METACOGNITION IN HIGHER EDUCATION

An Overview of Key Concepts and Metacognitive Instruction

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Abstract

This report examines the nature of metacognition and its role in supporting students' academic development. It begins by depicting the overall effect of metacognition on college students' learning through examining some meta-analyses, systematic reviews, and empirical studies of metacognitive supportive practices in higher education classrooms. Next, the report outlines three mechanisms in explaining how metacognitive knowledge, the regulation of cognition, and metacognitive experiences support learning. Research reviews suggest that metacognitive instruction can support student learning across disciplines, especially when it is explicitly taught and embedded in course tasks. At the same time, differences in study design, measurement, and instructional context mean that its effects vary, and findings should be interpreted with caution rather than as universally applicable.

Further, the report connected the findings from the reviews to the pedagogical recommendations for DKU faculty and other intellectual communities by identifying key principles of effective metacognitive instruction, including the importance of giving explicit instruction, emphasizing regulation, providing resources, promoting collaboration, and offering flexible support. Practical classroom strategies, such as structured reflection, peer collaboration, and ongoing dialogue, are presented as ways to cultivate metacognitive skills and empower students to take control of their learning. In light of the opportunities and challenges posed by GenAI, this report also synthesizes findings from recent reviews and studies on its impact on learners' metacognition, ensuring that the pedagogical recommendations remain aligned with current teaching and learning conditions in higher education.

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INTRODUCTION

Have you encountered students who seem unaware of which strategies help them learn best, or why they're using certain approaches? Are your students revising their work without checking whether their methods are actually working? Did you recall the moment when students showed an overly positive or negative self-evaluation of themselves? The answer to these questions is metacognition. Coined by Flavell in the 1970s, metacognition is broadly understood as "thinking about thinking", and it refers to the knowledge that learners construct and the ability they develop to regulate their learning to achieve their goals. Over the past five decades, the exploration of metacognition has been at the center of educational research. Identified as the key variable that matters to students' learning, metacognition is one of the key variables that is strongly associated with individual students themselves. In Wang et al.'s (1990) meta-review of variables related to learning, metacognition has been widely recognized and cited as the core factor of learning, cited by educators and scholars in varied fields. Metacognition is not simply an abstract concept, but a central mechanism that shapes how students understand themselves as learners and how effectively they engage in the learning process.

Research has evidenced that metacognition is closely associated with the effectiveness of learning, and its development is crucial for enhancing learning abilities. Unlike the role of cognition in learning, metacognition requires learners to reflect on their strengths and weaknesses in past learning experiences, understand the affordances and constraints of tasks, and be aware of the strategies that can aid their learning. Cultivating metacognition fosters the thinking process of identifying the gap between their learning and the expectations set for them, which further supports them in understanding how learning works. Therefore, metacognition empowers learners to make sense of their own learning, supports them in understanding assessment and feedback effectively, and facilitates the transfer of knowledge that directs future learning.

However, how confidently can educators who work closely with college students say that metacognition truly matters for learning? Although numerous empirical studies across disciplines have examined metacognition, questions remain about how rigorous and robust this evidence is in demonstrating its effectiveness for student learning. Besides, due to the varied scholarly definitions of what metacognition entails, some scholars have also pointed out that metacognition is a “fuzzy” concept (Scott & Levy, 2013), highlighting the distinctions and nuances in understanding the nature of its components to understand how metacognitive mechanisms support learning. This also connects to the learning and teaching associated with metacognition, directly influencing educators to understand metacognition and design pedagogical interventions around it within and beyond the classroom context. Building on the foundational understanding of metacognitive knowledge and the regulation of cognition, this report will center on discussing the overall effectiveness of metacognition and the mechanisms that matter to the interpretation of its effectiveness in enhancing learning and pedagogical innovation.

