMAI (Sperling, Howard, Miller, & Murphy, 2002) focus on metacognitive knowledge and skills. The original MAI includes eight subscales, (a) declarative, (b) procedural, and (c) conditional knowledge; (d) planning; (e) information management strategies; (e) monitoring; (f) debugging strategies; and (g) evaluation of learning. The JMAI is modeled after the MAI and includes two versions, one 12-item measure specific to Grades 3–5 and another 18-item measure specific to Grades 6–9. Versions of the MSLQ, MAI, and JMAI all can be found online and used free of charge.

In a recent study, students' creative metacognition was measured by coding students written self-reflections after a creative drawing and writing exercise for four aspects, including contextual knowledge, self-awareness, strategy selection, and self-regulation (Anderson & Haney, in press). The success of that approach indicates teachers can use students' classroom-based, authentic written self-reflections to gauge the development of specific types of metacognitive knowledge and skills.

1.6. CONCLUSION

Research shows that metacognition is essential for students to effectively self-regulate their learning. Interventions that aim to enhance students' metacognitive abilities are associated with improved academic performance, especially if they combine instruction in metacognitive knowledge and skills and address motivation, self-efficacy, and emotion. School leaders, teachers, and parents all have critical roles to play in creating learning conditions that promote metacognition and foster ownership of learning. School leaders have the responsibility for aligning curriculum, assessment, and professional learning to promote metacognition as well as supporting teachers in measuring students' metacognitive development. As the following section describes, teachers have a range of evidence-based instructional practices at their disposal, all of which should be adapted according to students' developmental, individual, and cultural assets and needs.

PART 2.
MAKING THE ABSTRACT EXPLICIT: PROMISING APPROACHES TO IMPROVE METACOGNITION

2.1. INTRODUCTION

The ultimate goal of policies, practices, and programs focused on improving students' metacognitive knowledge and skills is to shape students into autonomous, lifelong learners. Lifelong learners with strong metacognitive skills have the ability to own every aspect of their learning, from developing a detailed plan to achieving a self-selected goal, monitoring and controlling progress, and evaluating performance, carefully. Students need to be provided consistent, challenging, and authentic opportunities to develop and continuously expand their metacognitive knowledge and improve their metacognitive skills. When provided with such opportunities, students' ability to use metacognition to self-regulate their learning becomes automated and teachers can gradually cede control over learning to students.

Approaches to providing students with opportunities to hone their metacognitive abilities vary widely in scope. Section 2.1 describes policy initiatives rolled out by large governmental systems, such as individual nation-states and governmental coalitions, that target a broad set of skills, of which metacognition is often a part. These large systems attempt to promote metacognition distally by relying on a few powerful policy levers, including testing and accountability systems, academic standards and curriculum, and professional learning for educators. Strong coherence among these levers is necessary for the success of large-scale policy initiatives (Fullan & Quinn, 2016).

Similarly, smaller nongovernmental systems often use broad programmatic approaches that target a multitude of skills. For example, IB programmes aim to develop students' international-mindedness by targeting a set of 10 attributes (see the IB Learner Profile). The teaching and learning approaches used by IB to target these attributes include a heavy focus on improving students' metacognition (see *Teaching with ATL in mind in the IB Diploma Programme*; King, 2013). Like IB, Cambridge Assessment International Education (CAIE) offers four programs with nearly a million students participating annually in more than 150 countries. CAIE explicitly designs its course syllabi and assessments to promote metacognition and provides teachers with resources and training on metacognition (CAIE, 2019). Part 3 of this policy paper presents IB stakeholders with recommendations meant to strengthen and reinforce IB's potential to improve students' metacognitive abilities. These recommendations are also applicable to stakeholders in similar nongovernmental systems.

Ultimately, students acquire and learn to develop metacognitive skills through learning opportunities (i.e., metacognitive experiences) inside and outside the classroom. Therefore, the remainder of Part 2 presents illustrative examples of research-based instructional practices to provide teachers with tools for improving students' metacognition. We focus narrowly on metacognitive practices within each phase of the self-regulated learning process: establishing a metacognitive knowledge base, goal-setting and planning, monitoring and control, and self-evaluation and reflection. We also present a promising program, Cognitive Acceleration, to show the strengths and weaknesses of standalone approaches that are isolated from a school's curriculum.

2.2. SYSTEM-LEVEL POLICIES AIMED AT PROMOTING METACOGNITION

Several national governments and international organizations are moving toward, or have already prioritized, the attainment of higher order thinking skills as a key educational outcome for students (Care, Kim, Vista, & Anderson, 2018). A recent synthesis of more than 30 frameworks from around the world found general agreement that meta-learning, or "how we reflect and adapt," is a vital skill for 21st century learning (Horvathova, 2019). Meta-learning includes "metacognition (predicting, monitoring, and evaluating one's learning), as well as internalizing a Growth Mindset about one's capabilities" (Horvathova, 2019, p. 48). Learning how to learn, which is at the core of metacognition, is seen as a critical skill for addressing the growing list of unique and complex challenges that are defining the 21st century.

For example, the goal of OECD's *Future of Education and Skills 2030 Project* is to help policymakers in member nations prepare their educational systems for an uncertain future full of unprecedented social, economic, and environmental challenges (OECD, 2019). OECD encourages member nations to prioritize three types of skills: (a) cognitive and metacognitive skills, (b) social and emotional skills, and (c) practical and physical skills. Metacognitive skills are seen as an increasingly critical competency for individuals who will undoubtedly be challenged to learn new knowledge and skills for jobs that have not been invented yet or for jobs that will be fundamentally altered due to the effects of globalization, climate change, and technological advances (Horvathova, 2019; OECD, 2019). In other words, large governmental systems see metacognition as key to producing lifelong learners equipped with the skills necessary to adapt to an ever-changing world.

Many national systems have long prioritized discrete content knowledge that can be measured by standardized assessments, notably numeracy and literacy proficiency, at the expense of higher order thinking (Care et al., 2018). **Therefore, positioning large-scale systems to promote higher order thinking skills, such as metacognition, is a monumental task that requires teaching and learning to be altered in fundamental ways**. The following sections describes large-scale policy initiatives in Israel, New Zealand, Northern Ireland, and Singapore to show the similarities and differences in policy approaches for 21st century learning and to

highlight lessons learned. We focus on teachers' beliefs and professional learning, curriculum integration, and assessment as key areas that large-scale systems should address when prioritizing higher order thinking skills.

TEACHERS' BELIEFS AND PROFESSIONAL LEARNING

All educators hold a set of beliefs about the nature of knowledge, ways of knowing, and the role of instruction in learning. For example, a teacher who believes students learn best when a person of authority provides them with information is likely to rely on direct instruction and eschew the types of techniques that promote self-regulated learning (Moos & Ringdal, 2012). Even if teachers believe in the concept of self-regulated learning, if they do not have a repertoire of metacognitive knowledge at their disposal, they are unlikely to be able to explicitly teach and model metacognitive techniques for students (Askell-Williams et al., 2012). As school leaders know and research emphasizes, implementing practices that are in conflict with educators' core values and beliefs will most likely be unsuccessful. Shifting values and beliefs is exponentially more challenging when attempting to alter the practices of teachers across an entire country (Zohar, 2013).

