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The role of metacognitive knowledge and regulation in mediating university EFL learners’ writing performance

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ABSTRACT
This empirical study explores metacognition and its relationship with writing performance. Through multivariate analyses, the study investigates the role of metacognitive knowledge and regulation in mediating writing performance. Participants were 882 students from eight universities in China who were learning English as a foreign language (EFL). Results reveal that scores on six parameters of metacognition (declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, and evaluating) were positively correlated with EFL writing performance. Parameters of procedural knowledge, planning, monitoring, and evaluating were more highly correlated with writing compared with other parameters. Results also revealed that scores on metacognitive regulation can play unique roles in predicting writing proficiency over and above prediction based on scores on metacognitive knowledge. These findings underscore the importance of enhancing metacognitive regulatory skills for university EFL learners’ writing performance.

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Metacognition; metacognitive knowledge; metacognitive regulation; writing performance; EFL learners

Introduction
Writing is connected to innovation, for which students are required to be analytical thinkers. Along with the development of the information economy, writing instruction is also in the process of revolution and innovation. Instruction on self-regulated writing strategies can be a powerful tool to facilitate changes in writing and transform traditional assignments into engaging, innovative experiences (Teng 2016, 2019). In order to help teachers prepare for implementing self-regulated writing strategies for innovative writing instruction, it is necessary to discern the predictive role of each self-regulated strategy in writing performance. In traditional writing instruction, the focus has been on diagraming sentences, learning specific grammar rules, and other conventions through editing students’ writing. Unlike traditional teaching, where time for teaching is structured around the class and all students follow a fixed schedule, innovative learners need to determine when and how to engage with writing on their own and be highly self-directed to achieve their pre-determined goals. This requirement fits well with the purpose of the present study, which is to determine the predicting effects of self-regulated strategies on learners’ writing performance, thus providing insight into metacognition and innovative writing instruction.

Acquiring written literacy in English has been found to be challenging for students learning English as a foreign language (EFL). EFL students’ difficulty with academic writing in English is exacerbated in EFL contexts that offer limited English input. University students in China are required to learn English, and in many institutions, learning English-language academic writing has become essential. The important role that English plays in Chinese EFL students’ academic learning is...
tremendous; however, the amount of English input and use of English in Chinese society remains limited. Chinese remains the dominant language in students’ schooling and daily lives while they attempt to learn to write in English. Hence, their written English skills have become concerning, and learners might possess different repertoires of strategies for learning to write in English.

Self-regulation is also thought to affect writing performance. The teaching of EFL writing in China is largely test-driven and product-oriented. In most circumstances, students are passive, and teachers do not aim to cultivate students’ motivation for writing (Reynolds and Teng 2019). In addition, writing curricula, writing teaching syllabi, and writing assessments are prescribed by authorities such as faculty or administrative committees (Zhao 2010). Within a product-oriented and teacher-centered approach, students have few opportunities to become involved in the writing process, and the extent to which students are self-regulated in their writing has become an important factor that mediates their writing outcomes (Teng and Zhang 2016).

Along with the innovative pedagogy of using process-oriented writing instruction, EFL writing in China has focused on individual differences in writing strategies and how these differences predict writing outcomes (Teng and Huang 2018). However, little attention has been paid to understanding other types of writing strategies (e.g. metacognitive writing strategies) in EFL writing (Teng and Huang 2018; Teng and Zhang 2016). As Teng (2016) observed, Chinese EFL students often have limited repertoires of writing tools, and metacognition has predictive power in influencing how students tend to apply writing strategies. Considering the critical role of metacognition in mediating EFL students’ learning outcomes, it is essential to explore the extent to which metacognitive knowledge and regulation can predict or improve their writing outcomes. Contributions of the present study include enhanced understanding of the predictive power of metacognition and guidance for teachers to foster instruction of targeted metacognitive writing strategies for EFL students. Findings also offer insights into applying educational psychology theory, such as self-regulation and metacognition, to the teaching of EFL writing.