Following that, the report reviews existing research on metacognitive instruction in higher education, emphasizing the need for intentional scaffolding and teacher facilitation to activate and develop metacognitive awareness. A synthesis of key principles from recent scholarly reviews then outlines shared features of effective instructional strategies, offering practical insights into implementation. Finally, the report concludes with a curated list of classroom activities that align with these principles, providing educators with concrete examples of how to integrate metacognitive practices into their teaching in meaningful and context-sensitive ways in the era of GenAI.

Overall Effect on Student Learning Outcomes

Building on evidence from recent meta-analysis and systematic review of metacognitive practices in higher education (Dannis & Somerville, 2023), in science education (Antonio & Prudente, 2022), and language learning and teaching (Wongdaeng & Higgins, 2023), research consistently suggests that metacognitive instruction has a generally positive but context-dependent impact on student learning outcomes. Across disciplines, metacognitive practices are most reliably associated with improvements in students' metacognitive awareness, self-regulation, and strategic engagement with learning tasks, while effects on academic performance (e.g., grades or task scores) tend to be more modest and variable. Rather than functioning as a direct determinant of achievement, metacognition appears to operate as a supportive learning resource that enhances students' ability to plan, monitor, and evaluate their learning, thereby indirectly contributing to performance gains over time. Importantly, the magnitude and nature of these effects depend on factors such as instructional design, the degree of explicit scaffolding, disciplinary context, and opportunities for sustained practice. Overall, the evidence from the reviews and studies mentioned above indicates that metacognitive instruction is not a universal solution for improving learning outcomes, but it represents a robust and pedagogically meaningful lever for fostering students' long-term learning capacity and adaptability across higher education contexts.

Research on metacognition in education generally falls into two broad strands. One strand consists of descriptive studies that examine learner-level variables to better understand the nature and role of metacognition, while the other focuses on intervention studies that investigate instructional practices designed to foster students' metacognitive development. Across both strands, academic performance is commonly used as a key outcome variable, typically operationalized through task-based performance measures, course-level assessments, or broader indicators such as grade point average (GPA).

Based on the findings from Dannis and Somerville's (2023) review, descriptive studies consistently indicate a statistically significant, though modest, relationship between metacognition and academic performance. Correlation coefficients reported across studies tend to fall within a small range (approximately $r = .15–.20$) (Vrugt & Oort, 2008; Cooper & Sandi-Urena, 2009; Muis et al., 2011), suggesting that while metacognition alone does not strongly predict academic success, it plays a meaningful contributory role in students' learning outcomes. This pattern is further supported by meta-analytic evidence. The findings in Richardson et al.'s (2012) large-scale meta-analysis suggest that demographic and psychosocial predictors of undergraduate academic performance showed a small but significant association between metacognition and GPA (average-weighted correlation $r+ = .18$). This indicates that the factor of metacognition is comparable to that of other well-established predictors in higher education, such as socioeconomic background and intrinsic academic motivation. Taken together, these findings suggest that metacognition should not be understood as a singular or dominant determinant of academic achievement. Rather, its significance lies in its consistent association with learning outcomes and, importantly, in its malleability. Unlike many structural or dispositional factors, metacognitive ability has been shown in intervention research to be responsive to instructional support, making it a particularly relevant target for pedagogical design in higher education.

Another meta-analysis conducted by Antonio and Prudente (2022), synthesizing data from 10 quasi-experimental studies (total sample = 1,079 students) conducted between 2013 and 2018, examines the effectiveness of metacognitive instruction on students' science learning achievement, finding an overall effect size of 0.808—indicating a significantly large and positive impact. This meta-analysis shows metacognitive instruction as an effective pedagogy in science education; while moderator analysis reveals significant differences in effect sizes across students' education levels (largest at the elementary level with ES=1.049, followed by secondary with ES=0.649 and tertiary with ES=0.399, though the latter is based on only one study) and scientific disciplines (larger in Physical Science with ES=0.833 than in Biological Science with ES=0.707, with no studies on Earth Science), the instruction proves effective across all tested levels and disciplines, with common strategies including ICT integration (Information and Communication Technology integration) (40%), metacognitive prompts (40%), student-led discussions (20%), concept mapping (20%), metacognitive writing (10%), and practice/training (10%)—some studies combining multiple strategies yielding larger effects—though the research has limitations such as a small number of included studies and unanalyzed variables like intervention duration and student backgrounds.

