Research Article

Linking Metacognition, Workplace Cognitive Competencies and Performance: An Integrative Review-Based Conceptual Framework

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ABSTRACT

A key driver of workplace cognitive competencies is metacognition which has been shown to impact performance among nurses, teachers and firefighters, however, it is scarcely studied among managerial employees. The research investigating this relationship is also scattered across multiple domains limiting its' utility for researchers and practitioners. This paper, therefore, presents an integrative review of the existing empirical literature from the Web of Science and Scopus database to trace the linkages of metacognition, workplace cognitive competencies and performance at work. The identified linkages are then formulated into a conceptual framework clarifying how various workplace cognitive competencies and performance may be linked to metacognition. The findings indicate linkages between metacognition and various workplace cognitive competencies such as problem-solving, decision-making, innovation, creativity and knowledge acquisition. The present research also establishes the link of metacognition and cognitive competencies with learning, individual and firm performance. The review paves way for metacognition to be considered as a distinct construct in the workplace, identifies gaps and provides direction for future research.

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Introduction

Modern jobs with high usage of technology place higher demand for cognitive competencies on workers (Hardy et al., 2019; Torraco, 2002). Research on the workplace cognitive competencies (such as decision-making, problem-solving, innovation or creativity, knowledge acquisition and learning tasks) over the last four decades has shown the validity and utility of them in predicting workplace performance in different settings (Boyatzis, 1991; Boyatzis et al., 2017; Rozhkov et al., 2017; Ryan et al., 2009). Hacker et al (2009) have mentioned that metacognition is the key driver of competencies like learning, decision-making, problem-solving and collaboration impacting performance at work and this has been scarcely studied by organisational psychologists.

A few studies relating metacognition to cognitive competencies are available in niche areas such as nursing (Oh, 2016), teaching (Duman, 2018) and fire-fighting (Frye & Wearing, 2016), but studies involving practising managers are virtually limited. The studies in these areas have examined the linkage of metacognition with cognitive competencies such as decision-making (Mattingly et al., 2016; Shepherd et al., 2010), problem-solving (Liu & Liu, 2020a; Urban & Wood, 2017), innovation or creativity (Berraies, 2020) and knowledge acquisition (Zumbach et al., 2020). Recently, researchers (Cho & Linderman, 2019; Lyons & Bandura, 2019) in the management field have demonstrated that metacognition is linked to managerial performance, thereby suggesting that the metacognition of an individual is a likely determinant of his/her performance in the workplace. The logical linkage of metacognition to cognitive competencies and performance prompted us to identify the linkages studied in the literature. We focused only on empirical work which provides evidence of relationships among the variables studied.

The current work is an attempt to provide such a conceptual framework relating metacognition to various cognitive competencies impacting performance in the workplace. We arranged and integrated the diverse body of empirical literature relating to metacognition among

professionals to trace these linkages. Furthermore, we identify themes based on various cognitive competencies and then formulate and present an integrative conceptual framework linking metacognition to the cognitive competencies impacting employee performance. Finally, the available insights from the existing body of knowledge help to identify research gaps and recommend directions for future research in the field of organisational psychology and management.

This study attempts to reflect upon the following research objectives;
RO1: To identify and integrate empirical literature linking metacognition and cognitive competencies impacting performance in the workplace.
RO2: To formulate an integrative conceptual framework based on the identified empirical linkages using relational and thematic analyses.
RO3: To discuss the consolidated insights from the metacognition literature and make propositions regarding the linkages between components and sub-components of metacognition with the cognitive competencies at work that facilitate individual performance.
RO4: To identify research gaps in the literature for providing directions for future research and implications for researchers and practitioners.

Theoretical Background

Metacognition

The term metacognition was first coined by John Flavell in 1976 in his seminal work "Metacognitive Aspects of Problem Solving" (Flavell, 1976). Metacognition simply means 'cognition about cognition, 'knowing about knowing' and 'thinking about thinking' (Alter & Oppenheimer, 2009). The research on metacognition has been drawn over the years from three distinct theoretical paradigms of cognitive development psychology (Piaget, 1950), cognitive psychology (Hart, 1965) and social development psychology (Vygotsky, 1962). The definition of metacognition evolved with Gavelek and Raphael (1985, pp.22-23) defining it as "the abilities of individuals to adjust their cognitive activity to promote more effective comprehension " thereby suggesting that control or adjustment of cognitive activity was an inherent

part of metacognition. Eventually, it was defined as the information individuals possess while completing a task including a deliberate organization in cognitive processes (Brown et al., 1983). Another definition by Paris & Winograd (1990) included two essential features of metacognition: "self-appraisal and self-management of cognition". Matsaggouras (1994) further specified that metacognition includes awareness and control of emotions that accompany the cognitive processes and the person's ability to monitor them. Livingstone (1997) suggested that whereas cognition is the set of all mental abilities and processes related to knowledge, metacognition involves overseeing cognitive goals to ensure they have been met. The commonality in the evolving definitions of metacognition was that it included monitoring strategies for the learning process (Bonner, 1998). Eventually, researchers began to see metacognition as a master that coordinates the smooth operation of all other cognitive processes (Hacker et al., 1998).

In essence, metacognition represents the control that the individual has over their cognition as a function of an ability that differs within individuals, to consider alternative cognitive strategies to cope with a changing environment (Haynie et al., 2010). The term 'Metacognition' has been used interchangeably in literature with Metacognitive Ability by various researchers (Jia et al., 2019). Over the years, there has been the development of various theoretical models of metacognition discussing its' various components and sub-components. The sequential examination of these theoretical models suggests that the conceptualisation of metacognition started with the model proposed by Flavell (1981). He described metacognition as consisting of four subcomponents - knowledge, experiences, goals-tasks, and strategies. Further, Brown (1987) clarified the two-component model consisting of two main aspects of metacognition i.e. metacognitive knowledge (also referred to as metacognitive awareness) and metacognitive regulation (or metacognitive skill). Although, several authors have put forth various subcomponents of Metacognitive Ability, nearly all of the relevant research in the last twenty years on metacognition has

confirmed Brown's two-component model of metacognition (Harrison & Vallin, 2018; Kuhn & Dean, 2004; Schraw et al., 2006).