Review of literature

Self-regulation

From the sociocognitive perspective, self-regulation is a generic construct including the regulation of social behavior, metacognition, and motivational regulation (Zimmerman 2011). Self-regulated learning (SRL) has been conceptualized as a built-in process by which learners independently, metacognitively, motivationally, and behaviorally plan, monitor, and evaluate their learning (da Silva Marini and Boruchovitch 2014). SRL is influenced by personal processes, environmental events, and behavioral attributes and includes a series of components: identifying a topic, setting goals to familiarize oneself with said topic, adopting strategies to examine the topic, and evaluating and modifying these strategies while developing a deeper understanding of the subject matter in one’s mind (Zimmerman and Schunk 2001). Learners, drawing upon different dimensions of SRL strategies, can discern how to control their internal states, beliefs, social behaviors, and external environments in the learning process (Zimmerman 2013). As noted in previous studies (Donker et al. 2015), students with better self-regulation may exhibit greater self-efficacy, be more cognizant of their strengths and weaknesses, and be more likely to achieve academic success. This pattern has been acknowledged as a process of planning, monitoring, and regulating actions toward learning objectives (Ziegler, Stoeger, and Grassinger 2011) or a sequenced set of processes when managing internal and external distractions (Ben-Eliyahu and Bernacki 2015).

Research in education has traditionally defined SRL as a multifaceted notion, incorporating metacognition, affect, and diverse social dimensions into the learning process. From a theoretical standpoint, it is reasonable to explore SRL as a multidimensional construct that includes internal and external factors. The present study focuses on metacognition, a central component of self-regulation. Metacognition is an important aspect of the educational domain. From an empirical perspective, this
study explores how different writing strategies related to metacognition influence students’ writing outcomes in the EFL context.

**Metacognition**

Metacognition, according to Flavell (1979), encompasses learners’ awareness of their own thinking processes as well as the executive processes involved in overseeing and regulating cognitive processes. Efklides (2008) later described metacognition under the umbrella of cognition, which functions at a meta-level and is connected to the object-world through metacognitive monitoring and control. Metacognition has been classified into three dimensions: metacognitive knowledge, metacognitive control, and metacognitive experiences. In defining metacognitive knowledge, Efklides (2001) framed it as a type of knowledge retrieved from memory and a standard for learners to know about themselves and others as cognitive beings as well as their relations with various cognitive tasks, goals, strategies, or experiences. This definition resonates with an early proposal that metacognitive knowledge involves how cognitive processes should be understood or controlled (Flavell 1999). Although Flavell (1979) suggested person, task, and strategy knowledge as constituting metacognitive knowledge, Paris, Cross, and Lipson (1984) argued that metacognitive knowledge could be organized into declarative, procedural, and conditional knowledge. These three knowledge types have been discussed frequently in subsequent work on metacognition. Declarative knowledge refers to general processing abilities about oneself as a learner and the factors that may influence academic success. Procedural knowledge refers to knowledge of how to successfully solve problems or complete a learning task. Conditional knowledge relates to one’s awareness of when and why to employ specific strategies. However, scholars have argued that expert learners need these three types of knowledge along with the ability to use knowledge effectively (Desoete 2008; Teng 2017a), which has been described collectively as metacognitive control.

Metacognitive control has been identified as the ability to deal with mental operations in metacognitive processes to attain cognitive objectives (Desoete 2008) or to employ knowledge to regulate cognitive processes and use metacognitive strategies to control one’s learning (Ozsoy 2011). However, triggering learners’ metacognitive control processes is challenging, and metacognitive experiences may benefit the self-regulation process (Koriat 2007). Metacognitive experiences have been explained as cognitive or affective experiences consciously stored in a learner’s intellectual enterprise (Flavell 1979) or the awareness that follows from a learner attempting to process the information needed to complete a task (Efklides 2008). Hence, metacognitive experiences establish the basis for a learner’s online awareness while performing a task, during which the connection between metacognitive control and metacognitive experiences becomes apparent. Brown (1987) suggested that metacognitive control and experiences be subsumed into metacognitive regulation, which reflects how learners identify distracting stimuli (internal and external) and sustain effort for executive functions over time. According to Schraw (1998), metacognitive regulation entails three skills: planning, monitoring, and evaluating. Planning refers to the ability to appropriately select strategies and adequately allocate resources for relevant tasks. Monitoring is how learners employ strategies to monitor task performance. Evaluating taps into learners’ appraisal of their regulatory processes and products of their learning.