Wongdaeng and Higgins (2023) conducted systematic review and meta-analysis of 29 relevant studies on metacognitive interventions in tertiary EFL contexts reveal that such instruction holds substantial potential for improving EFL learners' language performance, with an overall average effect size of 1.33 indicating a large and positive impact of metacognitive interventions, where 28 out of 32 reported effects exceeded 0.4—considered desirable in education. Positive outcomes were observed across various language skills including reading, listening, writing, speaking, and vocabulary, with key contributing factors being explicit instruction, clear pedagogical sequencing, a focus on metacognitive regulation (planning, monitoring, evaluating) rather than merely metacognitive knowledge, provision of supportive materials (e.g., handouts, portfolios), collaborative learning environments, teacher support, and opportunities for self-paced practice. However, the overall effectiveness cannot be definitively confirmed due to significant limitations: high heterogeneity among studies ($I^2 = 94.85\%$), likely inflated results from very small sample sizes in most studies, and evidence of publication bias. Additionally, a few studies reported no effects, attributed to factors like online learning with limited student interaction or process-based instruction in control groups similar to the intervention.

Confidence in the Evidence Base

Taken together, the meta-analytic and systematic review evidence suggests that metacognitive instruction is a promising and effective pedagogical approach across a range of disciplines and educational contexts. However, the strength of the conclusions that can be drawn from this literature depends critically on how the underlying evidence is produced and interpreted. While many studies report moderate to large effect sizes, particularly in intervention research, these findings must be contextualized within the methodological characteristics and limitations of education research more broadly.

One important consideration is the diversity of research designs and outcome measures used to examine metacognition. Descriptive studies often rely on correlational analyses linking students' self-reported metacognitive awareness to academic performance indicators such as course grades or GPA. As reflected in multiple meta-analyses, these relationships are statistically significant but modest in magnitude, indicating that metacognition is one of many interacting factors that contribute to learning outcomes rather than a singular determinant of success. Intervention studies, by contrast, tend to report larger effects, particularly when metacognitive instruction is explicitly scaffolded and integrated into disciplinary learning tasks. However, these effects are often observed in short-term, context-specific instructional settings, limiting the extent to which findings can be generalized across courses, institutions, or student populations.

Another challenge is measuring metacognition itself. Most existing evidence relies on self-report tools, reflective writing, or post-task surveys, which are good for capturing changes in learners' awareness, beliefs, and perceived control over learning. While these measures are pedagogically useful, they do not always align closely with students' observable regulatory behaviors during learning activities. Process-oriented or online measures—such as think-aloud protocols, classroom observations, or learning trace analyses—provide deeper insights into how metacognition works during learning, but these methods are usually resource-heavy and limited to small groups. Therefore, the strongest evidence about how metacognition operates often comes from qualitative or mixed-methods studies, while claims about how much it improves performance remain more tentative.

Meta-analytic findings also reveal substantial heterogeneity across studies, particularly in higher education contexts. Large effect sizes reported in some reviews—especially in EFL and science education—are accompanied by high levels of statistical heterogeneity, small sample sizes, and indications of publication bias. These patterns suggest that instructional effectiveness is highly sensitive to factors such as disciplinary norms, students' prior experiences, instructional duration, and the degree of alignment between metacognitive activities and learning goals. Consequently, the evidence does not support a one-size-fits-all model of metacognitive instruction, but rather points to the importance of contextually responsive design.

