



Innovating Thought: Theorizing Metacognition

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Received: 3 June 2024/ Accepted: 07 August 2024/ Published: 06 September 2024

Abstract

The present article explores how the concept of metacognition has evolved, from its philosophical origins to current interdisciplinary applications. The paper transversally traces, how metacognitive theories have been integrated by various fields. First of all, is emphasized the progressive character of the development of the metacognitive theory; second, the features that establish it as an independent theory are highlighted. Finally, the article explores current and future concerns, trends and directions in research. Thus, the following discourse exploratively investigates how metacognition with its ancient history on "thinking about thinking", have been innovated by various current scientific fields.

Key words: Education; metacognition; metacognitive theory; neuroscience; philosophy; psychology

How to cite: Onciu, O. (2024). Innovating Thought: The Progressive Theorization of Metacognition. *Journal of Innovation in Psychology, Education and Didactics*, 28(1), 61-74. doi:10.29081/JIPED.2024.28.1.06

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1. Introduction

In ancient Greek, the word "μετά" (meta) was used to denote something that successively follows something else or something that transcends a certain aspect. Although the prefix itself is 2,000 years old, the concept of metacognition as a stand-alone term was first introduced relatively recently, in the 1970s by John Flavell (1979). Nowadays, there is an infusion of "meta" - terms and "meta" – concepts, in a wide variety of fields: metacognition, metamemory, metaperception, metalanguage. Metaethics, metacommunication, metadata, metaprogramming, metanarrative, meta-analysis.

This evidence in itself denotes two things: on one hand, it means valuable possibilities, dimensions and depths for certain relatively new fields of research (Hacker, 2008). On the other hand, it illustrates the complex structure the concept itself.

Accordingly, the current paper focuses on an interdisciplinary approach where we explore how, over time, "meta" concerns can be found in fields such as philosophy, psychology, neuroscience and education, offering a fascinating combined perspective. Each of the mentioned fields has contributed to consolidate the understanding of such a complex phenomenon as metacognition. And each field highlighted different aspects of this phenomenon transforming it, over time, into a self-standing concept.

In short, although the genesis of metacognition can be traced back to ancient Greece, the field of psychology had to appear (with the first studies on cognition, metacognition, memory and metamemory), in order for metacognition itself to emerge as a concept, and not only as a phenomenon (Flavell, 1979). Later, science made possible the identification of the brain's regions where metacognitive processes take place, surprising the entire scientific world, with the fact that metacognition is not a strictly human-specific phenomenon (Fleming & Dolan, 2012). Meaning that the "thinking cane" of the Greeks was not valid anymore (Smith & Washburn, 2005). Finally, when mass education brought the demand of efficiency to education, teachers realized the implication of metacognition in learning processes and began to integrate the concept into their pedagogies. This was the moment that made metacognition a significant tool, articulating metacognitions as a practical model (Dignath & Büttner, 2008).

2. Origins of metacognition

Metacognition has crossed various disciplines, evolving into a central concept in modern psychology and the field of education. This expansion demonstrates the ability of the concept to provide not only a theoretical framework for understanding internal thought processes but also practical tools for improving learning and personal decision-making. In the educational context for example, metacognitive skills are seen as essential for self-regulated learning. Students who are aware of their cognitive processes can more effectively regulate how they approach learning tasks, identify strategies that increase their performance, and critically reflect on the effectiveness of their study methods (Dignath & Büttner, 2008). The field's research, have shown that good metacognitive awareness is associated with better emotion management and increased resilience in the face of stress and failure (Ryum, 2017). Consequently, in cognitive-behavioral therapy, metacognitive techniques are used to help individuals recognize and regulate negative automatic thoughts, contributing to symptom relief in anxiety and depression disorders (Wells, 2000). Finally, in the neurosciences and the digital age, metacognition takes on new dimensions as a research point, but also as applicability. Information and communication technology now offers new environments, in which metacognition can be studied, developed, and also applied; from educational games that promote critical thinking to online learning platforms that allow users to monitor their progress and adjust their learning strategies in real-time (Kizilcec, 2017). Thus, metacognition continues to be a pillar in understanding the complexity of human thought and how

the individual interacts with the surrounding world, continuing to demonstrate its importance by surpassing the academic field, into the personal and professional areas.