Metacognitive knowledge refers to an individual's knowledge of his/ her cognitive structure and process (Flavell, 1979). It is a part of the individual's evaluation of their belief system but may be inaccurate such that individuals may overestimate or underestimate their competencies (called metacognitive accuracy) (Veenman et al., 2006). This ability to be metacognitively accurate can be quantified and increased with training and improvement techniques (Knox et al., 2017). *Metacognitive regulation* on the other hand refers to an individual's ability to monitor and evaluate his/ her cognitive activity. It is concerned with planning, critical evaluation and conscious execution of appropriate actions to achieve a particular goal (Martinez, 2006; Schraw et al., 2006).

Metacognitive Ability thus enables individuals to engage in self-awareness (i.e. knowledge) and regulation of cognitive processes. These two components of metacognition have been further subdivided into sub-components by various authors (Schraw et al., 2006) as briefed in Appendix A. These components and sub-components of metacognition have been used interchangeably in the literature in various professional domains.

Cognitive Competencies

Competency is defined as his/her "capability or ability" associated with a motive that impacts the achievement of goals and objectives. These competencies are something that an employee "must know" and "able to do" to perform a task effectively. Traditionally, Spencer and Spencer (1993) defined competencies as "the underlying characteristics of the person that lead to or cause effective or superior performance". The increment in the dissatisfaction associated with the traditional measures of cognitive intelligence has led to the emergence of scholarly interest in the concept of competencies (Boyatzis et al., 2017). These competencies account for a large amount of variance in performance at work, especially among studies examining the performance of professionals (Ryan et al., 2009). Spencer and Spencer (1993)integrate a parsimonious framework of competencies into

emotional, social, and cognitive. Recently, there has been a growing interest in cognitive competencies in the workplace with an increment in the requirement of analytical and conceptual thinking while performing a task at work. Cognitive competencies are said to help individuals in analysing information and situation at work. They help individuals to approach tasks by looking at them as an element of a larger system instead of viewing them as small components (Ackoff & Addison, 2010). These cognitive competencies are not restricted to personal traits of individuals, rather they can be developed through individual interventions such as learning, monitoring and regulation (Bonesso et al., 2018). Given the role of metacognition in cognitive monitoring, cognitive regulation, success on learning tasks, and the high cognitive demand of present-day jobs prompted us to further explore the literature to find linkages between metacognition, cognitive competencies, and performance at work.

A quick review of the literature revealed the presence of various studies in other professional domains except for the managerial workspace. This called for an integrative literature review.

Method

An integrative review is a form of literature study that reviews, synthesizes and critiques literature related to a subject matter comprehensively to formulate a new framework or viewpoint on the area of review (Torraco, 2005). This form of review is used to address both a mature topic or a new or emerging topic such as the one in this work (Snyder, 2019). According to Shahbaz and Parker (2021), a replicable integrative review must begin with defining the research objectives and proceed to formulate a conceptual framework through discrete steps (Fornes et al., 2008; Wollard & Shuck, 2011). In line with their recommendations, the current work flows through five steps (1) Defining the research objectives (mentioned in the introduction section) (2) Identifying sources, database and keywords (3) Selecting and evaluating the studies (4) Formulation of a conceptual framework (5) Reporting of discussions.

Identifying sources, databases and keywords

The multidisciplinary databases Web of Science (WoS) and Scopus were accessed to maintain the quality and consistency of the articles reviewed for the literature (Aghaei Chadegani et al., 2013). A systematic search was conducted (on 25th February 2022) on these databases to identify all peer-review papers published on the topic in the last 31 years, i.e., 1990-2022. Since the first objective of the study was to identify the linkage of metacognition with various cognitive competencies impacting performance in the workplace. A preliminary search of the databases clarified that very few relevant results could be elicited in the context of the workplace by using a combination of the following broad keywords "Metacognition", "performance", "work performance" and "employee performance" in the title, abstract and keyword. The search query was thus expanded to identify the linkage of metacognition with various workplace cognitive competencies such as problem-solving, decision-making, innovation and creativity along with performance (Rozhkov et al., 2017; Ryan et al., 2009) among professionals from diverse fields. Since these competencies impact individual and overall firm performance (Cho & Linderman, 2019; Lyons & Bandura, 2019) which has been recently explored with metacognition in a few studies in the field of management. These key terms recognised for metacognition and workplace cognitive competencies took account of the diverse terminology for metacognition, performance and dimensions of cognitive competencies. This ensured the complete coverage of the broad and scattered literature on metacognition relevant to the field of management.

A BOOLEAN search criterion (title, abstract and keyword) was performed in this review as used across disciplines to structure query (Pohl et al., 2010) in the databases as follows:

TS (Metacognition OR Metacognitive Skills OR Metacognitive Ability) AND TS (Performance OR Decision making OR Problem Solving OR Innovation OR Creativity)

The search query resulted in 7,127 results (included only articles in; English language, published post 1990 and journal & review articles). We

removed the articles (n=6,762) relating to the domain of neurology, animal metacognition, child development and clinical metacognition. Post-data extraction we moved on to the screening stage of the integrative review process with 365 studies.

Selecting and evaluating the studies

The articles obtained were then examined to qualify for the study's inclusion and exclusion criteria. As recommended by Torraco (2005) initial primary screening was performed by reviewing the title, abstract and keywords of the articles. These studies were either included in OR excluded for further full-text analysis.