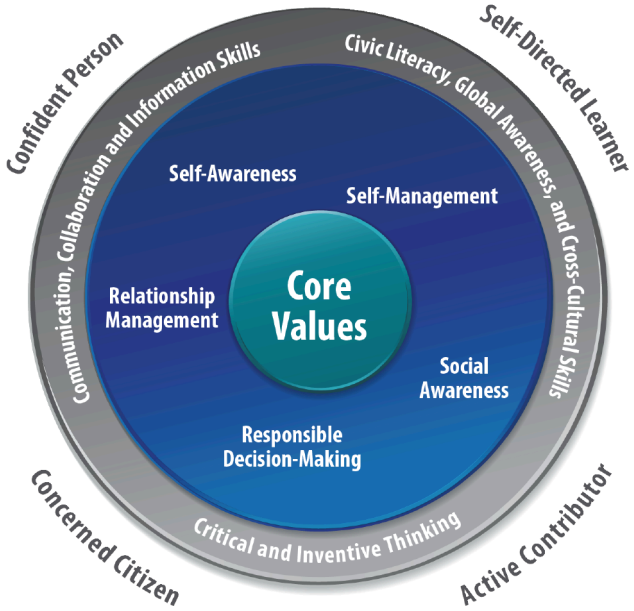


Figure 2: Singapore's Framework for 21st Century Competencies and Student Outcomes
More information can be found at:
https://www.moe.gov.sg/education/education-system/21st-century-competencies

Singapore provides an example of the challenge that arises when teachers' values and beliefs conflict with large-scale policy initiatives. Singapore's 21st Century Competency and Student Outcomes framework (see Figure 2) includes several skills, such as self-awareness, self-management, and critical thinking. In one study, two main cultural challenges were identified specific to teaching critical thinking in Singapore schools: "social expectations of teachers as knowledge transmitters and students as passive learners, coupled with a notion of critical thinking as adversarial" (Tan, 2017, p. 998-999). When critical thinking is interpreted as adversarial it conflicts with the cultural values of collegiality and communality that are prevalent among Asian societies (Tan, 2017). And when teachers are viewed as knowledge transmitters it can conflict with the idea that students should develop a wide

range of metacognitive learning strategies that allow them to self-regulate their learning, independently (Tan, 2017). The case of Singapore shows that in addition to essential training on how educational research has come to understand metacognition and how metacognition develops for students across time, teachers also need resources, training, and support to adapt strategies for metacognitive learning to fit their culturally-informed instructional approach and teaching context.

INTEGRATING METACOGNITION INTO THE CURRICULUM

Gallagher, Hipkins, and Zohar (2012) show that educational systems can position metacognition as a cross-curricular skill; as a process and outcome of learning; or as an overarching, system-wide goal. For example, the various skills that make up Northern Ireland's "Thinking Skills & Personal Capabilities" framework (see Box 4) are positioned as a means to achieve subject-specific outcomes. In other words, these skills are infused within and across different subject-area curricula.

Box 4: Northern Ireland's Thinking Skills and Personal Capabilities.

The following skills aim to develop students' personal and interpersonal skills, capabilities and dispositions, and ability to think both creatively and critically.

- Managing information
- Thinking, problem-solving and decision-making
- Being creative
- Working with others
- Self-management.

More information: http://www.nicurriculum.org.uk/curriculum_microsite/TSPC/what_are_tspc/index.asp

Contrast this approach with that of New Zealand, where key competencies related to metacognition are positioned as both a learning process and key standalone outcomes (see Box 5). New Zealand's approach conveys to educators that thinking skills, such as metacognition, are "the means to other valued learning ends as well as ends in themselves" (Gallagher et al., 2012, p. 137). In Israel, the teaching of thinking skills is the overarching goal of the national "Pedagogical Horizon" policy (see Box 6). Pedagogical Horizons sought to move away from content knowledge attainment to focus on how students learn by integrating thinking strategies into curricula, encouraging inquiry-based learning, and fostering the development of metacognitive knowledge (Zohar, 2013). There are advantages and disadvantages to each of these approaches, but regardless of the approach taken, it is critical that related polices, such as assessment, align and reinforce the focus on metacognition.

Box 5: Key competencies in New Zealand's Curriculum

Key competencies

- Thinking
- Using language, symbols, and texts
- Managing self
- Relating to others
- Participating and contributing

More information: https://parents.education.govt.nz/primary-school/learning-at-school/new-zealand-curriculum/#NZcurriculum

SYSTEM-WIDE ASSESSMENT FOR METACOGNITION

None of countries analyzed by Gallagher et al. (2014) had yet achieved coherence across their systems with respect to promoting higher order thinking, with assessment posing a significant challenge in all three countries. For example, Northern Ireland provided numerous types of resources and support for implementing higher order thinking strategies in the classroom, but its national assessment system did not prioritize these skills. That misalignment forced educators into the difficult position of balancing the pursuit of higher order thinking while also addressing accountability metrics (Gallagher et al., 2014). New Zealand has a strong tradition of school independence and self-sufficiency. Therefore, schools already predisposed to promoting higher order thinking experienced greater success implementing the government's higher order thinking priorities. However, other schools struggled with implementation due to a lack of adequate resources and supports for teachers, and overall success for all schools was hard to measure in the absence of a national testing system (Gallagher et al., 2014). Finally, similar to Northern Ireland, many of the promising initiatives supporting Israel's Pedagogical Horizon were hampered by an assessment system that "generated intensive pressure to 'teach to the test throughout the school system" (Gallagher et al., 2014, p. 140).

Box 6: Israel's "Pedagogical Horizon"

Israel instituted a new national policy referred to as "Pedagogical Horizon" in 2007, which prioritized the teaching of thinking skills as a key goal for all students. Part of rationale for "Pedagogical Horizon" was as follows: "One of the main goals of the education system has been, and still is, for graduates to have extensive knowledge in a variety of academic disciplines. However, our future graduates will not be able to rely on a set, pre-defined body of knowledge that they have acquired at school; rather they will need, higher-order thinking abilities, the ability to make judgments, and the skills for creative and critical thinking, all of which will enable them to attain new knowledge throughout their lives" (Zohar, 2008, p. 78-79).

System-level coherence occurs when policy initiatives, support and capacity-building mechanisms for educators, and accountability and assessment systems are all aligned to one overarching goal (Fullan & Quinn, 2016). In the case of promoting self-regulated learning, leaders in large systems might consider taking a metacognitive approach recognizing that the "route to thinking-rich instruction in all classrooms is neither short nor smooth" (Zohar, 2013, p. 245). System leaders should learn about and experiment with different strategies for altering educators' beliefs, building their capacity, and measuring progress. Ongoing monitoring of the implementation and effectiveness of these various strategies should inform policy innovations that continually enhance system coherence. Finally, routine formative evaluations conducted internally and from independent educational research should be used to develop new strategies and innovations. Systems that clearly exemplify the principles of self-regulation increase their chances of having their schools and teachers equip students with the metacognitive skills necessary for lifelong learning.