Overall, the current evidence base supports a cautiously optimistic interpretation of metacognitive instruction in higher education. The consistency of positive associations across research traditions lends credibility to metacognition as a meaningful target for pedagogical intervention, while its demonstrated malleability distinguishes it from more stable demographic or dispositional predictors of learning. At the same time, limitations in research design, measurement, and generalizability underscore the need for continued investigation using multi-method, longitudinal, and context-sensitive approaches. For instructional decision-making, this means that metacognitive practices are best viewed not as guaranteed solutions for improving performance, but as strategic supports that can enhance students' capacity to engage productively with learning when thoughtfully implemented.

Mechanisms: How Metacognition Supports Learning

It has been five decades since the theory of metacognition emerged in the 1970s, and today, metacognition is still pivotal for understanding individual learning processes. Metacognition is defined as "a person's knowledge and beliefs about human minds and their doing" (Flavell et al., 2002, p.6). The notion of metacognition encompasses the structures and organization of one's learning and thinking processes, and includes the information obtained and utilized in the learning and thinking processes. Fundamentally, two pillars of metacognition theory include metacognitive knowledge and the regulation of cognition.

Mechanism 1: Awareness of Person, Task, and Strategies

Metacognitive knowledge includes knowledge of oneself, task knowledge, and knowledge of available strategies (Pintrich, 2002). Person knowledge involves understanding oneself as a learner, including awareness of personal traits and mental processes that can affect learning, such as one’s age, interests, motivation, and confidence in one's own abilities (Wenden, 1999).

Task knowledge refers to understanding what a learning task entails, including its objectives, characteristics, and the requirements it imposes on the learner. Finally, Strategy knowledge refers to knowing which learning strategies can help meet the task’s cognitive objectives and how effective those strategies are. Focusing more on the working process of metacognition, Schraw and Moshaman (1995) further divide metacognitive knowledge into declarative knowledge, procedural knowledge, and conditional knowledge. Declarative knowledge involves the factors or information that affect cognitive performance. Procedural knowledge refers to the strategies and rules governing how to perform tasks. Conditional knowledge involves individual judgments to determine in which learning situation to use declarative and procedural knowledge.

Mechanism 2: Ongoing Regulation During Learning

The regulation of metacognition refers to the introspective process during which individuals self-manage their cognitive behaviors. Because regulation of metacognition only happens while cognitive behaviors are taking place, the construction of the notion focuses more on the process and strategies that occur during the cognitive process. The regulation of cognition is divided into planning, monitoring, and evaluating. Planning refers to the ability to identify a problem, analyze it, and choose a strategy to address it. Monitoring refers to the evaluation of one’s cognition and efforts toward a specific task. Compared to planning and monitoring, which usually co-occur with the cognition process, metacognitive evaluation occurs when certain tasks are completed, focusing on assessing the quality of a completed project (Bui & Kong, 2019). It is worth noting that the components of metacognitive regulation are similar to the metacognitive regulatory strategies proposed by Schraw (1998). Both metacognitive knowledge and regulation are often intertwined during one's problem-solving process. Understanding the constructs of metacognition offers explanations for how individuals control their use of metacognitive knowledge, as well as the strategies they use in regulating their learning.

Numerous empirical studies have examined the functions of metacognition in enhancing students' academic performance. Taking research on academic writing in a tertiary setting as an example, based on the findings of existing research, the distinctions between metacognitive knowledge and the regulation of cognition often signal writing performance, and they explain how individual capacity has been developed (Brown, 1987; Flavell, 1979). For example, Victori (1999) found that skilled and unskilled L2 writers have distinguished performance in metacognitive knowledge through analyzing case study data from think-aloud protocols and interviews. To establish a model of knowledge of cognition in English as their second language (ESL) writing, Ruan (2014) conducted small group interviews of 52 Chinese university students and found that the variables of motivation, self-efficacy, and writing anxiety consisted of students' metacognitive personal knowledge. Ruan's (2014) study explained that metacognitive knowledge influenced how students approached writing while using the language they were studying.