**Metacognition and language learning**

The key feature of metacognition and language learning is what learners think about their own ability to learn languages and monitor their language-learning process. In the literature, metacognition appears essential to language learning (Haukás, Bjørke, and Dypedahl 2018). Teng (2019) found that learners with a more refined sense of metacognition demonstrated better reading proficiency compared with their counterparts with a less profound sense of metacognition. Similarly, Teng (2017b) argued that learners with low metacognitive ability were more heavily influenced than
those with high metacognitive ability in terms of learning words. In particular, metacognitive knowledge and metacognitive regulation interact to produce individual differences in students’ vocabulary learning. Macaro and Erler (2008) examined the effect of metacognitive reading strategy instruction for students learning French as a foreign language. During 14 months, the instructor spent an average of 10 min per week on the strategy program, which consisted of cycles of awareness-raising, modeling, practicing strategies, and evaluation. Reading comprehension scores between the intervention and comparison group were not significantly different before the intervention, but significant differences were detected post-intervention. Relatedly, Anderson (2008) suggested that metacognition consists of five skills in which language learners can be trained: preparing and planning for learning; selecting and using learning strategies; monitoring strategy use; orchestrating various strategies; and evaluating strategy use and learning.

As highlighted in the above studies, metacognition determines whether language learners are willing to transfer or adapt their learning to new tasks. For example, some learners might know more about language learning, thinking, and locating strategies for a task and would thus likely perform better. In addition, learners possess different conscious meta-strategic levels of higher-order thinking; therefore, a connection between metacognition and language learning performance can be determined, and metacognition is one way for language learners to recognize their strengths and weaknesses as task performers or test takers (Haukås, Bjørke, and Dypedahl 2018). Consistent with other studies, learners who have a sense of their strengths and weaknesses tend to keep their learning strategies and resources under surveillance and evaluate their cognitive readiness for relevant tasks (e.g. Bransford, Brown, and Cocking 2000). In a similar vein, compared to low-performing learners who are unable to monitor their mental processes, those with outstanding learning performance more often apply effective strategies to solve task-related problems, consciously attempt to determine how to apply strategies and employ them effectively, and exercise control over what to focus on and how to pursue pre-determined goals (Hacker and Dunlosky 2003).

**Metacognition and writing**

Research has identified an association between metacognition and writing. First, writing can be considered a constructive process that requires the text producer to take deliberate, analytical action (Vygotsky 1987). From this perspective, writers must maximally compact inner speech to be understood, which requires them to create a web of meaning that links previous, current, and new knowledge. Hence, writing has been defined as part of a generative act for constructing meaning (Flower 1989). Such construction of knowledge and meaning is considered part of metacognitive development (Pugalee 2001). Thus, metacognition and writing are interrelated such that regulating one’s mental activities is integral to employing appropriate strategies to produce intended written output.

On the basis of Garofalo and Lester’s (1985) proposed metacognitive framework, the relationship between metacognition and writing can be summarized in four phases: orientation, organization, execution, and verification. In the first phase, writers must discern problems in writing. The main metacognitive behaviors in this phase include comprehension strategies, information analysis, task assessment, and difficulty assessment. In the second phase, writers are required to organize planning behaviors and monitor actions for their writing. In the third phase, writers adhere to their prior plans; they must also monitor their progress and make decisions involving trade-offs in writing speed, accuracy, and complexity (Teng 2016). In the fourth phase, writers need to verify their decisions and results of their executed plans. Decisions based on metacognitive behaviors may influence executive actions involved in writing.

Scholars attempting to delineate the complex relationship between metacognition and writing have focused on writers’ meta-monitoring of composing processes (Negretti 2012), laying a foundation for subsequent research. Later studies revealed a connection between metacognitive capacities and enhanced writing skills (Harris and Graham 2009; Teng 2016). However, in light of participants’ partial gains and challenges in metacognitive development to support the learning and
transfer of writing-related knowledge, the relationship between metacognition and writing warrants further investigation.