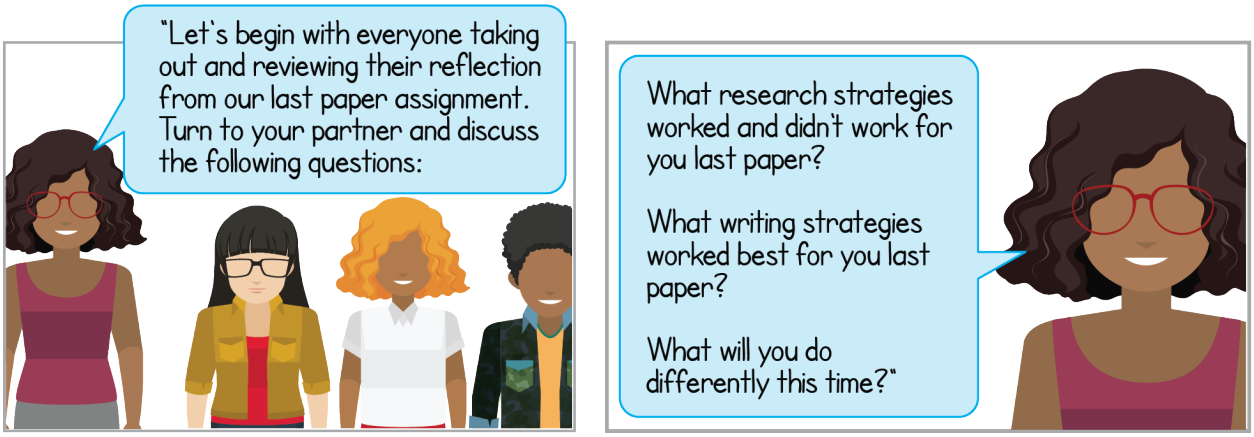
2.3. TEACHING PRACTICES FOR METACOGNITIVE SKILL DEVELOPMENT

Rather than presenting a comprehensive list of instructional practices, this section describes **how metacognition surfaces across parts of the self-regulated learning process: (a) goal-setting and planning, (b) self-monitoring and self-control, and (c) self-evaluation and reflection**. Illustrative examples of core instructional practices are described within each phase of that process. These core instructional practices should look different based on various factors (e.g., age, subject, and cultural background). In other words, adaptation, including cultural adaptation, is expected and necessary for these practices to be implemented effectively. Research shows evidence-based practices often have a better chance of being implemented, sustained, and effective when cultural adaptation occurs in partnership with those implementing and receiving the program (Castro, Barrera, & Martinez, 2004). Finally, before describing these practices within the self-regulated learning process, we begin by describing the importance of developing students' metacognitive knowledge base, a necessary precursor to effective self-regulated learning.

PROMISING PRACTICE 1. DEVELOPING STUDENTS' METACOGNITIVE KNOWLEDGE

Learning context: A teacher assigns upper secondary students a paper assignment on the history of global pandemics in a social studies course. In 10 pages, students are to (a) briefly describe the major global pandemics during the past 150 years, (b) what lessons the world learned from those crises, and (c) how those lessons are or are not informing the response to COVID-19. Students are encouraged to use illustrative examples throughout the paper.

After introducing the paper assignment, the teacher says:



The teacher then calls on three students to explain to their classmates what they learned about themselves and what they will do differently for this paper.

THE SELF-REGULATED STRATEGY DEVELOPMENT MODEL

The Self-Regulated Strategy Development (SRSD) model (Harris & Graham, 1996) has shown promising effects on students' writing ability through development of their metacognitive knowledge base (Rogers & Graham, 2008). Below is a brief description of how the SRSD model was used in the United States to develop Grade 3 students' metacognitive knowledge about writing quality stories.

The primary goal of the SRSD model is to promote students' independent use of learning strategies and self-regulated behavior as it pertains to writing a quality story of the appropriate length with a coherent structure (Tracy, Reid, & Graham, 2009). In the SRSD model, "students learn when, where, and how to apply" learning strategies and teachers scaffold instruction so students own their learning process as soon as possible (Tracy et al., 2009, p. 327). Five different stages of instruction were used to achieve this goal. The first three stages are presented below and focus in part on developing students' metacognitive knowledge.

In the first stage, the teacher introduced students to the necessary background knowledge on specific learning strategies (Tracy et al., 2009). **Students learned two mnemonic devices: POW (i.e., Pick my idea, Organize my notes, Write and say more) for planning their writing and WWW (e.g., Who, When, Where) for remembering the seven parts of stories**. Teachers also introduced students to the common characteristics of a good story and the concept of transfer to explain how these mnemonic devices could be used for other writing tasks. During the first stage, students used both mnemonic devices to develop their own baseline story, collectively worked through a story with their teacher using the WWW strategy, and set a goal to use both strategies in the future. The teacher reviewed these strategies before subsequent classes.

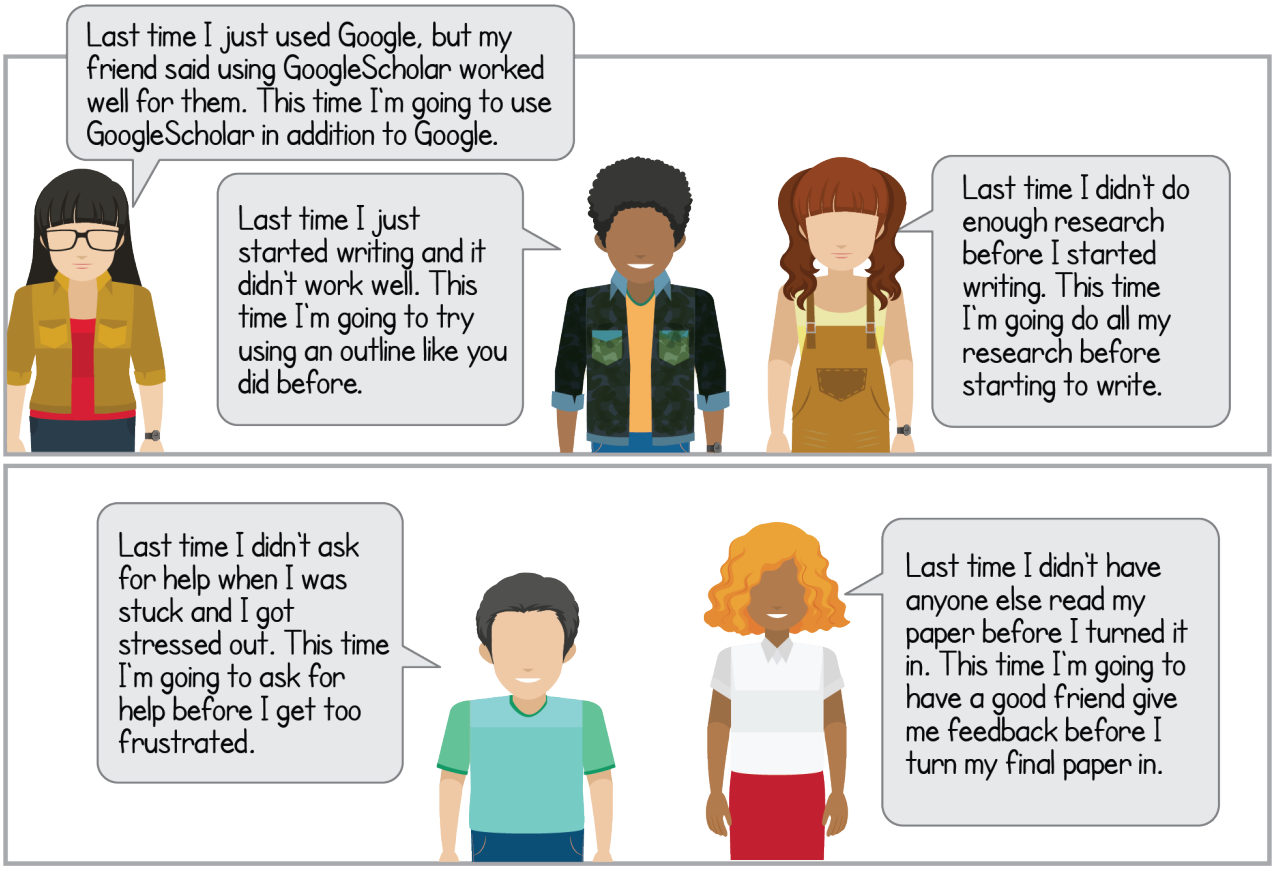
In the second stage, the teacher and students continued to discuss the strategies and introduced self-monitoring tactics (Tracy et al., 2009). To support self-monitoring, the teacher provided students with a rocket ship worksheet where students recorded whether their baseline story covered all seven story parts. In the third stage, the teacher modeled how to write a story using the above learning strategies and describing their thinking aloud. Students also participated in the third stage by helping the teacher develop their story and recording the seven different parts of the story on a worksheet. Finally, **the teacher used questions (e.g., "What comes next?") and "self-statements" (e.g., "I'm almost finished") to model how to be aware and control one's own internal dialogue** (Tracy et al., 2009, p. 328).