2.1. Origins of "μετά" (meta)

Even though the term itself was used for the first time in 1979, the concern for consciousness and the phenomenon of thinking, occupied a central role in philosophical theories, since Greek antiquity. The concept of self-awareness and self-reflection was central recurring themes of the ancient Greek valuable thinkers. As far as is currently known, Socrates was the first to emphasized the importance of this, arguing that knowledge begins first of all with the awareness and understanding of one's own person and the limitations it brings with it (Moore, 2015). Further, the idea of leading an "examined life" was extended by Plato, and this emphasized that for a truly deep understanding of the surrounding world, reflection on one's own thoughts and beliefs is necessary (Irwin, 1995). Further, the concept that would later be known as "metacognition" was shaped by the exploration of epistemology - the study of knowledge. This highlighted that self-awareness and reflection are essential to the process of intellectual accumulation, as also to understanding of knowledge. Aristotle, reinforced in his work "*Metaphysics*", how the idea of self-knowledge is an essential component of human knowledge. Recent modern philosophers such as René Descartes, Kant and Sartre, have continued to explore the emergent nature of self-awareness and its role, in the human existential experience. An *add litteram* statement, was the philosophical aphorism "*Cogito, ergo sum*" ("I think, therefore I am"); which emphasizes the importance of self-awareness (Descartes, 2008). Building a meta layer for self-awareness, Immanuel Kant further proposed the concept of "transcendental self". This new dimension, argues that there is an aspect of the self that is not influenced by direct experiences or sensory perceptions, but is our essence, independent of external circumstances. This aspect, can observe, analyse, monitor and evaluate (Kant, 2008). In contemporary philosophy, the nature of metacognition and its impact on how we perceive and understand the world, have been explored from various and quite unique angles, providing even new aspects for this concept (Dennett, 1996; Searle, 1992). Specifically, Dennett, analysed metacognition through theories of consciousness, suggesting the rationale, in which *how* we reflect on our own thoughts is the most essential fact for understanding consciousness itself. On another hand, Searle approached metacognition from a perspective related to intentionality and subjective experience - very similar to the "*qualia*" type of awareness-, laying the foundational link between subjectivity, emotions and metacognition. Nowadays, the development of metacognitive skills is considered an essential component to achieve contemporary success. Individuals who have the ability to reflect on their own thought processes are better equipped to deal with the complexities of the world. Therefore, the legacy of metacognition has deep ancient roots in philosophy, but today it is concretized with practical applications in fields that extend on a wide spectrum, varying from education to personal development. For example, since the 20th century, newly research fields have considered that the study of the mind, the process of thinking and the mechanisms behind it, are areas of great importance. We refer to fields such cognitive psychology with its subdomains of cognitive development but also more niched subdomains such as the psychology of social development (Akturk, 2011). Neuropsychology has also examined metacognition even more closely; once considered to be *the* ability that differentiates humanity from the rest of beings, it was challenged by neuroscientific research that showed that certain animals, such as pigeons, monkeys and rats, possess metacognitive abilities such as memory monitoring and adjusting behavior based on information (Smith & Washburn, 2005; Kornell, 2009; Crystal, 2009).

Thus, metacognition began to take shape as a distinct field of study, as early as 1979, when Flavell published his work "*Metacognition and Cognitive Monitoring*", laying the foundations for further developments in the field (Flavell, 1979). Several other important models followed, such as the theoretical framework proposed by Nelson and Narens in their article "*Metamemory: A*