Continuing this line of inquiry, more researchers are diving into how metacognitive knowledge may impact language learners in the long run. A longitudinal study conducted by Negretti (2012) illustrated that metacognitive knowledge of tasks promoted the development of L2 students’ ability in self-regulation and fostered the formation of a personal writing approach. Negretti’s (2012) finding contributed to identifying the qualitative changes in student metacognitive awareness of the *Task.* Collectively, these studies highlight that metacognitive knowledge—particularly in relation to tasks, strategies, and personal beliefs—plays a pivotal role in shaping students’ writing development and their capacity for independent learning. Understanding these dynamics is essential for informing pedagogical practices that support student writers.

Mechanism 3: Affective and Experiential Mediation

In Flavell’s 1979 model of metacognition, he also proposed another important component—metacognitive experiences. As Flavell explained, “metacognitive experiences are especially likely to happen in situations that stimulate a lot of careful, highly conscious thinking” (p. 908). His definition of metacognitive experiences (ME) emphasizes that complex thinking processes should be embedded in school tasks where learners are cognitively or affectively involved in the cognitive process, which supports learners in generating numerous thoughts and feelings about their own thinking. However, in most of the studies that center on the effectiveness of metacognition and learning performance, researchers often focus more on metacognitive knowledge and the regulation of metacognition, rather than metacognitive experiences. This is because the nature of experiences and affection is not trainable in pedagogy design (Bui & Kong, 2019; Lee & Mak, 2018), and it is also difficult to be measured by a validated instrument. Therefore, when it comes to measuring changes in learners’ metacognition, most frameworks of metacognition in educational research do not include the component of metacognitive experience.

Meanwhile, it should not be denied that metacognitive experiences are inextricably influential in shaping learners' learning trajectory and affect their investment in learning, and it is often referred to as the "concurrent metacognition" that focuses on specific aspects of cognitive process, resulting in being impacted by the affection that learners experienced during the cognitive process. Therefore, both pleasant and unpleasant feelings may impact learners' judgment of the experiences, resulting in either a positive or a negative interpretation of the experiences. For example, a pleasant learning experience may contribute to the positive understanding of the cognitive process in learning, eventually shaping the learners' judgment of learning. Compared to metacognitive knowledge and metacognitive regulation, although metacognitive experience is omnipresent and seems to be an essential component in learning, the feeling and the consequential judgments are often nonanalytic, and it plays the hidden factor that pedagogical design and application should take into consideration.

Actionable Recommendations for DKU Faculty

Although metacognition is widely recognized as a critical contributor to student learning success, its activation and development do not occur automatically in higher education classrooms. In the context of DKU, students bring diverse educational backgrounds and prior learning experiences, which means that while some may possess metacognitive knowledge, they do not consistently apply it when engaging with new disciplinary tasks or unfamiliar assessment expectations. As prior research suggests, the activation of metacognition is closely tied to teacher scaffolding embedded in everyday instruction rather than isolated training (Lee & Mak, 2018). In this context, metacognitive instruction at DKU should be understood as a deliberate pedagogical approach that supports students in articulating, monitoring, and regulating their learning processes in relation to course-specific goals and standards. Therefore, a central task for DKU faculty across disciplines is not whether to teach metacognition, but how to identify and adopt shared instructional principles, such as explicit instruction, structured reflection, and guided evaluation, that can be flexibly integrated into existing course designs to support students' metacognitive engagement in diverse learning contexts.

Shared Principles of Metacognitive Instruction

Metacognitive instruction in higher education can be effectively implemented using a structured, scaffolded, and collaborative approach that emphasizes both explicit teaching and student-regulated learning. While one of the main goals is to encourage students to develop self-regulated learning strategies, teachers should not take a completely "hands-off" approach. Instead, they should actively support students in developing their metacognitive skills. Therefore, the remaining question is "How to implement metacognitive strategies?" Based on three systematic reviews focusing on the field of language learning and teaching (Wongdaeng & Higgins, 2023), college students' critical thinking (Rivas et al., 2022), and research on metacognition in Science Education (Zohar & Barzilai, 2013). The following key principles emerge from the synthesis of these three key scholarly reviews:

1. Explicit Instruction Through Progressive Phases: A teacher should clearly explain the skills that students will be working on. Both reviews provide evidence that explicit instruction is more effective than implicit instruction. In explicit instruction, teachers set clear learning expectations and guide students through tasks step by step, gradually transferring the responsibility for learning from the instructor to the student.