This example illustrates one approach to implementing the core instructional practices related to developing primary school students' metacognitive knowledge base. This teacher began with using explicit language to describe the importance of metacognition, focused on a specific set of learning strategies, worked through an example with students, modeled for students, prompted self-awareness and self-encouragement, and promoted

transfer in later instructional stages. This example also demonstrates the importance of effective planning strategies within the self-regulated learning process.

PROMISING PRACTICE 2.
SETTING TASK-SPECIFIC GOALS AND CREATING DETAILED PLANS

Learning context: After asking students to reflect, the teacher asks students to set some individual goals and develop a detailed plan for writing the paper on the history of global pandemics.



Metacognitive knowledge is critical for setting quality goals and developing effective plans. Too often the simple act of setting a goal is considered sufficient (Dent & Koenka, 2015). **In particular, overly broad goals can mask the more proximal steps necessary to complete a task. More detailed, intermediate goals are more useful for planning purposes because they provide more detail on specific aspects of a task** (Dent & Koenka, 2015). With more details available, students can tap into their metacognitive knowledge base and prior metacognitive experiences to plan out and choose the most appropriate learning strategies for each step they encounter. Metacognitive knowledge can help improve learning efficiency when students select effective

learning strategies during the planning process—rather than having to modify their approach later on because they initially chose learning strategies ill-suited for the task.

THE IMPROVE METHOD

Mevarech and Kramarski's (1997) IMPROVE method (Introducing new concepts, Metacognitive questioning, Practicing, Reviewing and reducing difficulties, Obtaining mastery, Verification, and Enrichment) provides an illustrative example of how question prompts can promote detailed planning. The IMPROVE method has consistently demonstrated effectiveness in improving mathematics achievement across several studies (Donker et al., 2014), including those conducted recently (Gidalevich & Kramarski, 2019). The IMPROVE method was developed in Israel to enhance the mathematics abilities of Grade 7 students through small-group collaboration.

The phase of introducing new concepts in the IMPROVE method is akin to building students' metacognitive knowledge whereas the metacognitive questioning phase helps students effectively plan how to approach mathematics problems. **The IMPROVE method uses three distinct types of metacognitive questions: *comprehension, strategic, and connection questions.*** For illustrative purposes, each of these questions is presented in relation to a mathematics lesson on linear graphs (Kramarski & Mevarech, 2003). In this study, teachers provided students with a list of metacognitive questions to use in small groups, and teachers modeled how to use the questions for students (Kramarski & Mevarech, 2003).

Comprehension questions introduce students to the problem and relevant concepts, test their initial knowledge, and identify possible gaps in understanding. Comprehension questions in Kramarski and Mevarech's study included the following: "What does the x-axis represent? What does the y-axis represent? What is the trend of the graph? What are the specific points on the graph?" (p. 286). Students were then provided with an acronym to remember the comprehension questions. **Strategic questions asked students what strategies could be used, why certain strategies could work, and how to use different strategies to solve the problem at hand.** Specific strategies for understanding linear graphs included "adding steps to a graph to calculate the slope, using data tables, and referring to the algebraic representation of the graph" (p. 286). Connection questions prompted students to find problems similar to the current task in order to identify additional strategies that could be employed, such as different types of graphs students already understood.

These three types of metacognitive questions, especially when modeled by teachers, can provide a powerful planning tool for guiding students' work. When students begin a task with a solid understanding of their current knowledge and examples of potential learning strategies that may be helpful, it provides them with the ability to develop specific, proximal goals to complete. For example, imagine students who discovered they did not know how to calculate a slope from a linear graph based on the comprehension questions above. The strategy questions might give them multiple approaches for calculating a slope value, whereas the connection

questions might alert them to a tactic that worked for them in the past, both of which would allow the students to choose which strategy suited them best. Additionally, working through this problem with peers can provide a powerful modeling experience that makes students aware of other strategies that may work. This approach contrasts with traditional direct instruction, where a teacher might show how to complete the linear graph problem using only one strategy. When approached in this manner, teachers are likely to gloss over concepts some students may not yet understand and neglect different strategies that may work better for some students. Providing students with metacognitive planning supports can help alleviate both of these concerns.

PROMISING PRACTICE 3. USING SELF-MONITORING AND SELF-CONTROL TO COURSE CORRECT

Learning context: A parent notices their child exhibiting frustration while working on their paper at home.

Students' metacognitive monitoring and control are at the crux of the self-regulated learning process (Dent & Koenka, 2015). **Self-monitoring alerts students when they have trouble understanding or when a learning strategy seems ineffective.** As Dent and Koenka (2015) argue, "Awareness is not enough. Self-monitoring must

first trigger self-control, whereby students modify their approach to the task based on internal feedback" (p. 432). Effective self-monitoring and self-control can overcome poor goal-setting and planning.

RECIPROCAL TEACHING

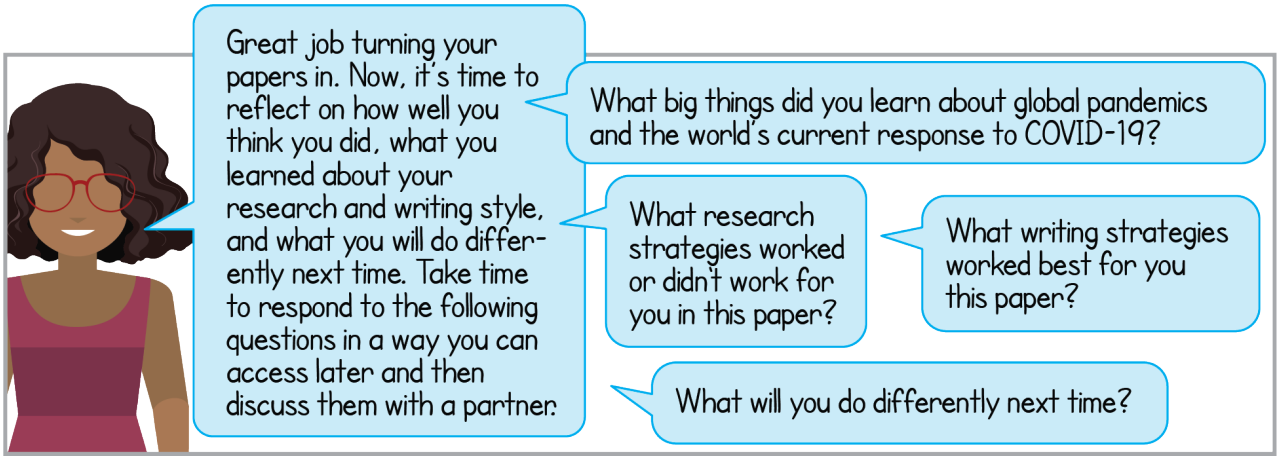
Reciprocal Teaching provides an example of an instructional model designed to improve reading comprehension by improving students' monitoring and control skills (Palincsar & Brown, 1984). The goal of Reciprocal Teaching is to help students become competent readers by equipping them with a battery of learning strategies for identifying and correcting reading miscues. Reciprocal Teaching was identified as one of the top five most effective teaching strategies in Hattie's (2009) meta-analysis of more than 800 studies.