We included studies that -

1. Explicitly used the components and sub-components of metacognition; metacognitive knowledge and metacognitive regulation (refer to Appendix A) in their title, abstract and keywords. Studies that didn't directly investigate metacognition and its' sub-components were thus excluded.

2. Explored metacognition in the context of cognitive tasks/managerial work/cognitive competencies such as *decision-making, problem-solving, innovation or creativity, knowledge acquisition, learning tasks and individual, team & firm performance* in the context of various professional domains relevant for managerial work.

3. Were published in journals in the domain relevant for the field of management such as *Business; Business Finance; Psychology Applied; Industrial Relations; Labor Psychology; Economics; Management, Social Sciences and Interdisciplinary categories.*

4. Belonged to peer-reviewed journal papers so that they present scientifically validated knowledge.

All duplicate articles (n=35) were eliminated. A total of 253 articles were then excluded for not meeting the inclusion criteria. The remaining 77 articles were then reviewed through full-text examination (Refer: Figure 1).

Formulation of a Conceptual Framework

After the full-text examination of the 77 articles, 39 were found to be relevant to the objective of the study (Refer: Figure 1). In the full-text screening of the articles the authors examined the metacognition construct investigated and measured in the study. The studies which didn't specifically investigate the knowledge and regulation components and sub-components were excluded from the review. Also, the studies that investigated metacognition specifically with cognitive competencies/tasks/work relevant for workplace were included in the review.

The selected studies were then examined through the technique of relational and thematic analysis (Wollard & Shuck, 2011) to detect the relationship of components and sub-components of metacognition with various workplace cognitive competencies. The following themes were identified from the included articles: *Performance on academic and learning tasks; Decision Making; Problem Solving; Innovation Performance; Individual Performance & Firm Performance*. These categories were then processed by developing a conceptual framework, presenting the visual link between concepts and constructs (Wollard & Shuck, 2011).

The following diagram illustrates the search and selection process of the review (Figure 1).
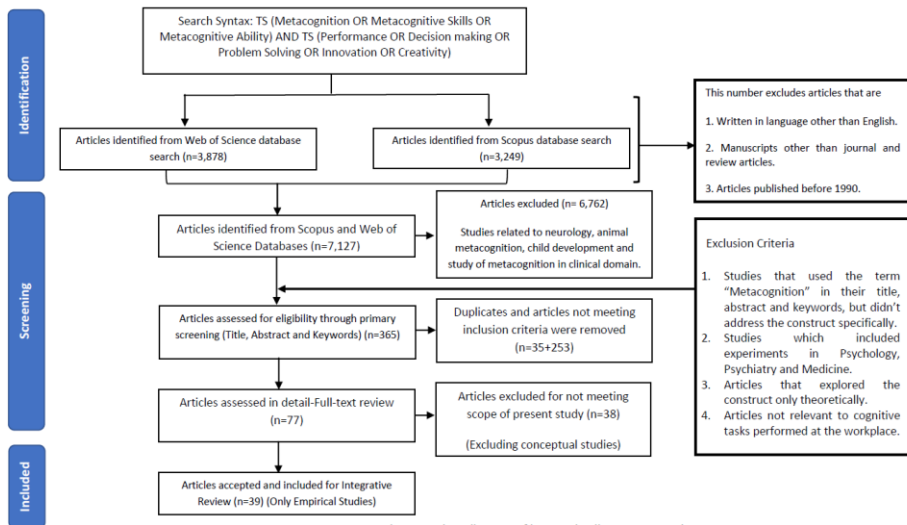
Figure 1. Flow diagram of integrative literature search

General Discussion

Researchers' interest in exploring linkages between metacognition and various cognitive competencies to improve performance at work has been steadily increasing since the 2000s. Predictably, most of the research remains confined to journals of Psychology/ Applied Psychology which carry research that is relevant to the domain of Organisational Psychology & Behaviour, Human Resource Management and Performance Management. Out of 77 relevant articles, 39 articles had direct implications for the field of management. Further, it became evident from the review that the researchers in the field of Computer-Human Interaction are actively investigating metacognition to understand performance in learning environments as well as work contexts. The analysis also depicts that research in the context of sports, entrepreneurship, security forces, fire workers and managerial professionals have pointers on linkages between metacognition and cognitive competencies at the workplace.

A large proportion of the 39 relevant studies have their origins in the USA and Australia however, researchers from 15 other countries (Austria,

France, Ireland, Germany, Japan, Macau, and others) too have begun work on the subject. The review highlighted the scarcity of literature on management professionals in the field of metacognition as the majority of the studies are restricted to professional domains other than management. The findings indicate the presence of three studies investigating the positive impact of metacognition on employee performance among management professionals and the glaring need to explore it as an essential construct at work.

The identified key features of the included studies (latest 6 years) are tabulated in Table 1 (Refer to Appendix A for the features of 39 studies). The majority of the included studies have adopted an experimental research design (23) for investigating the relationships among the constructs. Eight studies have used the survey method, seven studies have utilised questionnaires for data collection and one has used the interview method. The components of metacognition have also been studied as intervening variables with academic and managerial cognitive competencies. Four studies have used metacognitive intervention as a mediating variable and two studies have considered the moderating role of metacognition with workplace competencies.

The relational analysis of the 39 studies included in the review (tabulated in Table 1 and Appendix B) clarified the various linkages of metacognition (its' components and sub-components) with various cognitive competencies in the workplace. Further, there was a need to identify the major themes with which the various components of metacognition are investigated in the literature.