Theoretical Framework and New Findings" (Nelson and Narens, 1990). This phase was then followed by researchers turning their attention into improving the methods used to measure metacognition and metacognitive processes. This concern for how metacognition was measured brought the development of appropriate instruments and multiple techniques, such as confidence ratings (Crawford, 1996) and learning judgments (Baumeister, Alquist, & Vohs, 2015); Castel, McCabe, & Roediger, 2007; Putnam, Deng, & DeSoto, 2022). Also, in recent years, the interest in the neural basis of cognition, proved to be a natural continuation for the conceptual development of metacognition. In 2012, Fleming and Dolan identified specific brain regions involved in metacognitive processes (Fleming, 2012), adding once again, a new depth to the understanding of the domain and consolidating its position as a central field in the cognitive sciences (Schneider & Lockl, 2002). As early as the 1950s and 1960s, thinkers such as Jean Piaget (1952) and Lev Vygotsky (1978), developed theories which emphasized the importance of metacognition, self-awareness, monitoring, and evaluation, in the context of learning and memory. They were suggesting it once again but this time with quantitative data and measures, that cognitive development depends not only on the accumulation of knowledge, but also on awareness of the mental processes involved in the learning itself. More precisely, Piaget, through his theory on the stages of cognitive development, emphasized the importance of self-reflection in adapting to new information, and Vygotsky emphasized the social role in cognitive development, suggesting that self-awareness and monitoring are essential in learning, especially through interactions with others. Later, in the 1970s and 1980s, a new wave of theories of metacognition began to emerge, aiming to analyse further, the thought process itself. At that time, John Flavell (1979) defined metacognition as being "the knowledge and beliefs about one's own and others' cognitive phenomena". And at the same time, another researcher, David B. Resnick (1987), highlighted the importance of metacognitive strategies (planning, monitoring and self/evaluation) in achieving success in learning. Concomitant, during the same period, academics began to observe similarities between metacognition and another important area within the domain of cognitive psychology: Theory of Mind. The close association interposing metacognition and Theory of Mind, was one of deep interdependence, with both concepts being fundamental pillars in cognitive psychology. The main reason was that both phenomena, involve the ability to acknowledge, understand and manage not only one's own mental processes but also those of others (Lockl & Schneider, 2006). More specifically, Theory of Mind—as a higher-order cognitive function—plays a key role in the development of metacognition, helping individuals to understand their own cognitive states, as of others. Positive correlations between Theory of Mind and metacognition were demonstrated then, when metacognition was considered in a broader sense to include not only awareness of one's own cognitive processes but also those of other people (Schneider & Lockl, 2002). Ultimately, researchers proposed that Theory of Mind can be considered *a*) a basis for metacognition, focusing on the cognitive aspects of mental states (Karen Bartsch, 1996), while other researchers saw Theory of Mind as *b*) an early form of metacognition (Kuhn, 2000) or even described metacognition as *c*) an "applied theory of mind" (Timothy, 2002).

Closer to the present time, in the 2000s, interest in metacognition continued to grow, exploring its relationship with other cognitive processes and concepts, such as critical thinking, lifelong learning, and decision making. At the same time, metacognition was introduced in the domain of education with a new value, being recognized as a crucial concept in the study of learning and being integrated into strategies and educational programs at all levels.

3. From concept to theory framework

3.1. Construct crystallization

The process of theoretical crystallization of metacognition included essential steps that significantly transformed the initial understanding of the concept of "thinking about thinking" (Table 1). The origins of metacognition, highlighted by Socrates and Plato, emphasize the crucial role of self-knowledge and introspection in ancient Greek philosophy. Socrates, for example, argued that true knowledge begins with introspection and self-awareness, and individuals were encouraged to reflect on their beliefs, assumptions, and the products of their minds through Socratic dialogue. This reflective practice is closely aligned with what we define today as the metacognitive process of monitoring and regulating cognitive activities. As a student of Socrates, Plato was the one who expanded the subject and introduced new information on the basis previously laid by the ideas of his mentor. Socrates argued that true knowledge begins with introspection and self-awareness, but the concept did not define what this "true knowledge" meant and what its source was. Thus, Plato proposed the idea that we already possess knowledge as previous knowledge, and individuals could remember or access this knowledge through cognition and introspection. Plato's theory of forms thus played an important role in understanding metacognition. Plato believed that individuals can gain universal truths and knowledge by reflecting and examining their beliefs (Fine, 1993). We know today that this type of introspection involves processes (for example, self-reflection), which are included in the field of metacognition. These initial observations by philosophers about the human capacity for self-reflection provided a starting point for further investigations in various academic fields (Jones, 2020).