In the traditional gradual-release design, teachers model effective learning strategies, allow students to practice various techniques with guided support, and ensure students have opportunities to learn from their peers (Pratt & Urbanowski, 2015). The goal of teacher modeling is to show students how to recognize when a reader gets stuck and the various strategies to improve comprehension. One helpful modeling strategy for students is the use of *clunks* and *clicks* for young readers to identify when they are stuck, which is called a "clunk", and the "aha moment" when they understand, called a "click" (Pratt & Urbanowski, 2015). Readers can use several strategies to turn clunks into clicks, such as trying to infer what the word means from the rest of the sentence and using in-text pictures as clues (Pratt & Urbanowski, 2015). Guided practice requires students to begin identifying and correcting clunks on their own, with the support of prompting questions from teachers (e.g., "Does that make sense? What made you go back and reread?"; Pratt & Urbanowski, 2015, p. 564). Finally, to provide additional examples, teachers encourage students to model strategies for their peers. Importantly, for Reciprocal Teaching to be effective, teachers must meet students in their zone of proximal development with respect to reading material. This zone represents the area where reading is challenging for students but not so difficult they struggle to learn the material even with guided teacher support (Vygotsky, 1978).

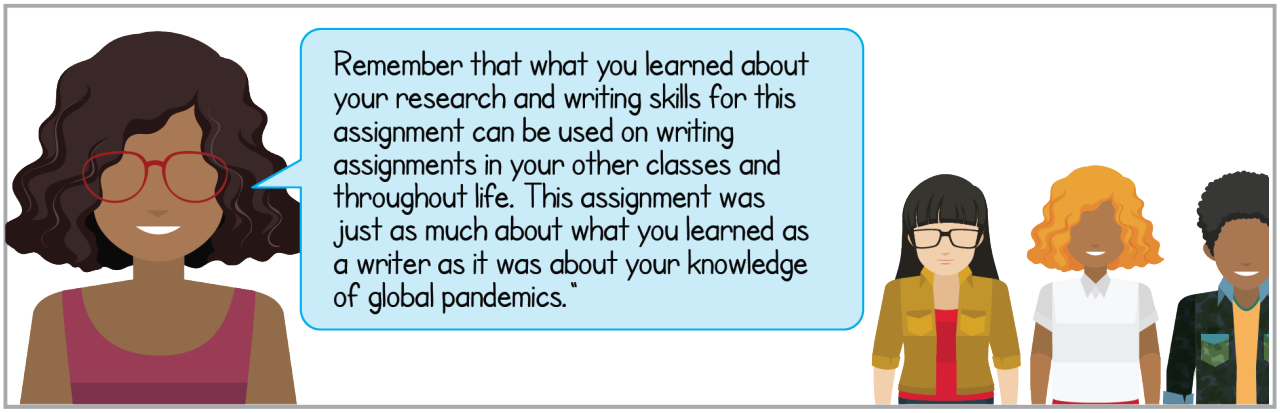
When done well, Reciprocal Teaching (and similar methods), can provide students with the knowledge, tools, and support to begin developing ownership over their learning through effective monitoring and control. Reciprocal Teaching can also promote inclusivity by allowing students to develop strategies and ways of knowing that are responsive to their cultural backgrounds. These different ways of knowing and strategies can be shared among students to promote cultural understanding. Adhering to the core principles of Reciprocal Teaching, however, requires a great deal of patience and trust from teachers, especially when there is a preference to direct rather than facilitate learning (McAllum, 2014). Therefore, efforts to implement Reciprocal Teaching must be attentive to teachers' pedagogical beliefs.

PROMISING PRACTICE 4.
USING SELF-EVALUATION TO SOLIDIFY UNDERSTANDING AND GENERATE FORMATIVE INFORMATION

Learning context: The teacher asks students to reflect on the paper assignment right after they turn the papers in.



The teacher then calls on three students to explain to their classmates what they learned about themselves and what they will do differently.



The goal of self-evaluation involves more than engaging in the act of reflection for its own sake. Rather, the goal is for students to produce formative information they can use to improve their performance on future tasks. Therefore, how valuable self-evaluation and reflection are to individual students is connected to the level of challenge they encounter during a particular task (Dent & Koenka, 2015). **When students encounter little or no difficulty in completing a task, there is little formative information that can be generated to expand their metacognitive knowledge or understanding of learning strategies** (Dent & Koenka, 2015). Although some

students have the capability of storing the lessons they glean from reflection in their memory, other students need tools for documenting their insights.

REFLECTIVE JOURNAL WRITING

Reflective journal writing is one promising approach to recording self-evaluations and improving students' self-regulated learning (Al-Rawahi & Al-Balushi, 2015). **In addition to evaluating their overall performance, reflective journal writing can provide a venue for students to document the effectiveness of their planning process and to record the monitoring and control tactics they employed when faced with difficulties**. However, students are unlikely to use reflective writing for such purposes unless teachers provide a structure that includes explicit metacognitive prompts (Nückles, Hübner, & Renkl, 2009). When done well, reflective writing can explicitly integrate all aspects of self-regulated learning.

Box 7: Al-Rawahi and Al-Balushi's (2015) reflective journal template

Students were asked to respond to the following six sections in their reflective journal.

- The objectives of the lesson (reflecting on the initial goal).
- Their dialogue with peers and their teacher (monitoring their engagement).
- Their scientific observations (monitoring their conceptual understanding).
- Their main conclusions (monitoring their current status relative to the initial goal).
- Their evaluation of what they learned, what they still do not understand, and what they need to work more on (self-monitoring and self-control toward initial goal).
- Their feelings after the lesson (explicit emotional and motivational attitudes).

In a study of 15 year old Omani students, those who used a research-informed reflective journal template for eight weeks in a science course significantly improved their use of self-regulated learning strategies compared to a control group (Al-Rawahi & Al-Balushi, 2015). **The authors recognized reflection may be particularly beneficial in science courses where students are generally not provided with opportunities to personalize their learning.** In an effort to connect learning to the self-regulated learning process, the authors designed a reflective journal template for students to complete after each lesson. The template required students to respond to six sections (see Box 7), each linked to research and the self-regulated learning process.

As Al-Rawahi and Al-Balushi (2015) acknowledge, reflective journal writing is just one mode of self-evaluation and reflection. Student reflections can take many forms, including more open-ended writing, oral presentations, and artistic expressions. In fact, the integration of different artistic processes into learning across content areas has demonstrated positive effects on students self-beliefs, metacognition, and performance related to creativity (Anderson & Haney, in press). The type of reflective practices adopted by teachers should be informed by academic content and course structure as well as individual-level considerations, such as age, language barriers,

and learning and physical disabilities that may make some modes of reflection more accessible and beneficial than others. Moreover, different modalities for reflection will align more strongly with different cultural backgrounds and assets of students.

Notably, self-regulated teaching practices are often designed and implemented in conjunction with one another. That is, although the examples above described distinct practices within each self-regulated learning phase, most models combine planning, monitoring, and evaluating practices (Donker et al., 2014). Moreover, the most effective models also include practices for developing metacognitive knowledge *and* skills (Dignath et al., 2008) and aim to address students' motivation and self-efficacy (Donker et al., 2014). The programmatic example described below represents one promising integrative approach.

2.4. A PROGRAMMATIC APPROACH TO ENHANCING METACOGNITION: THE COGNITIVE ACCELERATION PROGRAM

Research suggests the most effective approach to improving students' metacognitive abilities is to embed the practices described in the previous section into existing curriculum (Veenman & Beishuizen, 2004). However, in this section **we provide an example of a well-known standalone program—Cognitive Acceleration—to illustrate the type of learning environment conducive to metacognition and the pedagogical and practical challenges of creating such an environment**. The wide-scale adoption of Cognitive Acceleration models across the world also shows how cultural adaptation is necessary for metacognitive instructional practices to be implemented effectively and sustained across time.