Table 1

Key features of studies selected for integrative review (Latest 6 years)

No.	Author (Year)	Subject	Field/Industry	Sample Size	Research Design	Study Design			
						Independent Variable	Dependent Variable	Moderating Variable	Mediating Variable
1	Zumbach et al. (2020)*	Students	Gaming and Technology	131	Experimental Study	Metacognitive Strategies (Training and Prompting)	Knowledge Acquisition[#]*** Cognitive Load***		
2	Liu and Liu (2020b)*	Students	Gaming and Technology	159	Experimental Study	Metacognition Goal-orientation	Problem-Solving[#]*** Learning Performance[#]**		
3	Zhao and Ye (2020)*	Undergraduate Students	Students	230	Experimental Study	Metacognitive Calibration	Performance on learning task[#]*	Time Spent on task	
4	Cho and Linderman (2019)	Managers	Operational Management	235	Survey Study	Managerial Metacognition	Firm Performance[#]** Performance[#]*		Social Process Improvement Practices*** Technical Process Improvement Practices***
5	Najmaei and Sadeghinejad (2019)	CEO and Top-management team members	Entrepreneurs (SME)	105	Questionnaire Study	Teams' metacognitive ability diversity	Firm Performance[#]		Innovativeness* Pro-activeness Risk-Taking
6	Berraies (2020)	Manager	Diverse fields	186	Survey Study	Metacognitive CQ* Cognitive CQ Behavioural CQ Motivational CQ	Innovation Performance[#]*	Collaborative Climate	Knowledge Sharing*
7	Yoo et al. (2018)	Staff, Managers, Executives	Electronics, Automobile, Construction	415	Survey Study	Technological Innovation	Business Performance[#]***		Metacognition at

No.	Author	Population	Field	Sample	Method	Metacognition Variable	Outcome	Moderator	Organisational Level
			, Textile, Food & Beverages				Organisation Effectiveness***		Organisational Level
8	Rhodes et al. (2018)	CEO and Senior executives	Entrepreneurs	140	Quantitative Study	Teams' metacognitive knowledge diversity; Teams' metacognitive experience diversity	Firm Performance#***		Top Management Teams Entrepreneurial Orientation
9	Pan and Sun (2018)	Professionals	Marketing, Service, R&D, and Technology	361 & 62	Questionnaire Study	Metacognition	Employee adaptive performance#	Job Complexity***	Emotional Control***
10	Hidayat et al. (2018)	Students	Mathematics	538	Survey Study	Metacognition	Mathematical modelling competencies#*		Cognitive Strategy**; Self-Checking**
11	Elferink-Gemser et al. (2018)	Athletes	Table Tennis	60	Psychological Test	Metacognition and Executive functions	Performance#*		
12	Kim (2018)	Students	University Students	30	Experimental Study	Metacognitive monitoring feedback	Performance in Computer-based training#*		
13	Urban and Wood (2017)	Entrepreneurs	Entrepreneurs	784	Questionnaire Study	Entrepreneurial Metacognition***; Corporate building blocks***; Entrepreneurial alertness	Corporate entrepreneurial activity#	Firm age and size, sector, gender, education, work tenure	
14	Kiso and Hershey (2017)	Professionals	Diverse Fields	90	Questionnaire Study	Self-regulated learning; Financial Knowledge; Financial worry; Retirement metacognition*	Problem-Solving#; Financial Planning activities#		

Note. For the studies with significant results *p<0.05, **p<0.01, ***p<0.001
For the variables included in the conceptual framework.

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Identification of Themes

The strategic diagram visualization instrument was used to detect the themes of various cognitive competencies at work investigated with metacognition through the R software, bibliometrix package (Refer: Figure 2). The strategic diagram presents the themes using a co-word analysis where the nodes in the network represent the keywords and the linkage between these nodes is the number of times the same articles mention the linked keywords (Chen et al., 2016). The clusters of keywords represented by node shape in the network are identified using the community detection algorithm (Newman & Girvan, 2004). The keywords are indicative of the themes in the knowledge domain and the co-occurrence of these in a document is indicative of the linkage of the relationship between the themes of the document. The strategic diagram in this study constituted of authors' keywords used in the 39 included studies. We considered 200 keywords out of a total of 455 keywords using bibliometrix package by categorizing various themes based on two measures; centrality and density (Cobo et al., 2015). Centrality (Relevance degree) indicates the degree of interaction between the themes (in this case interaction between metacognition and the various cognitive competencies). The size of the nodes is representative of the degree of centrality of each keyword. Density (Development degree) measures the strength of internal ties within a theme i.e. the strength of relationships within metacognition and cognitive competencies.

The four quadrants presented in the strategic diagram represent the four types of themes – the upper right quadrant is the "Motor Theme" indicating high centrality and high density i.e. themes which have been well developed and important in the research field; the upper left quadrant is the "Niche Theme" with high density and low centrality, themes which have marginal relevance for research; "Emerging or Declining theme" is represented in the lower left quadrant of the diagram depicting themes which are marginal and weakly developed with low density and low centrality. At last the "Basic or General theme" is represented in the lower right quadrant, these

are found to be interconnected with other themes however are not well developed (low density and high centrality) (Bamel et al., 2022).

We identified nine themes, spread across the four quadrants. The "Motor Theme" quadrant depicts 'Academic and Learning Performance', 'Decision Making' and 'Problem Solving'. This quadrant confirms the high development of these themes with metacognition in the academic domain among students. The 'Academic and Learning Performance' includes sub-themes namely, knowledge acquisition, to name a few. While the term 'decision making' includes sub-themes related to strategic, financial and team decisions. The theme of problem-solving included the sub-themes such as; learning performance, goal-orientation and cognitive strategy. However, a portion of these themes fall under "Basic Themes" and there is a need to further explore the relationships of these themes with metacognition with organisational perspective.

The "Basic or General theme" includes 'Individual Performance', 'Team Performance' and 'Firm Performance'. This indicates that these themes are interconnected with metacognition via other themes and need further investigation of having a direct causal relationship. The high centrality of these themes is indicative of the strength of its ties with the other themes over the years. Furthermore, the size of the circles shows that these themes are less researched in the area of management however, constitute keywords related to the managerial workplace indicating the presence of metacognition and performance at the workplace.