2. Emphasize Regulation through Guided Practices: Rather than focusing solely on helping students understand metacognitive terms, instruction should stress the process of regulation and strategic application of skills. Effective metacognitive instruction teaches students how to plan, monitor, and reflect on their learning during real tasks, and use task prompts and reflective questions to guide the regulation process. Meanwhile, teachers serve as collaborators, prompting students to use strategies while providing immediate feedback.

3. Support with Materials and Tools: Teachers should provide students with tangible tools to practice metacognitive strategies. This could include handouts outlining steps for planning and reflection, learning diaries or portfolios to document their thinking processes, and checklists for self-monitoring during tasks, concept mapping, and visualization. Additionally, it could include ICT used for teaching or facilitating metacognition.

4. Promote Collaborative and Reflective Environments: All three systematic reviews emphasize the importance of fostering a learning environment where students learn with and from one another. Therefore, they could have opportunities to work in pairs or groups to explain their thought processes, justify their reasoning, and reflect on their work together. Cooperative practices, such as regular peer discussions and reflection activities, can foster group responsibility for problem-solving and learning strategies, further supporting metacognitive growth.

5. Supporting Independent and Self-Paced Practice: To foster long-term metacognitive growth, it is essential to provide opportunities for independent and self-paced practice. The independent practice phase encourages students to internalize strategies and make autonomous decisions about their learning processes. Importantly, instruction should also account for the fact that students progress at different paces. Providing flexible timelines, varied task options, or self-check tools can help accommodate diverse learning needs and promote sustained engagement.

Classroom Activities to Develop Metacognition

For teachers who know the notion of metacognition, creating tangible classroom activities that infuse metacognitive instruction plays a pivotal role in the effectiveness of teaching practices. These classroom activities connect students to the learning goals, construct different metacognitive experiences, and can be adapted to the learning context. Approaches that center on fostering critical thinking and student collaboration are evidenced to be effective approaches in supporting metacognitive development. For example, Vilet et al. (2014) tracked 170 second-year bachelor's students in psychobiology at the University of Amsterdam across two 4-week compulsory courses by comparing student groups from both traditional lecture mode and flipped classroom mode, and the study found that the flipped classroom group significantly enhanced the motivated strategies components—critical factors in boosting students' metacognitive development for learning. The study concludes that flipped-class pedagogy—when integrated into traditional curricula—effectively fosters metacognitive development (via critical thinking) and collaborative learning, making it a valuable tool for higher education. However, it emphasizes that repeated implementation of flipped sessions across curricula is necessary to sustain these metacognitive benefits, as one-off use fails to solidify long-term strategy adoption. For research on pedagogical design and metacognition, this work highlights the importance of active pre-class preparation, peer interaction, and targeted in-class engagement in supporting metacognitive growth—while also underscoring the need for curricular consistency to maintain such gains.

Self-regulated learning also plays a pivotal and inseparable role in promoting metacognition. Self-regulated learners have the motivation to be responsible for their learning before, during, and after learning experiences. They are able to effectively assess their own knowledge and the gap in their knowledge. Making a judgment in choosing effective learning strategies to address the gaps in learning, and better navigating their learning trajectory by making changes in fostering future learning. In the long run, self-regulated learners gradually became adaptive and owned the expertise in detecting issues in learning, proposing constructive feedback to themselves, and innovative solutions in overcoming challenges in learning. Therefore, self-assessment and activities in the same vein are reflective in nature, empowering students to develop awareness or the capability of analyzing their own learning or thinking process, namely, metacognition. For example, Siegesmud (2017) summarized key strategies and resources that the American Society for Microbiology published in 2012, displaying the key strategies to help students self-assess. These key strategies include: (1) Providing learning objectives that students can use to guide their learning, (2) Providing clear learning objectives, (3) Using exam wrappers, (4) Reflective journals, and (5) Activities accompanied by self-regulatory steps and circles.