Cognitive Acceleration was developed at King's College in London during the 1980s (Adey, 1999). The original program, referred to as Cognitive Acceleration through Science Education, was designed as a science intervention for improving thinking and reasoning ability of students 11 to 14 years of age (Adey, 1999). Now commercially available as "Let's Think" (https://www.letsthink.org.uk/), the original Cognitive Acceleration program included more than 30 lessons designed to be taught *separately* from the general science curriculum across two academic years (Adey, 1999). Lessons assumed a hierarchical order and were intended to build on each other (McCormack, Finlayson, & McClouglin, 2014). The professional development recommended for the program requires a dozen days of trainings across the two years of program implementation.

The Cognitive Acceleration program is grounded in the work of psychologist Jean Piaget, who argued students need the ability to consistently hold several pieces of information and ways of thinking in their mind at once to be effective scientific learners (Adey, 1999). Cognitive Acceleration was built on the premise that students largely do have this capability in the early years of adolescence (Adey, 1999). To "accelerate" students' natural cognitive development, the creators of Cognitive Acceleration designed a program around five core pillars (see Box 8).

The Cognitive Acceleration approach is not a completely linear or sequential process, especially as it relates to metacognition, which is ultimately at the crux of the program (Adey, 1999). The metacognitive aspect of Cognitive Acceleration closely resembles the monitoring and control as well as the self-evaluation phases of the self-regulated learning process. The concrete preparation pillar focuses on establishing the necessary metacognitive knowledge base before proceeding with problem-solving. Cognitive Acceleration also adheres to the other core instructional practices of using prompting questions and modeling (done by peers in this case). Finally, another major theoretical tenet of Cognitive Acceleration is ensuring the problem, or cognitive conflict, students are attempting to solve resides within Vygotsky's (1978) zone of proximal development.

Box 8: The five pillars of Cognitive Acceleration

Students were asked to respond to the following six sections in their reflective journal.

- **Concrete Preparation**: Teachers describe the nature of the task, define related concepts for students, and present the strategies used to complete the task.
- **Cognitive Conflict**: Teachers present a problem that challenges students' current understanding and requires them to consider different possibilities.
- **Social Construction**: Teachers facilitate students' working to resolve the cognitive conflict with the use of prompting questions and scaffolded support.
- **Metacognition**: Teachers create space for students to gain awareness of their thinking, how they approached the problem, and what they learned.
- **Bridging**: Teachers help students explore ways to transfer what they have learned to new and related tasks or to real-world problems.

The Cognitive Acceleration program demonstrated effectiveness in early studies for improving cognitive development in the short-term and academic achievement more distally—a result that has been replicated across time, subjects, and geography (Oliver & Venville, 2016). For example, Cognitive Acceleration programs have demonstrated effectiveness in improving mathematics achievement and motivation in Tonga (Finau, Treagust, Won, & Chandrasegaran, 2015), scientific reasoning in Malawi (Mbano, 2003), science achievement in Pakistan (Iqbal & Shayer, 2000), cognitive development in Australia (Oliver, Venville, & Adey, 2012), and science reasoning ability in Ireland (McCormack et al., 2014)

McCormack et al.'s (2014) study on the implementation of Cognitive Acceleration across six secondary schools and 11 associated feeder primary schools in Ireland demonstrates **the level of cultural adaptation that can be required to align teaching and learning to the core components of metacognitive instruction**. Adaptations to evidence-based practices, such as Cognitive Acceleration, should address three areas: (a) best available research evidence, (b) the needs and characteristics of the population receiving the intervention, and (c) the expertise and experience of the practitioners responsible for implementation (Satterfield et al., 2009). In McCormack and colleagues' study, implementation adhered to the core components of Cognitive Acceleration

while also making several necessary modifications. Below are a few of the key contextual considerations that informed adaptations to the program.

- Science courses were relatively new in primary schools whereas secondary schools had a well-established, government-mandated science curriculum.
- The types of learning opportunities and teaching methods students experienced differed significantly as they moved from primary to secondary school.
- Primary teachers were generalists while secondary teachers operated as specialists.
- Only 4% of secondary schools in Ireland employed laboratory technicians.

The researchers responsible for implementation made several adaptations to the design of the Cognitive Acceleration program in light of these and several other contextual considerations (McCormack et al., 2014). For example, because primary school teachers operated as science generalists rather than specialists, the researchers added informational and explanatory content to their training materials. Primary school teachers also received additional content knowledge training during in-person professional development sessions. Because time was more limited and a mandated curriculum already existed, the main adaptations in secondary settings required integrating Cognitive Acceleration lessons into the existing curriculum and scaling back the activities specific to transfer (e.g., Bridging). From a practical standpoint, very few secondary schools employed laboratory technicians, as compared to the UK where the program originated, so researchers provided secondary teachers with all of the lab materials necessary to complete each lesson. Finally, teachers were provided with flexible options for receiving training and a core group of teachers worked with the researchers to adapt materials as issues arose (McCormack et al., 2014).

The contextual considerations and adaptations described above, which represent only a fraction of the changes made by McCormack and colleagues (2014), are meant to demonstrate the type of sustained effort necessary to implement Cognitive Acceleration or a suite of similar metacognitive instructional practices. Researchers, in close collaboration with the teachers implementing the program, made modifications that touched on several aspects of the learning environment, not just the content taught during lessons. The overall policy context in Ireland also resulted in different types of program design changes at the primary and secondary levels. The adaptations, however, focused primarily on policy, logistical, and practical considerations. As implementation of Singapore's 21st Century Competency and Student Outcomes framework demonstrates (see Section 2.2), adaptations that also take into consideration cultural norms and practices that may conflict with the Cognitive Acceleration's aims and programmatic design are equally important.

2.5 CONCLUSION

As described, there are several promising approaches for improving students' metacognitive abilities. Teachers can experiment with multiple instructional strategies and reflective practices during each phase of the self-regulated learning process. Teachers can model the same kind strategy selection and testing process that students must employ. Teachers can adhere to the core practices of using explicit metacognitive language, asking probing questions, providing specific examples, modeling, and prompting transfer. Lessons from implementation of the Cognitive Acceleration program demonstrate the need for schools to carefully adapt metacognitive practices to each context. At the system level, school leaders should pursue organizational coherence to support metacognitive development by aligning curriculum, assessment, and professional learning to self-regulated learning and metacognition.

PART 3.
RECOMMENDATIONS FOR IB STAKEHOLDERS

IB programmes have been identified as models for improving students' metacognitive abilities (Conley, 2014; Li, 2012). This recognition comes as no surprise given several key aspects of all IB programmes explicitly identify metacognitive skills as specific aims. For example, IB's approaches to learning aim to "empower IB students of all ages to become self-regulated learners who know how to ask good questions, set effective goals, pursue their aspirations and have the determination to achieve them" (IBO, 2017, p. 7). Closely resembling self-regulated learning, IB's approaches to teaching involve a "cycle of inquiry, action, and reflection—an interplay of asking, doing, and thinking" (IBO, 2017, p. 6). As another example, *The Programme Standards and Practices* for all IB programmes provides guidance to IB schools on creating learning environments that support self-regulated learning and metacognition (IBO, 2014). The recommendations below are meant to strengthen and reinforce IB's potential for producing metacognitive-oriented students who become lifelong learners. Our recommendations are based on the literature presented in this paper, lessons learned from promising approaches to improving metacognition, and a review of key IB documents.