The "Emerging theme or declining theme" quadrant depicts the following themes; 'Creativity', a small part of 'Entrepreneurial Cognition' and 'Innovation Performance'. The sub-themes discussed sporadically in this section are related to culture, entrepreneurship, collaboration, knowledge sharing and cooperation. Innovation, creativity and entrepreneurship are gaining traction in recent years due to their relevance in the modern and expanding workplace and therefore, require further investigation. The "Niche themes" quadrant does not depict any themes in the context of metacognition at the workplace which has marginal relevance for research.
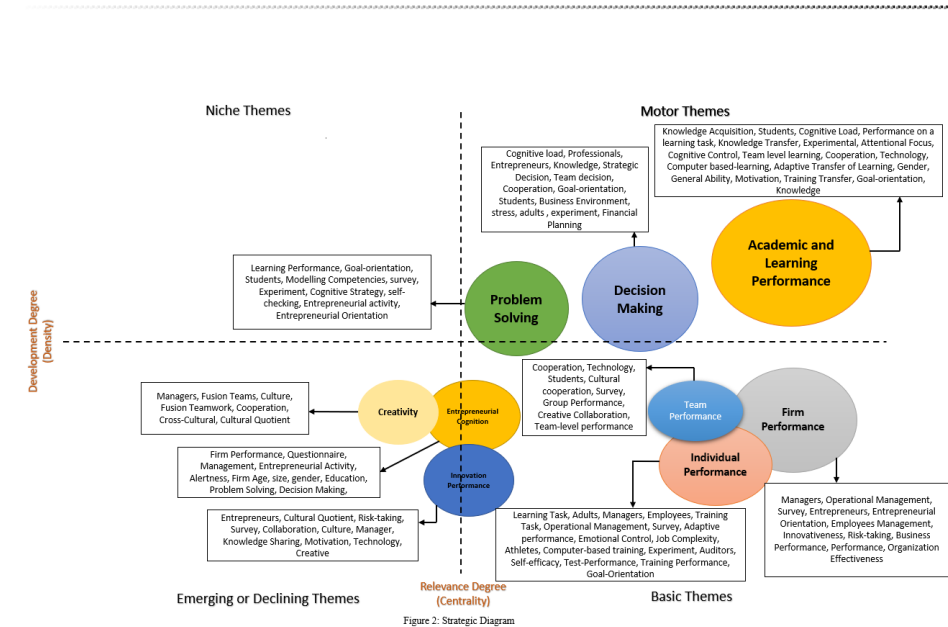
Figure 2: Strategic Diagram

Figure 2. Strategic Diagram

Further, a detailed analysis of the identified themes under each quadrant of the strategic diagram is conducted. A linkage description number is assigned to every established relationship between components of metacognition and the above-identified themes based on the empirical evidence from the extant literature (Refer to Table 2). These themes were then presented through one-way, two-way and expected links which are represented through arrows as visualised in the framework (Figure 3). The empirical studies investigating metacognition with various cognitive competencies and performance are limited to fields other than management such as nursing, fire-fighting, teaching and sports. Therefore, based on empirical linkages explored in these niche domains the authors make some expected propositions linking components and sub-components of metacognition with the cognitive competencies that could facilitate individual and firm performance in the field of management.

Academic and Learning Performance

Metacognition and its sub-components have been majorly empirically explored in the context of educational learning. The linkage of academic and learning performance with metacognitive skilfulness and metacognitive accuracy provides evidence for the workplace in terms of performance on training tasks and knowledge acquisition. The accuracy of the metacognitive judgement is considered relevant for successful learning of the task (Miller & Geraci, 2014). The studies emphasize the role of metacognitive calibration and monitoring accuracy in the enhancement of individuals' knowledge and application of learning strategies. This has also confirmed the importance of the application of metacognitive training and learning strategies to promote individual metacognition among employees (Zhao & Ye, 2020). These components are also found helpful in identifying the difficulties of performing a task and thereby behavioural changes required to develop greater knowledge, performance strategies and confidence of individuals in the task to be performed (Ford et al., 1998; Schmidt & Ford, 2003). The metacognitive strategy component such as planning, monitoring, reviewing & evaluating also tend to influence the attention and cognitive control exerted by individuals while training on a task (Brick et al., 2015). Metacognitive training is therefore found helpful for trainees in carrying out corrective actions in a learning or training task (Kim, 2018) as it increases the capabilities of an individual to gain new knowledge by continuous awareness and monitoring of their strengths, weakness and learning strategies (Zhao & Ye, 2020). Metacognition acts as a directive for better test preparation and information processing required in a job application test (Clause et al., 2001). Various interventions such as self-directed prompts are found to be beneficial in the reviewed studies (Zumbach et al., 2020) and are found to cultivate strategic learning activities amongst learners resulting in better learning performance (Bannert et al., 2015; Schmidt & Ford, 2003). These linkages have also been confirmed amongst dyads and teams (Dierdorff & Ellington, 2012; Norman & Furnes, 2016). Prior research evidence also confirms how improvement in the learning and training performance of the employees

further raises their work performance through the acquisition of knowledge and skill set required for the job to be undertaken (Greco et al., 2018; Guan & Frenkel, 2019). Hence, we propose;

Proposition 1: The Components and Sub-Components of metacognition of an individual are related to Performance on a learning, knowledge acquisition or training task at the workplace and thus with the work performance (1 →2, 3→2, 4→5→6; Figure 3).