3.2. Formulation of hypotheses

Assumptions in metacognition were influenced along by the works of Aristotle who, through rigorous analysis of logic and reasoning, laid the foundations for a more extensive understanding of cognitive processes. As Plato's student, Aristotle benefited from a remarkable philosophical education and had the opportunity to progress the construction of his mentor's idea. By developing the concept of introspection, and introducing the idea of "*nous*", Aristotle made a significant contribution to understanding the process of self-reflection and exploring the depths of human cognition. The ability to reflect on one's thoughts and inner experiences has become a central aspect of philosophical and psychological thinking, partly thanks to the ancient works and the influence of Aristotle. The introduction of the concept of "*nous*", or intellectual intuition, then proposed perspectives toward deeper research on how the human mind works and acquires or generates knowledge. The complex concept brought the discussion to a higher level of understanding, which can be reached through intuition and deep reflection (Irwin, 1988). This approach was instrumental in defining metacognition as a distinct field of study, recognizing the need for self-assessment and cognitive adjustment as an integral part of critical and reflective thinking (Davis, 2020). Later, the Age of Enlightenment, characterized by intellectual progress, significantly brought back interest in philosophical themes. The thinkers of the world once again drew attention to *thinking* and all its related phenomena. This period marked a substantial change in the perception and understanding of one's cognition. If before this, introspection was predominantly considered to be a subjective and unreliable means of accessing knowledge about the mental processes of the individual (a less credible and deeply subjective tool), the Enlightenment thinkers once again capitalized on the methodical foundation of the Greek philosophers, promoting a more structured and accurate analysis of cognitive introspection. To begin with, Rene Descartes attributed special importance to self-reflection and introspection in the development process of the human mind. His strong focus on self-knowledge and introspection has increased the interest and development of the concept through deep exploration

of beliefs and knowledge. Thus, Descartes promoted a critical approach to thinking, inviting individuals to carefully examine their understanding of reality by manifesting a radical and deep doubt but also by self-analysis that facilitated a greater awareness of mental processes and cognitive mechanisms. Thus, emphasizing the importance of self-reflection and the critical exploration of knowledge, Descartes significantly influenced the way we relate to cognitive processes and the way the individual understands his mind, or even creates it. Later, Immanuel Kant introduced the concept of "transcendental apperception", suggesting that the mind can reflect but at the same time be aware of its mental activity (Kant, 2012). This is a point of self-knowledge and self-reflection that is at a much more refined level, where the mind recognizes the fundamental structures that make experience and knowledge possible. This approach later profoundly influenced modern and contemporary philosophy, laying the foundations for the further development of studies of consciousness and self-reflection within philosophy and theories of mind.

3.3. Empirical testing

John Flavell, in his work in the 1970s, provided an empirical framework for metacognition by identifying and describing the processes of monitoring and controlling cognition. It laid the foundation for empirical testing of metacognitive theories through experimental studies that measured how individuals monitor and regulate their cognitive processes (Flavell, 1979). Yet before that, Jean Piaget made a significant contribution to understanding the foundations of metacognition by exploring how children become aware of their knowledge and thinking processes. Piaget was among the first to recognize and analyse in detail these aspects of cognitive development. His research highlighted a crucial stage in the cognitive evolution of the individual, associated with the emergence of reflective thinking and cognitive awareness. Then, Piaget argued that there are several stages of cognitive development that children go through, starting with sensory-motor understanding and reaching formal operational thinking. During these stages, the ability to reflect on one's mental processes becomes more and more sophisticated. Later, in the stage of formal operations, adolescents and young adults begin to manipulate ideas abstractly and reflect on their thought processes, a turning point in metacognitive development. Piaget considered this capacity for self-reflection to be fundamental to what he called "*genetic epistemology*" (Piaget, 1950). Reflecting on Piaget's contributions, (Steinbach, 2008), underlines the importance of Piaget's early recognition of "thinking about thinking", as a fundamental aspect of cognitive development. This ability to self-monitor and evaluate one's knowledge not only improves learning and problem-solving but also contributes to the formation of a personal epistemology about the nature of knowledge and learning. Furthermore, to bring the interdisciplinary perspective back to attention we can say that understanding how students reflect on their thought processes and how they can be encouraged to become more aware of their learning strategies, has led to the development of pedagogical methods that promote metacognition.