3.1. RECOMMENDATIONS FOR IB – AS A LEADING INTERNATIONAL CURRICULUM AND ASSESSEMENT DESIGN ORGANIZATION

As mentioned above, metacognition already has a visible presence in IB programmes. Below are two recommendations, one focused at the system level, and another that targets a key area where IB specifically addresses metacognition.

RECOMMENDATION 1: MAKE METACOGNITION EXPLICIT

Metacognition by its very nature is abstract and often occurs unconscious to the learner. For example, when students use metacognition to adopt, adapt, and refine learning strategies they are generally unaware they are doing so. That is why making metacognition explicit in teaching and learning is so important. When students are aware of what metacognition is and how it operates, they are more likely to develop the skills necessary to develop lifelong ownership of their learning (Conley, 2014). The Theory of Knowledge (TOK) course is one example of an explicit metacognitive experience for IB Diploma Programme students. The TOK course requires students to reflect on their own knowledge, articulate how they know what they think they know, and develop strategies for acquiring knowledge.

There are several other avenues to making metacognition explicit in IB. First, because one of IB's aims is to develop students' self-regulated learning skills, **metacognition should be well defined in curriculum standards, targeted in assessment, and a consistent aspect of IB's system of professional learning**. School leaders, teachers, students, and parents should be able to recognize the role of metacognition in developing internationally-minded students, have resources and training on how to use metacognition, and understand how metacognition is measured in classroom and summative assessments. Simultaneous audits of IB's curriculum, assessment, and professional learning systems for alignment and coverage of metacognition can have the added benefit of improving system coherence. For example, the principles and practices for the Diploma Programme and Middle Years Programme both explicitly reference metacognition, but position it slightly different within approaches to teaching and learning. The Middle Years Programme aligns metacognition closely with reflection whereas the Diploma Years Programme positions metacognition more broadly as an overarching thinking skill. Describing and positioning metacognition within teaching and learning consistently across IB systems and programmes can help ensure IB teachers provide students with continual access to similar metacognitive experiences.

RECOMMENDATION 2: ENSURE STUDENTS USE THEIR REFLECTIONS

Reflection is an attribute on the IB Learner Profile that asks students to consistently reflect on their strengths and weaknesses as learners and thoughtfully consider the world around them (IBO, 2013). Research on the IB Diploma Programme in the U.S. and Canada shows that IB school leaders and teachers often described reflection in metacognitive terms as a critical process for improving academic growth (Stillisano et al., 2016). However, in interviews some educators described reflection as a simple review of past events (Stillisano et al., 2016). The main modes of reflection observed across the IB schools included in the study were peer-to-peer reflection, class discussion, critical writing, and self-evaluations of performance (Stillisano et al., 2016). Below are recommendations that build on the Stillisano and colleagues' study by situating reflection within the self-regulated learning process and ensuring accessibility to reflective opportunities.

Self-evaluations and reflections are most useful when the formative information generated is used to make goal-setting, planning, and monitoring strategies more effective. Therefore, reflection within the IB programme should be explicitly connected to the other phases of the self-regulated learning process. Students are more likely to improve their future performance when they reflect on the usefulness of their initial goal, how well they planned, and how well different learning strategies worked for them (Al-Rawahi & Al-Balushi, 2015). Students should also be provided with opportunities to reflect using **different modes of expression that align to their unique assets and cultural background**, including oral presentations and artistic expression, such as in storytelling, dance, theater, the visual arts, or music and sound. In addition to the other aspects of

metacognition, reflection plays a role in how students make sense of and meaning from what they learn. That meaning-making process is personal, social, and cultural, so reflection in different modalities can be key to culturally responsive and sustaining practices (Anderson, 2018). Finally, young students may lack the vocabulary necessary to adequately reflect and, consequently, need explicit modeling from teachers and guided support. Similarly, following Universal Design for Learning policies, teachers should be attentive to language barriers and learning and physical disabilities to ensure they design reflective opportunities that all students can access and from which all students can benefit.

3.2. RECOMMENDATIONS FOR IB SCHOOL LEADERS AND TEACHERS

This section describes four recommendations to school leaders and teachers that all share a common goal: To ensure students are provided with consistent opportunities to improve their metacognitive knowledge and skills. Achieving this goal requires addressing the learning environment, ensuring what is taught is measured, evaluating teachers' beliefs and capacity to teach metacognition, and improving overall system coherency.

RECOMMENDATION 3: CREATE LEARNING ENVIRONMENTS THAT FOSTER METACOGNITION

IB's programme standards and practices specific to teaching and learning strongly align with self-regulated learning and metacognition (IBO, 2014). These teaching and learning standards focus on creating learning environments that build students' metacognitive knowledge (Standard C3.3), present students with a range of learning strategies (Standard C3.9), and provide students with opportunities for reflection (Standard C3.13). When implemented effectively, these standards, along with the other 13 standards for teaching and learning, are well aligned with research on learning environments that enhance metacognition.

We recommend that schools and teachers consider two additional principles that will ensure the entirety of the self-regulated learning process and student motivation are addressed. First, teachers should ensure students are presented with consistent opportunities to set and plan long-term and proximal goals for their learning that are personally meaningful (Dent & Koenka, 2015). With this additional principle, teachers can draw connections between students' prior knowledge base, their use of learning strategies, and their performance on specific tasks to make metacognition explicit to students. Second, emphasizing student choice and personal relevance can improve students' engagement and motivation (Perry et al., 2008). Allowing students to make some choices on what they learn, how they learn, and what they know, can foster ownership of learning and provide students with the confidence to express themselves individually and culturally.

RECOMMENDATION 4:
MEASURE METACOGNITIVE KNOWLEDGE AND STRATEGY USE REGULARLY

Teachers need access to information on students' metacognitive knowledge and their understanding of various learning strategies to create flexible learning environments in which all learners can thrive. Schools and teachers also need methods for measuring metacognitive skill development. Researchers have created several self-report surveys for such purposes (Gascoine et al., 2017). These measures range from integrative student surveys that focus on metacognition and related concepts, such as motivation (e.g., Motivated Strategies for Learning Questionnaire), to others that focus exclusively on metacognition (e.g., Metacognitive Awareness Inventory and the Junior Metacognitive Awareness Inventory). Teachers can also use classroom-based self-reflections to measure metacognitive knowledge and skills (Anderson & Haney, in press) and informally ask students to describe their thinking aloud to quickly gauge students' metacognitive abilities. Schools should take a holistic approach that includes occasional schoolwide administrations of self-report scales, ongoing classroom-based formative measures, and informal teacher observations. Holistic use of multiple measures can lead to the development of a well-rounded, nuanced evaluation of students' metacognitive abilities and to more effective planning by teachers and school leaders.

RECOMMENDATION 5:
EVALUATE TEACHERS' BELIEFS AND PROVIDE NEEDED SUPPORT

Even the most well designed programs will experience significant challenges if implementation conflicts with teachers' core values and beliefs. If teachers believe students are incapable of regulating their own learning or teachers themselves struggle to regulate their learning, they are unlikely to create learning environments that promote metacognition (Moos & Ringdal, 2012). School leaders should use prior knowledge, teacher interviews, and classroom assessments to evaluate whether teachers' beliefs and actions lead to student-centered learning environments where students are given the support, guidance, and autonomy to own their learning process. Even teachers who fundamentally believe students can and should self-regulate their own learning may lack the necessary instructional resources and support for changing their behavior and instruction. There are numerous potential resources that can support students' metacognitive growth. Below are three types of resources:

- Developmental frameworks that describe the progression of students' metacognition.
- Models for tapping into and leveraging students' prior knowledge and cultural assets.
- Practical examples for how to model metacognitive practices for students.