When synthesizing relevant studies regarding metacognitive development activities, shared pedagogical designs are found across varied disciplines and fields. Drawing upon the systematic reviews (Wongdaeng & Higgins, 2023; Rivas et al., 2022; Zohar & Barzilai, 2013), Table 1 provides a list of classroom activities that could develop learners' metacognition. These reviews concluded that *Reflective Questions*, *Metacognitive Writing*, *Cooperative Activities*, and *Reflective Dialogue* are the most common approaches, all characterized by reflective and collaborative elements that engage students as knowledge creators, assessors, and innovators. Frankly, this collection of activities only presents a snapshot of the whole range of activities that are experimented with in college classrooms, but it could enhance the feasibility of educators in higher education in implementing metacognitive instruction.

Table 1: Classroom Activities to Support Metacognitive Development

Activity	Purpose	Example
Reflective Questions	Identifying what already know; articulate what have learned	e.g., pre and post learning survey/self-assessment
Metacognitive writing	Writing (usually in a routine form) as opportunities to reflect on, describe and analyze learners' thinking and learning	e.g., journals, report, short reflection
Cooperative Activities	Fostering metacognition through peer interactions that assist knowledge gap noticing and peer learning	e.g., peer review, peer teaching, flipped class, group debrief/discussion
Reflective dialogue	Having purposeful, open-ended conversations—either with peers, teachers, or oneself—that focus on exploring one's	e.g., Think-Aloud Pair Reflection, dialogical feedback

	experiences, thought processes, and learning strategies.

As shown in the list above, the activities that aim to support the development of metacognition are not separable from reflection and self-regulation. Although the form of activities ranges from written to spoken, or performed individually or collaboratively, the capacity of these activities evokes deeper thinking about learners' understanding of their learning, thereby encouraging self-directed actions to take control of the learning process. The examples listed above are some basic and frequently used classroom activities. In practice, the combination or adaptation of activities often occurred to meet the needs of a certain group of learners, a specific classroom environment, and tangible expectations.

Assessment of Metacognition as a Pedagogical Concern

Educational research focusing on the advancements in the study of metacognition has prompted parallel discussions about the tools and practices appropriate for its assessment. A variety of methods have been employed, including self-report questionnaires, structured interviews, think-aloud protocols, classroom observations, stimulated recall, computer-based log analyses, and eye-tracking procedures (Veenman et al., 2006). Each of these methods entails specific strengths and limitations. For instance, questionnaires are efficient for large-scale data collection but often show weak correspondence with learners' demonstrated behaviors during task performance, whereas observational or think-aloud approaches yield richer process-level data but are labor-intensive and less scalable.

A critical distinction in this body of work is that between off-line measures, which are administered before or after a learning task, and on-line measures, which capture students’ metacognitive activity during the task itself. Online assessments tend to provide more accurate and predictive insights into learning performance than offline measures, even when the latter are conducted retrospectively. Yet, the field still lacks multi-method research designs that integrate both perspectives to capture the complexity of metacognitive processes. For educators, this raises an important pedagogical issue: without a clearer understanding of what dimensions of metacognition are best assessed by which methods, instructional efforts to foster students’ metacognition may risk being guided by incomplete or misleading evidence.

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Metacognition in the Era of GenAI

The rapid development and the widespread use of Generative AI (Gen AI) have become key focal points and challenges in higher education. Particularly for students and educators who are learning and teaching with the company of this omnipresent, adapting into the era of GenAI demands a high level of self-regulation, but it is also challenging for students to maintain the practice of self-regulation by resisting the temptation of AI use when it can offer fast and easy access to information.