4. Refinement and extension of theory

Metacognition, therefore, became a concrete and independent term in 1976, when John Flavell, in the work "*Metacognitive aspects of problem-solving*", used this term to refer to "thinking about one's thinking". Flavell then focused on several "*meta*" aspects that he considered of supreme importance for learning and solving problems (Marulis, 2020).

(a) The first "*meta*" aspect refers to the awareness of situations in which the intentional storage and awareness of certain information can be beneficial for future learning. This includes developing effective memorization strategies.

(b) The second "*meta*" aspect involves keeping the information current and ready for use. Monitoring and constant updating of knowledge are essential for this aspect.

(c) The third "meta" aspect occurs when information is not intentionally stored for later use. In this sense, Flavell emphasizes the deliberate avoidance of the use of the term "memory" when describing these meta capacities, because he says that the processes of metacognition can be both internal (e.g. mental monitoring) but equally external (e.g. the use of notes previously taken). Before the 1976 paper, Flavell also wrote about "metamemory" and researched this concept, which makes the chronological distinction between the two terms not always very clear. However, even Flavell himself indicated that memory can be seen mostly only as "applied cognition" (Flavell, 2000). Memory is therefore recognized as an essential component of cognition because metacognition includes all the "meta" aspects associated with cognitive processing. This term is most appropriate in the authentic context of learning, which frequently involves several cognitive processes simultaneously. John Flavell, in his initial work on metacognition, placed the concept within the theory of information processing in cognitive development, drawing inspiration from the theory of Piagetian stages. According to it, as we develop and accumulate experience, we become more competent in monitoring our thinking, understanding what we need to monitor, and how to regulate thinking by setting goals and implementing strategies, to achieve them and to evaluate progress. In this sense, in 1979, Flavell proposed a cognitive monitoring model dividing metacognition into four main components: (a) metacognitive knowledge, (b) metacognitive experiences, (c) metacognitive goals, and (d) metacognitive strategies. Metacognitive knowledge includes understanding one's thinking and the thinking of others, such as knowledge of tasks and strategies for approaching them, referring to the awareness of one's cognitive abilities, the types of tasks, and the strategies that can best be used to learn or solve problems. Metacognitive experiences refer to conscious experiences associated with cognitive or affective processes, such as realizing the difficulty of a task or the feeling of having the answer to a question "on the tip of one's tongue". This component involves the recognition and regulation of cognitive and emotional states during the thinking process. Then, the cognitive objectives are the individual goals or intentions in the thinking and learning process, guiding how a person approaches a learning or problem-solving task and determining what exactly he wants to achieve. Finally, cognitive strategies become metacognitive, when actions or techniques are applied to achieve the established cognitive objectives. These are cognitive, when they refer to how information is processed, or metacognitive when planning, monitoring, and regulating the thinking process is involved. Flavell emphasized that the effective interaction between these four components can lead to higher levels of thinking, through the development and application of metacognitive skills.

Building on this groundwork established by Flavell, subsequent research in psychology and neuroscience has expanded the theory of metacognition. Particular attention has been paid to the neural mechanisms of metacognition and the educational impact of metacognitive training. These investigations have helped refine and expand the theory to include various aspects of metacognition, from self-regulation to impact in educational and therapeutic contexts (Dunlosky, 2013).