First, this research brief did not uncover any specific framework that describes in detail the developmental progression of metacognition, others exist that focus on the metacognitive aspects of different skills. For example, the *Essential Skills and Disposition Framework* includes developmental trajectories for collaboration,

communication, creativity, and self-directed learning from beginner to emerging expert levels with a focus on the metacognitive aspects of each skill (Lench, Fukuda, & Anderson, 2015). Second, a strength of metacognitive learning is that teachers can provide guided support for students to identify personal and cultural knowledge that can enhance their learning. One particularly useful model for tapping into students' cultural assets is referred to as *funds of knowledge* (Moll, Amanti, Neff, & Gonzalez, 1992). Students' funds of knowledge include the range of prior knowledge from their home and cultural backgrounds that enhance personal relevance. For example, students who are emergent bilingual have unique linguistic assets that, if leveraged by teachers, can improve reading comprehension (Kolić-Vehovec & Bajšanski, 2006). Finally, teachers need access to practical examples to show ways to implement metacognitive instructional practices in the classroom. Similar to students, modeling of metacognitive behavior is beneficial for teachers.

RECOMMENDATION 6: ALIGN CURRICULUM, ASSESSMENT, AND PROFESSIONAL LEARNING

Perhaps the most important lesson learned from system-level policies aimed at promoting metacognition is that curriculum, assessment, and professional learning must all be coherent and aligned. School leaders are well positioned to ensure these core components of teaching and learning are aligned to IB's principles and practices while also balancing the external demands placed on them by national and regional governments, local education agencies, parents, and the general public. IB may be one of many competing priorities for school leaders. Because of this, as the research on science education in Ireland showed, the type of teaching and learning environment a student experiences can often differ significantly from one classroom, grade, or school to the next (McCormack et al., 2014). School leaders must ensure that all students are provided with metacognitive instruction from all their teachers and consistent metacognitive experiences across classrooms.

3.3. RECOMMENDATIONS FOR IB PARENTS AND STUDENTS

Section 1.3 presented six types of parenting behaviors that will improve students' metacognitive skills (Pino-Pasternak & Whitebread, 2010). Below we recommend adding one type of behavior that draws on the evidence-based instructional practices.

RECOMMENDATION 7: PARENTS CAN MODEL METACOGNITIVE THINKING AND BEHAVIOR

All the promising teaching practices presented in Part 2 had one commonality; teachers modeled metacognitive thinking and behavior, especially for younger children, to provide students with an explicit example that could be adapted to their individual strengths. Because so much of learning occurs informally, often inside the home,

parents have an important role in modeling metacognitive thinking and behavior for students (Gonzalez-DeHass & Willems, 2016). When metacognitive behavior taught in school is reinforced at home, it sends a signal to students that they are expected to take ownership over their learning wherever they are. IB can facilitate greater connection between the learning environments students experience at home and in school by providing parents with guidance on behaviors, such as modeling, that improve students' metacognitively abilities.

RECOMMENDATION 8: ALL STUDENTS CAN OWN THEIR LEARNING

A deep base of metacognitive knowledge and strong metacognitive skills provide students with the necessary tools for effectively regulating and owning their learning. When developed over time and practiced consistently, metacognitive learners become skilled at setting challenging but achievable goals, planning what strategies to use and when to use them, recognizing when things are not going well and course correcting, and using reflection to improve their future learning experiences and make meaning from what they learn. The promising practices presented in this policy paper, although directed to teachers, can be adapted and used by students to improve their metacognitive skills for goal-setting, planning, monitoring, and reflection. Students who exhibit strong ownership of their learning also know to seek help when they are struggling with a task. Seeking help is not a sign of failure. Instead, seeking help can introduce students to new learning strategies and avoid unnecessary frustration and stress. Finally, all students, regardless of how well they currently use metacognition, should have the confidence to know that with continued practice and support from teachers, peers, and parents they will develop metacognitive knowledge and skills that allow them to become effective lifelong learners.

3.4. CONCLUSIONS

In closing, promoting metacognition is less about finding the perfect policy, practice, or program and more about creating a culture of teaching and learning that produces thoughtful and reflective students who are prepared and motivated to engage in independent, lifelong learning. The insights from research and the lessons learned from the promising approaches provided herein are meant to help teachers and school leaders take small steps toward creating cultures and learning environments that support metacognition.

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APPENDIX: A NOTE ON METHODOLOGY

The purpose of this policy paper is to provide a brief, broad overview of metacognition in primary and secondary education; present promising policies, programs, and practices; and to recommend ways for IB stakeholders to improve students' metacognitive abilities. As such, our literature review was not designed to be fully systematic in nature or to be the definitive account of any of the individual topics addressed in the policy paper. Each of the topics covered in this policy paper represents a specific area of research within the broad, multidisciplinary field of metacognition in education. Our goal was to provide a high-level overview of the field, with a focus on providing practical insights and practices that a variety of IB stakeholders can begin implementing in their daily work educating children.

We conducted a mixed methods literature review to collect research from academic databases and popular, practitioner-oriented sources (e.g., journals, magazines, websites; Grant & Booth, 2009). We began our literature review process by generating an initial definition of metacognition. We then employed that definition to develop search terms and parameters for searches in two academic databases: PsychNet and ProQuest's Education Collection. To keep the literature review manageable, we employed only two search terms: (a) metacogniti* AND "learn* strateg*" AND "self-regulat* and (b) metacogniti* AND meta-analy*. We limited our search for articles from 2000-2020 to again keep our search manageable and also to focus on the most recent and relevant literature.

The initial search produced 609 unique articles. From that initial pool, we excluded articles that were not grounded in primary or secondary education, studies that were completed in clinical settings, and those focused too narrowly on specific academic subjects or topics. That resulted in a secondary pool of 125 inclusions. From that pool, we further narrowed down to a core group of 28 articles that served as the starting point for framing the paper. We selected this core group of articles to ensure adequate coverage of the pre-determined paper sections created in collaboration with our IB Research Manager.

The remaining articles used in this review come from four sources: (a) references connected to the initial pool of 28 articles; (b) additional, targeted searches to reach full coverage across the different paper sections; (c) article recommendations from our IB Research Manager and the initial resources selected by IB as necessary context for the policy papers project; and (d) personal knowledge. First, we used a targeted snowball method (Wohlin, 2014) to identify relevant literature connected to the core pool of 28 articles. We looked backward by examining the original article's reference section, as well as forward by using GoogleScholar to identify what new articles cited the original article. This allowed us to identify important seminal articles, which is why some articles cited in the

policy paper were published before 2000. Second, we conducted targeted searches to fill gaps not covered by the core literature pool. For example, our initial search did not produce much research specific to the role of parents in promoting metacognition. Therefore, a separate, targeted search in the aforementioned databases and on GoogleScholar was used to identify the most relevant literature, focusing on literature reviews and meta-analyses. Also, in most cases, the literature used to frame Part 2 of this policy paper came from the core pool of 28 articles. Nearly all of the promising instructional practices presented in Section 1.3 were identified in the studies cited in meta-analyses presented in Part 1 or a core article. However, most of the necessary supporting literature was collected through secondary, targeted searches. We also reviewed relevant articles recommended for inclusion by our IB Research Manager, those that served as the impetus for the policy paper project, and those that provided necessary context on IB programmes. These articles were instrumental in framing the recommendations for IB stakeholders. Finally, we used our personal knowledge to include articles that provided needed contextual information, such as the description of cultural adaptation in Part 2.

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