Researchers have also unveiled the predictive role of self-regulation in writing. For example, Teng and Zhang (2016) developed a self-regulation writing strategies questionnaire to better understand how writing strategies for self-regulation mediate Chinese EFL students’ writing. The questionnaire was intended to address a multidimensional model, including cognition, metacognition, social behavior, and motivational regulation. Results showed that learners’ strategies in text processing, planning, monitoring, evaluating, feedback handling, emotional control, and motivation yielded significant predictions for EFL students’ writing proficiency. Following this, Teng and Huang (2018) delineated how other variables (e.g. Chinese EFL learners’ individual differences in English proficiency) introduced complexity into the predictive role of self-regulation on writing. EFL writing strategies related to different dimensions of self-regulation were correlated during the learning-to-write process. Hence, EFL learners’ use of writing strategies greatly affects their writing performance, as noted in other studies (e.g. Zhang, Aryadoust, and Zhang 2016). Based on these findings, metacognitive knowledge (i.e. procedural knowledge, declarative knowledge, conditional knowledge, and metacognitive regulation, namely planning, monitoring, and evaluating) may foster learners’ active engagement in their learning-to-write process and thus predict their writing outcomes. However, there has been little discussion of writing strategies based on metacognition theories, especially in EFL settings. Empirical research regarding the interplay among various dimensions of metacognitive writing strategies in influencing writing in EFL contexts is also limited. The present study therefore seeks to document how metacognitive writing strategies mediate EFL writing outcomes to enrich the knowledge base around self-regulation and writing in the EFL context.

The present study

Despite conceptual and methodological differences in the aforementioned studies, metacognition – encompassing metacognitive knowledge (i.e. declarative, procedural, and conditional knowledge) and metacognitive regulation of mental processes (i.e. planning, monitoring, and evaluating) – appears to function as a prime element in writing performance. As argued by Teng and Huang (2018), a hierarchical, multidimensional relationship exists between self-regulated writing strategies and writing proficiency; however, the mediating role of metacognition in EFL writing requires deeper exploration, as metacognition is inherently complex and EFL learners often lack authentic English exposure (Teng and Huang 2018). For example, writing studies have not yet clarified specific subcomponents of metacognition or their relationships and how they predict writing performance (Teng and Zhang 2016). Scarce evidence has revealed how metacognitive knowledge and regulation may be interconnected in EFL writing. In addition, although metacognitive regulation is essential to EFL writing (Teng 2016), it is unclear to what extent metacognitive regulation adds to the prediction of writing performance over and above the prediction afforded by metacognitive knowledge. Although metacognitive knowledge plays a major part in mediating writing performance, the importance of metacognitive regulation should also be given equal recognition. Despite emphasis on writing and metacognition, this study focuses on the relationship between EFL writing and each sub-component of metacognition.

Specifically, this study seeks to explore the role of metacognition on writing performance on the basis of the relationships among metacognitive knowledge, metacognitive regulation, and EFL writing performance. The following research questions guided this work:

(1) How are metacognitive knowledge, metacognitive regulation, and EFL writing performance correlated?
(2) To what extent do metacognitive knowledge and regulation predict EFL writing performance scores?
Method

Participants

Study participants consisted of 882 first-year EFL learners from eight universities in southwestern China. Students were studying different majors, including arts, accounting, marketing, management, education, and science. University English was a compulsory course (4 h per week). Of that duration, 1 h per week was devoted to English writing. Teachers mainly focused their writing instruction on explaining writing prompts, after which students practiced writing independently. In all, 882 out of 980 enrollees participated in this voluntarily. Participants were instructed they would be completing writing exercises that would not affect their normal studies. All participants signed a consent form on which they also provided demographic information such as their age, native language, and gender. All participants’ first language was Chinese. Because Chinese is not linguistically related to English, cognate influence from the first language was minimized. Participants’ mean age was 21.22 (SD = .61). The sample consisted nearly equally of women (n = 448; 54.4%) and men (n = 402; 45.5%). Participants reported having learned English for an average of 10 years.