5. Practical application and evaluation

In the last phase of theorizing, metacognition was integrated into educational practices, demonstrating its effectiveness in improving learning and problem-solving strategies. Methods for assessing and measuring metacognitive skills have become crucial to ensure theoretical applicability in real practices, reinforcing the role of metacognition as an essential tool in education and other fields of knowledge (Cronbach & Meehl, 1955). The progress in understanding an adequate measurement of metacognition has evolved in parallel with the efforts to define the concept itself. We therefore understand why the measurement of an invisible phenomenon, although empirically defined, is accompanied by a series of limits and difficulties.

The diversity of components calls into question, most of the time, the fidelity and validity of the measuring instruments, an aspect highlighted in the specialized works of Schraw and Moshman (1995). Besides this, metacognition cannot be directly observed in the behaviour of individuals, it is an invisible phenomenon. This implies the fact that most of the assessment tools are significantly based on self-assessments, that is, on the respondents' ability to report and analyse their cognitive processes. Additionally, there is a risk that metacognition will be confused with other terms and concepts from the specialized literature. Conditioned by its elaborate nature, research in the field of metacognition has often focused on the analysis of an isolated component or a limited number of characteristic elements. In the educational context, there is also a tendency for metacognition measurements to focus on theoretical concepts, decontextualized from practice and the real learning environment, which can limit their relevance and applicability in evaluating metacognition in authentic learning environments (Henter, 2016). However, a positive aspect of this process of exploring how metacognition can be evaluated correctly (adapted to the specific age, and empirical), is that in the field of metacognition, there is today a diversity of methods and tools used. We can mention eye movement recordings, observations, questionnaires, interviews, think-aloud protocol analysis, and stimulated recall (Veenman, 2006).

In almost every empirical or theoretical research on metacognition, the problem of measurement is discussed. This difficulty in measuring metacognition is often justified by the difficulties in defining the actual concept: "The concept of metacognition and its measurement methods remain partially unclear" (Jimenez, 2009). Because of these uncertainties and the diversity of investigation methods, studies replicated by independent researchers are rare. Moreover, there are as many approaches to measuring metacognition as there are empirical studies. This lack of uniformity stems, in part, from the still practiced use of the term "metacognition" in different contexts to denote a wide range of behaviours (Jacobs, 1987). Many researchers define metacognition as being composed of both knowledge and cognitive control. Instead, others argue that only knowledge should be included under this label, thus allowing a direct measurement of metacognition (Jacobs, 1987). However, although the current limitations of metacognition assessments cannot be eliminated, they can be partially reduced. Thus, the transition of metacognition from a philosophical concept to a solid and applicable theory illustrates a complex process of theoretical evolution, which continues to influence various academic fields and professional practices, reiterating the importance of "thinking about thinking" in understanding and improving the human capacity for knowledge and self-regulating.

Table 1. Stages of theory development

Stages of Development	Philosophy	Psychology	Neurosciences	Education
I. Construct Crystallization	Ancient Greek thought laid the philosophical foundations, emphasizing introspection and self-knowledge.	Flavell's initial observations (1976) on children's reflections led to identifying metacognitive processes.	No direct involvement in this stage.	No direct involvement in this stage.
II. Formulation of Hypotheses	Philosophers like Aristotle contributed foundational ideas on introspection and cognitive processes.	Development of theoretical frameworks to explain cognitive monitoring and control.	Research contributed hypotheses about brain mechanisms involved in metacognition.	Research contributed to understanding how educational strategies can incorporate metacognitive principles.
III. Empirical	Philosophy	Empirical	Provided evidence	Research provided

Testing	critiques and evaluates empirical testing methods and results, refining conceptual understanding.	investigations tested various aspects of the theoretical frameworks, solidifying empirical evidence for metacognitive processes.	supporting or refuting psychological theories about metacognition.	evidence on the effectiveness of metacognitive strategies in learning environments.
IV. Refinement and Extension of Theory	Contributions to the ongoing dialogue on the nature and implications of metacognition.	Further empirical investigations refined and extended the theory, enhancing understanding of metacognitive processes and components.	Research contributed to the understanding of neural substrates and mechanisms underlying metacognitive processes.	Contributions focused on how metacognitive theories can be effectively applied and tested in educational settings.
V. Practical Application and Evaluation	Explored practical applications of <i>thought</i> and <i>thinking</i> (cognition), in philosophy.	The research explored practical applications in learning, problem-solving, and psychological assessments, leading to the development of new metacognitive assessments.	Practical applications investigated the chemistry, the limitations, and the enhancements of metacognitive insights.	Focused on applying metacognitive strategies to promote self-directed learning and evaluating their impact on educational outcomes.