Recent research presents a nuanced and sometimes contradictory picture of GenAI's role in supporting students' metacognition. On the one hand, studies suggest that GenAI can provide personalized learning support and prompt learners to engage in self-reflection, including identifying affective states such as confusion or frustration, which may facilitate metacognitive awareness (Chan & Hu, 2023; Kloos et al., 2024; Kim et al., 2024). On the other hand, empirical evidence indicates that AI use tends to be more effective in supporting lower-order cognitive outcomes, such as understanding and applying concepts, while offering limited support for higher-order metacognitive processes, including planning, generating ideas, and evaluating learning strategies (Qiu et al., 2025; Spirgi & Seufert, 2025). Moreover, several scholars caution that GenAI tools may undermine metacognitive development by bypassing students' problem-solving processes, weakening opportunities for critical thinking, and raising concerns related to academic integrity (Chardonnens, 2025; Fan et al., 2024; Farrelly & Baker, 2023; Wang et al., 2025). These risks appear to be unevenly distributed: emerging evidence suggests that AI tends to amplify existing learner differences, benefiting students who already possess strong metacognitive skills while potentially exacerbating difficulties for those with weaker metacognitive regulation (Prather et al., 2024). Taken together, this body of research underscores the need for intentional pedagogical design to ensure that GenAI use supports, rather than substitutes for, students’ metacognitive engagement.

CONCLUSION

This report has examined the overall impact on teaching and learning in higher education classrooms through examining the results from meta-analyses of reviews, systematic reviews, and empirical studies of metacognition-supportive pedagogies, and the findings consistently suggest that metacognitive instruction has a generally positive but context-dependent impact on student learning outcomes. At the same time, the impacts of metacognitive instruction may show variances based on study design, measurement, and instructional context. Therefore, although metacognition could work as one of the contributing factors to learning effectiveness, its effectiveness may vary and should be interpreted with contextualized consideration.

The complex nature of the concept of metacognition also plays a pivotal role in understanding how it works in enhancing students' academic development. The report provides an overview of the mechanisms focusing on metacognitive knowledge and the regulation of cognition, emphasizing that understanding oneself as a learner, recognizing task demands, and selecting appropriate strategies are essential for effective learning. Additionally, the report highlights the crucial role of metacognitive experience, illustrating how learners’ thoughts and emotions during the learning process influence their motivation and engagement.

Despite the theoretical constructs of metacognition, its application in classroom research consistently underscores its vital role in fostering self-directed, reflective, and transferable learning. Effective metacognitive instruction is not innate;

it requires intentional design, scaffolding, and facilitation by educators. The synthesis of principles from recent scholarly reviews demonstrates that metacognitive instruction must be explicit, supportive, collaborative, and flexible. Finally, the practical classroom activities presented show that metacognition can be effectively cultivated through structured reflection, peer interaction, and ongoing dialogue. These strategies not only deepen students' awareness of their learning but also empower them to take control of their educational journeys. However, it is undeniable that the challenges in measuring and assessing metacognition have raised concerns that classroom research on metacognition may often be based on incomplete evidence.

Focusing on the role of metacognition in the era of GenAI, this report also synthesized studies and reviews focusing on the impacts that GenAI brought to students' metacognition. The findings offer a mixed picture of GenAI's role in students' metacognition: while GenAI can provide personalized support and prompt self-reflection, it appears to be more effective for lower-level learning tasks than for higher-order metacognitive processes such as planning, idea generation, and strategy evaluation. At the same time, scholars warn that GenAI may short-circuit the process of problem-solving and critical thinking, raising concerns about academic integrity and uneven benefits that favor students with stronger existing metacognitive skills. Together, these findings point to the need for intentional instructional design with caution on its impact on students' metacognition. For educators who continue to implement and refine metacognitive practices with GenAI-informed design, their efforts will not only improve immediate academic outcomes but also contribute to a deeper, evidence-based understanding of how learners regulate and reflect on their own learning processes.

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