Decision Making

Decision making an important workplace cognitive competency is found to be linked to components and sub-components of metacognition (Kiso & Hershey, 2017). An individual who has a strong awareness of his or her knowledge tends to further perceive lower cognitive difficulties in engaging in the cognitive task. The task-specific metacognitive perception (Kiso & Hershey, 2017) also helps an individual in determining the uncertainty and opportunities in the environment and avoiding errors associated with it (Frye & Wearing, 2016; Mattingly et al., 2016). It is therefore argued that individuals who are high on metacognition tend to exhibit less erratic strategic decisions while operating in a dynamic environment (Mitchell et al., 2011). The above studies indicate the role of individuals' metacognition in their decision-making. The literature further confirms how these individual differences in decision-making contribute to the work performance of employees engaged in a cognitive task (Ceschi et al., 2017). Based on the above discussion, we thus propose;

Proposition 2: The Components and Sub-Components of metacognition of an individual are related to his/her decision-making and thus to the work performance (7→8; Figure 3).

Problem Solving

The findings of the review confirm the link between individuals' metacognition and problem-solving also. The components of metacognition are found to help learners strategically analyse the problem, formulate a mental structure, select an appropriate strategy and identify the obstacles that may hamper the problem-solving process (Hidayat et al., 2018; Liu & Liu, 2020b). A study examining the impact of self-questioning techniques on problem-solving performance and metacognition of employees (Ng et al., 2011), confirmed a significant positive effect of self-questioning intervention techniques on problem-solving. The authors further suggested that the long-term application of these techniques can enhance the metacognition of the individual. The above studies, therefore, indicate that metacognitive interventions and training programmes can help improve the problem-solving techniques of an individual and thus work performance (Giampaoli et al., 2017; Ng et al., 2011). We therefore propose;

Proposition 3: The Components and Sub-Components of metacognition of an individual are related to his/her problem-solving and thus to the work performance (12→13; Figure 3).

Cultural Metacognition and Innovative Performance

Management researchers have found linkages between Metacognitive and Cultural Quotient among employees (Chua et al., 2012; Mor et al., 2013). A higher metacognitive cultural quotient is linked with higher knowledge sharing and further to the higher innovative performance of the firm (Berraies, 2020). The literature analysis further shows how individuals high on cultural metacognition work well in fusion teams, promoting creativity in multicultural teams (Crotty & Brett, 2012). The development of cultural metacognition also acts as a crucial dimension in strengthening knowledge sharing, creativity, innovative performance, cooperation and coordination at the workplace (Najmaei & Sadeghinejad, 2019). This improvement in innovation performance further contributes to the increment in performance at work. We therefore propose;

Proposition 4: The Components and Sub-Components of metacognition of an individual are related to his/her Innovative Performance and Cultural Metacognition and thus to the work performance (9→10→11; Figure 3).

Individual and Firm Performance

Recent empirical studies confirm the contribution of managerial metacognition in helping and identifying sources of errors and effective improvement strategies contributing to individual and firm performance (Cho & Linderman, 2019). These results imply the relevance of managerial metacognition at both individual and organisational levels in improving individual and business performance. Yoo et al. (2018) along similar lines investigated the positive mediating role of metacognition on the relationship between technological innovation capabilities, business performance & organisational effectiveness in the area of sustainable management. The results of the study provide evidence of how the positive role of metacognition at the organisational level helps SME managers in the problem-solving process and the successful improvement of business performance and organisational effectiveness. Rhodes et al. (2018) also established the importance of metacognitive knowledge and experience among managers for improvement in the performance of SMEs. These metacognitive components are found to be helpful for individuals to understand their range of knowledge, skills and decision-making thereby, resulting in positive firm performance. Along similar lines results of a doctoral study of 1216 working professionals from diverse fields by Bajaj and Jain (2020) also confirm the positive relationship between metacognitive scores and the performance of employees at the workplace.

Proposition 5: The Components and Sub-Components of metacognition of an individual are related to his/her Individual, Team and Firm Performance (14→19→20, 15→16→19→20, 15→17→18; Figure 3).

Table 2

Known linkages of metacognition and cognitive competencies in the workplace

Metacognition	Workplace Cognitive Competencies	Author (Year)	Linkage description no.
Metacognitive Accuracy (Metacognitive Monitoring; Accurate Calibration)	Performance on a learning task	Bannert et al. (2015); Zhao and Ye (2020)	1
Metacognitive Skilfulness (Task-Specific Metacognitive Activity; Use of Metacognitive Strategy)	Performance on a learning task	Liu and Liu (2020b); Kim (2018); Norman and Furnes (2016); Brick et al. (2015); Dierdorff and Ellington (2012)#; Crook and Beier (2010); Schmidt and Ford (2003)*; Tempelaar (2006); Clause et al. (2001)*; Fiore et al. (2002)	3
	Transfer of Learning	Keith and Frese (2005)*	4→5
	Knowledge Acquisition	Zumbach et al. (2020); Schmidt and Ford (2003)*; Ford et al. (1998)#; Fiore et al. (2002)	4
	Decision Making	Kiso and Hershey (2017); Frye and Wearing (2016); Mattingly et al. (2016); Robert Mitchell et al. (2011); Batha and Carroll (2007); Dierdorff and Ellington (2012)#	7

Metacognition (Metacognitive Awareness Metacognitive Ability Metacognitive Predisposition)	Problem Solving	Liu and Liu (2020b); ; Hidayat et al. (2018); Ng et al. (2011); Brand et al. (2003)	12
Managerial Metacognition	Firm Performance	Cho and Linderman (2019); Yoo et al. (2018)*; Rhodes et al. (2018)	16→19→20 17→18
	Performance	Cho and Linderman (2019); Pan and Sun (2018)	16
Cultural Metacognition	Innovative Performance	Berraies (2020); Crotty and Brett (2012)	10
Cultural Metacognition	Firm Performance	Mor et al. (2013); Chua et al. (2012)	10→11→19→20
Metacognition (Metacognitive Awareness Metacognitive Ability Metacognitive Predisposition)	Performance	Elferink-Gemser et al. (2018); Nietfeld (2003); Najmaei and Sadeghinejad (2019); Cho and Jung (2014)	14
Metacognitive Skilfulness (Task-Specific Metacognitive Activity; Use of Metacognitive Strategy)	Performance	Plumlee et al. (2015)	14

Metacognitive Activity	Collaboration in groups	Nonose et al. (2014); Kwon et al. (2013)	14→19

Notes. Performance = Individual Performance at the workplace.