Instruments

Metacognitive writing strategies questionnaire (MWSQ)

Measuring metacognition is challenging because metacognition is not an explicit behavior. Traditional methods for assessing metacognition include self-report questionnaires (Schraw and Dennison 1994) and think-aloud protocols (Veenman and Beishuizen 2004). Schraw (2009) argued that tools for measuring metacognition have strengths and weaknesses. Several steps were taken to avoid limitations of using questionnaire. First, the Metacognitive Writing Strategies Questionnaire (MWSQ) used in this study was developed through a multi-method technique aimed at generating items for the instrument (Appendix 1). As Dörnyei (2010) contended, involving learners in the item-generation process can enhance the credibility and quality of measurement items. The multi-method technique in the present study included five writing exercises, which were listed at the beginning of providing responses to the prompts. Then, participants were asked several questions related to metacognitive knowledge (e.g. their strengths and weaknesses). After completing some writing exercises, participants were presented with open-ended questions related to metacognitive regulation, such as how they plan, monitor, or evaluate their writing. A total of 16 EFL students from similar learning contexts were instructed to complete the multi-method technique. Their answers described the strategies they applied while completing writing exercises. Data transcription and analysis resulted in 56 items related to metacognitive writing strategies. Lastly, the author reviewed studies related to metacognition questionnaires (e.g. Schraw and Dennison 1994) and consulted with other researchers, after which 50 closed-ended items were selected. The revised list was sent back to the 16 students to be evaluated for clarity and readability. Five ambiguous items were eliminated thereafter. The final MWSQ instrument contained 45 items (Appendix 2) and was scored on a 7-point Likert scale anchored by 1 (strongly disagree) and 7 (strongly agree) to investigate trait features of each strategy. The mean scores of each strategy sub-category were summed.

The MWSQ, which is administered with no time limit, measures two metacognitive components (metacognitive knowledge and metacognitive regulation) and covers six metacognitive parameters. Declarative knowledge, procedural knowledge, and conditional knowledge include 8, 5, and 7 items, respectively. Skills of planning, monitoring, and evaluating include 6, 9, and 10 items, respectively. The first three parameters were subsumed into metacognitive knowledge (20 items), and the remaining three parameters fell under metacognitive regulation (25 items). The MWSQ was tested in a pilot study with another group of 40 university students from similar education backgrounds. The appropriateness of this measure in the pilot study demonstrated the usefulness of the assessment in testing individual differences in metacognition for this age group. Students at this education level understood the instrument well. Based on pilot participants’ feedback, minor modifications were made
to the format and instructions of the instrument. For example, the measure was originally developed in English but translated into Chinese to ensure readability for Chinese students.

Scores on Cronbach’s alpha were examined to identify the psychometric characteristics of metacognitive parameters. Scores were .71, .73, and .72 for declarative knowledge, procedural knowledge, and conditional knowledge, respectively; and .75, .79, and .81 for planning, monitoring, and evaluating, respectively. In the pilot study, the 40 university students were tested twice at 8-week intervals. Inter-test consistency was analyzed, revealing test-retest Pearson correlations of .81 (p < .01), confirming high reliability.

Writing test
The writing test was modeled after the academic writing test component of IELTS, intended to measure learners’ ability to produce two pieces of writing within a limited time. The test included two parts: the first required learners to write at least 150 words summarizing a graph about behaviors related to payment methods in different countries; the second instructed learners to compose an argumentative essay of at least 250 words, debating the advantages and disadvantages for university students when starting a business. This section tested learners’ ability to provide and justify an opinion, discuss the topic, summarize details, outline problems, identify possible solutions, and support their position with arguments based on their own knowledge or experience. The testing period was limited to 1 h, following the time allotment for the IELTS writing test. Cronbach’s alpha for the writing test was .76 (M = 18.71, SD = 5.61), indicating sound reliability.