6. Conclusions: From theory to innovation

From an academic perspective, innovation involves the introduction of new ideas, methodologies, or practices that significantly improve or transform existing paradigms. It involves a process of critical thinking, creativity, and practical application of new concepts (Rogers, 1995). In the field of metacognition, innovation is manifested through the continuous evolution of theories and practices that deepen the understanding of the processes of reflection on one's thinking and their implications in various fields. As noted above, the concept of metacognition, or “thinking about thinking,” has evolved significantly from its philosophical roots to its current interdisciplinary applications.

This evolution exemplifies innovation in several key ways. Originally grounded in the philosophical research of Socrates, Plato, and Aristotle, the understanding of reflection and introspection has been deeply enriched by the integration of perspectives from psychology, neuroscience, and education. The interdisciplinary approach has not only broadened the scope of metacognitive research but also opened new avenues for practical applications. Empirical methods of cognitive psychology have provided concrete frameworks for the study of metacognitive processes, while neuroscience has identified specific brain regions involved in these processes (Fleming & Dolan, 2012), and education has used these insights to improve learning outcomes (Dignath & Büttner, 2008). Modern empirical research, beginning with the pioneering work of John Flavell in the 1970s, has transformed these philosophical concepts into robust theories. Flavell's identification of metacognitive knowledge, experiences, goals, and

strategies provided a structured approach to the study and measurement of metacognition, thus laying the foundation for subsequent theoretical and practical advances (Flavell, 1979). His work emphasized the importance of self-awareness in cognitive processes, highlighting the need for individuals to monitor and regulate their thinking to achieve superior cognitive performance. At the same time, the application of metacognitive theories in education represents a significant innovation, demonstrating the practical-common utility of the concept. Metacognitive training programs have been shown to help students develop skills in planning, monitoring, and evaluating their learning, leading to improved academic performance and promoting lifelong learning (Schraw & Dennison, 1994).

Furthermore, the application of metacognitive strategies extends beyond the educational context into therapeutic settings, where these practices are used to help individuals manage emotions and mental health conditions, illustrating the broad applicability and impact of metacognition (Wells, 2000). Metacognition also plays a crucial role in the process of human innovation. By promoting self-awareness and critical reflection, metacognitive practices enable individuals to improve problem-solving skills, promote lifelong learning, and facilitate emotional regulation. Reflecting on one's cognitive processes helps identify effective strategies, thereby improving problem-solving skills essential in fields such as science, engineering, and technology. In addition, metacognitive skills encourage continuous learning and adaptability, crucial aspects in a rapidly changing world. Individuals proficient in self-reflection and self-regulation can navigate new challenges more effectively and acquire new skills more effectively (Bransford, 2000). Also, understanding and regulating thoughts and emotions through metacognitive practices can lead to better mental health and increased resilience, important for managing stress and maintaining motivation in the face of obstacles (Wells, 2000).

The future of innovation in metacognition lies in its potential to further integrate with emerging technologies and related fields. Artificial intelligence (AI), for example, can be used to develop personalized metacognitive training programs, improving individual learning experiences and outcomes. AI-based tools can provide real-time feedback and adaptive learning environments that respond to the user's metacognitive needs. Also, virtual and augmented reality (VR/AR) technologies can create immersive environments for metacognitive training, allowing users to practice and develop skills in a realistic yet controlled setting. Continued interdisciplinary research between fields such as cognitive science, education, and neuroscience will lead to deeper insights and more effective application of metacognition as a theory.

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