*: Indicates that metacognition is a mediating variable in the study;

#: Indicates that metacognition is a moderating variable in the study;

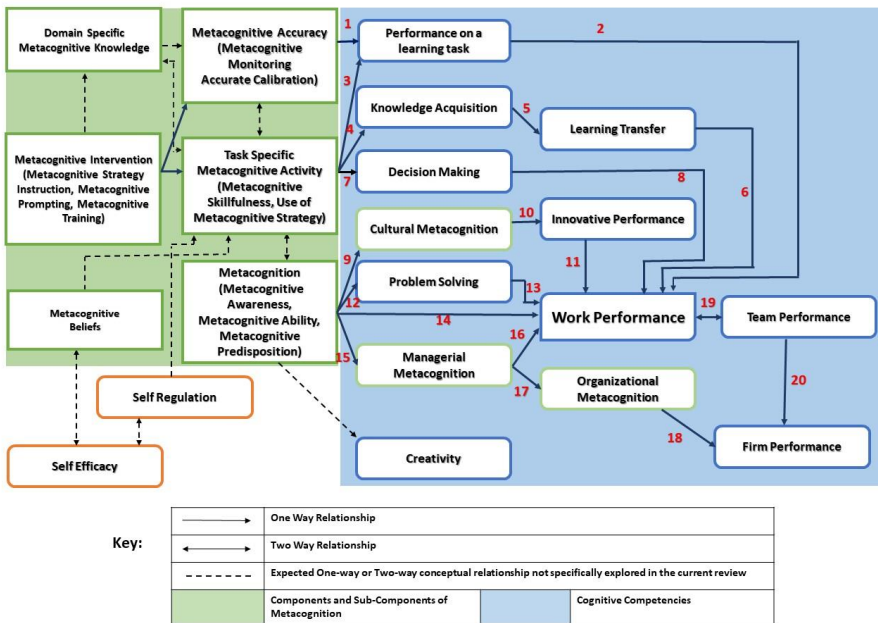( ): Terms used interchangeably in literature with Primary Construct.

Figure 3: Conceptual framework illustrating known and expected linkages of Metacognition

Figure 3. Conceptual framework illustrating known and expected linkages of Metacognition

Implications and Research gaps

The previous sections have addressed two foremost objectives of the study. Firstly, the identification and integration of linkages between

metacognition and workplace cognitive competencies and secondly, the formulation and presentation of these relationships into a comprehensive conceptual framework. The consolidated framework can be used by scholars and practitioners in the field of human resource management to study and develop the role of metacognition in the context of the workplace.

The 39 identified studies provide various workplace cognitive competencies such as learning performance, decision-making, problem-solving, and innovative performance apart from individual and firm performance linked with metacognition and its components. However, the review also confirms the sporadicity of this empirical evidence and limited literature directly investigating the link between managerial metacognition and work performance. Bajaj and Jain (2020) in a doctoral study have recently empirically substantiated the positive link of Metacognitive Ability scores with performance as adjudged by a mentor among 1216 working professionals. Their results have supported our assertion that there is a measurable link between metacognition and Employee Performance at the workplace, which require further investigation. Metacognition has also been found to be an important predictor of firm performance at the workplace in the field of operational management and sustainable management (Cho & Linderman, 2019; Yoo et al., 2018). Therefore, It is essential to investigate this relationship to understand which individuals may have a priori ability to metacognate and then appropriately recruit employees (Walker, 2016) based on the cognitive requirement of the task.

Further, the review also highlights an essential need to identify a measure of metacognitive awareness suited to the workplace. The existing managerial metacognition measures employed in the empirical studies are adopted from measures used in the context of entrepreneurial metacognition (Haynie, 2005; Haynie et al., 2012; Haynie & Shepherd, 2009), cultural metacognition (Chua et al., 2012; Van Dyne et al., 2012) and metacognition in learning (Yoo et al., 2018). The Metacognitive Awareness Inventory (MAI) by Schraw and Dennison (1994) can be considered a reliable measure of measuring metacognitive awareness at work.

Metacognition has also been seen as critical to performance in online learning environments (Liu & Liu, 2020b; Reisoglu et al., 2020; Zumbach et al., 2020) and a predictor of performance on cognitive tasks (Woolfolk & Shaughnessy, 2004) and learning (Pintrich et al., 2000). This evidence highlights the need to explore the role of managerial metacognition in the context of virtual teams and virtual work environments. Virtual work practices are likely to stay in place post-pandemic as firms realize the cost savings from having workers connect technologically (Kniffin et al., 2020). Therefore, the implications of an empirical examination of the role of managerial metacognition in a virtual context will provide insights for HRD scholars and practitioners.

The review has also confirmed the linkage between the components of metacognition with collaboration in a group or team tasks (Kwon et al., 2013; Nonose et al., 2014). This linkage further sheds light on the expected impact of metacognition on team-level outcomes. A review of the literature and empirical investigation of the same can establish a stronger case for metacognition and team-level outcomes at the workplace.

Finally, we propose to the researchers and practitioners in the field of organisational and business management to empirically examine metacognitive ability as a distinct construct among management professionals influencing workplace cognitive competencies and performance at work.

Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Appendix A

Sub-Components of Metacognitive Knowledge and Metacognitive Regulation

Dimensions	Definition
Sub-Components of Metacognitive Knowledge (or awareness)	
Declarative Knowledge	Declarative knowledge is a learner's knowledge of own resources and capabilities (Kuhn & Dean, 2004; Schraw et al., 2006).
Procedural Knowledge	Procedural knowledge is a learner's knowledge of the purpose of a task, the processes used to solve problems and his capacity to self-regulate tasks (Nelson & Narens, 1994; Schraw et al., 2006).
Conditional Knowledge	Conditional knowledge is the learner knowing the different conditions in which his declarative and procedural knowledge of a task can be applied (Schraw et al., 2006; Schraw & Dennison, 1994).
Sub-Components of Metacognitive Regulation (or Skills or activity or strategy)	
Metacognitive Monitoring	Monitoring involves making self-aware judgments about one's learning. It includes an awareness of task complexity (Efklides, 2006) and self-enhancement motivation (Jiang & Kleitman, 2015; Schraw et al., 2006).
Metacognitive Planning	Planning refers to the evaluation and employment of the most efficient resources and strategies (Li et al., 2015; Schraw et al., 2006).
Metacognitive Evaluation	Evaluation refers to the ability to make metacognitive judgments and interpret the outcome of the monitoring process (Schraw et al., 2006).

Appendix B

Key features of studies selected for integrative review (Study 15-39)

No.	Author (Year)	Subject	Field/Industry	Sample Size	Research Design	Study Design			
						Independent Variable	Dependent Variable	Moderating Variable	Mediating Variable
15	Norman and Furnes (2016)	Students	Technology	100 & 50	Experimental Study	Metacognitive Experiences	Learning for digital text[#] Learning for non-digital text[#]		
16	Frye and Wearing (2016)	Professionals	Bushfire Fighters	3 scenarios cases	Survey Study	Metacognition	Decision-Making [#*]	Stressful high cognitive load conditions	
17	Mattingly et al. (2016)	Entrepreneurs	Entrepreneurs from diverse industries	124	Conjoint Experimental Study	Entrepreneurial experience	Decision-Making[#]	Metacognitive experience Metacognitive knowledge*	
18	Bannert et al. (2015)	Students	Technology	35 & 35	Experimental Study	Self-directed metacognitive prompts	Behaviour and learning performance[#]*		
19	Brick et al. (2015)	Athletes	Runners	10	Interviews	Metacognition	Attentional Focus[#] Cognitive Control (Strategy)		
20	Plumlee et al. (2015)	Professionals	Auditors (Accounting)	108	Experimental Study	Metacognitive processes (Creative problem solving: Divergent and	Performance[#]***		

						convergent thinking)			
21	Nonose et al. (2014)	Students	Aviation Game	13 Teams	Experimental Study	Metacognition	Team Cooperation#*		
22	Cho and Jung (2014)	MBA students and employees	Entrepreneurs	190	Survey Study	Entrepreneur's metacognition	Firm Performance#*		Entrepreneurial Orientation**
23	Mor et al. (2013)	Students	MBA Students	200	Survey Study	Cultural Metacognition	Inter-cultural cooperation#* Cultural Performance# *		
24	Kwon et al. (2013)	Students	Web design research University Students	59	Experimental Study	Group Metacognitive Activity	Positive Interdependence* Group Performance#		
25	Chua et al. (2012)	Managers	Executive MBA managers	43,60,236	Survey Study	Cultural metacognition	Intercultural creative collaborations#*		
26	Dierdorff and Ellington (2012)	Students	Management Students	338/64	Experimental Study	Goal-orientation	Team Strategic Decision Making#** Team level learning# Cooperation#	Individual Level Metacognition and Self-efficacy** Team level Metacognition and Self-efficacy**	
27	Crotty and Brett (2012)	Managers	Diverse fields	246/37	Survey Study	Cultural Metacognition	Creativity#**	Fusion Team**	Fusion Teamwork**
28	Robert Mitchell et al. (2011)	Professionals	Technology	127	Conjoint Experimental Study	Metacognitive Experience Business Environment	Strategic Decision-Making#**		
29	Ng et al. (2011)	Professionals	Border Security Services	45	Questionnaire Study	Effects of self-questioning techniques	Problem-solving Performance#* Metacognition		

30	Crook and Beier (2010)	Students (Dyads)	Technology	64	Experimental Study	Metacognitive Activity	Learner Performance#*		
31	Batha and Carroll (2007)	Students	Undergraduate Psychology students	98	Experimental Study	Metacognitive Ability and strategy Metacognitive Strategy Instruction	Decision-Making#**		
32	Tempelaar (2006)	Undergraduate students	Students	729	Experimental Study	Metacognition	Academic Performance#*		
33	Keith and Frese (2005)	Students	Primary and Secondary Education	55	Experimental Study	Training Condition (error management vs error avoidant)	Adaptive Transfer of Learning#		Metacognitive Activity** Emotional Regulation*
34	Schmidt and Ford (2003)	Students	Technology (Web-based course)	70	Experimental Study	Metacognitive Intervention	Learning Performance***	Mastery orientation Performance Orientation	Metacognitive Activity
35	Nietfeld (2003)	Athletes	Sports (Runners)	45	Experimental Study	Racing Metacognition	Race Performance#*	General Ability Gender	
36	Brand et al. (2003)	Students (Dyads)	Business administration university students	107	Experimental Study	Metacognition	Problem-solving#*		
37	Fiore et al. (2002)	Students	Technology (Computer based training)	25	Experimental Study	Mental maps Metacognitive Predisposition Metacognitive Accuracy Dynamic Problem Solving	Learning Performance#* Knowledge Acquisition#* Task Performance#*		
38	Clause et al. (2001)	Job applicants	Law agency	493	Experimental and Questionnaire study	Self-efficacy Motivation	Test Performance#*		Metacognition Depth* Effort*
39		Students	Undergraduate Psychology students	93		Mastery Orientation*	Training Transfer	Knowledge	Self-Efficacy

Ford et al. (1998)	Experimental Study	Performance Orientation***	and Performance#	Metacognition

For the studies with significant results *p<0.05, **p<0.01, ***p<0.001

For the variables included in the conceptual framework.