However, the marking scheme did not follow the IELTS writing rubric; the recruited raters were not familiar with the writing rubric and suggested using the Chinese traditional writing rubric. The validity and reliability of the Chinese traditional writing rubric have been found acceptable according to many national standard tests (e.g. College English test). The marking scheme for each test section included content, organization, punctuation, word choice, and grammatical accuracy. Fifteen points were possible on each part (3 points per component) for a total of 30 points. Three raters who were not teaching the participants were invited and paid to score the written pieces. None of the raters were trained on the rubric, as they stated they were experienced and familiar with writing rubrics. However, a discussion session was held during which they reached a consensus on samples using the scoring system before they marked tests individually. First, two experienced raters marked the tests independently, and the inter-rater agreement was 95%. Second, a third and equally experienced rater was appointed to rate tests independently to clarify scoring differences between the first two raters. Scores on controversial items were determined by majority opinion.

Procedures
Data for this study were collected through paper-and-pencil tests. All tests were administered in a classroom setting and in single sessions on one day. Students first completed the writing test followed by the MWSQ, with the hope that learners who completed the timed writing portion would have material upon which to reflect when responding to the survey. Two teachers in the writing program at each university attended an instruction session. They were familiar with the procedure and purpose of this study. They served as the test administrators, ensuring that all testing sessions were conducted in the same manner and that participants received the same explanations.

Data analysis
Results were based on interval data. One-tailed Pearson product-moment correlation formulas and multiple regression analysis were chosen for statistical analyses. In the regression analysis, scores from the writing test were taken as the dependent variable, and metacognition scores were the independent variables. The significance level was set at .05.
Results

Table 1 presents the writing test results, metacognition results, and students’ scores on each metacognition parameter.

The average score on the writing test results was 18.16 of 30 ($SD = 6.21$). The total maximum score on metacognition was 211.88 of 315 ($SD = 6.8$). The total maximum scores on knowledge and regulation of metacognition were 91.21 and 120.67, respectively. In terms of metacognitive knowledge, the declarative knowledge score was 33.2, the procedural knowledge score was 24.7, and the conditional knowledge score was 30.31. For metacognitive regulation, the planning score was 30.36, the monitoring score was 40.14, and the evaluation score was 50.17.

Table 2 presents the correlation between WT and the six metacognition parameters. Significant relationships were observed among the six parameters as well as the writing test. Procedural knowledge ($r = .65, p < .05$), planning ($r = .61, p < .05$), monitoring ($r = .61, p < .05$), and evaluating ($r = .67, p < .05$) were more closely related than declarative knowledge ($r = .31, p < .05$) and conditional knowledge ($r = .47, p < .05$). Significant correlations emerged between each parameter of metacognition. Among them, the correlations between planning and procedural knowledge ($r = .61, p < .05$), monitoring and procedural knowledge ($r = .65, p < .05$), and evaluating and procedural knowledge ($r = .63, p < .05$) were noteworthy.

Table 3 displays the results of the Pearson product-moment correlations between scores on metacognitive knowledge and regulation and those on writing performance.

Metacognitive knowledge and regulation were each significantly correlated with writing performance ($p < .05$). Metacognitive knowledge produced a correlation of .70, indicating a strong relationship between a learner’s knowledge in thinking about thinking and the quality of his or her writing.

### Table 1. Descriptive statistics for the metacognition results.

<table>
<thead>
<tr>
<th></th>
<th>$M$</th>
<th>PMS</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT</td>
<td>18.16</td>
<td>30</td>
<td>6.21</td>
</tr>
<tr>
<td>MK</td>
<td>33.2</td>
<td>56</td>
<td>6.71</td>
</tr>
<tr>
<td>PK</td>
<td>24.7</td>
<td>35</td>
<td>6.89</td>
</tr>
<tr>
<td>CK</td>
<td>30.31</td>
<td>49</td>
<td>7.02</td>
</tr>
<tr>
<td>Total</td>
<td>91.21</td>
<td>140</td>
<td>6.87</td>
</tr>
<tr>
<td>MR</td>
<td>30.36</td>
<td>42</td>
<td>6.88</td>
</tr>
<tr>
<td>P</td>
<td>40.14</td>
<td>63</td>
<td>6.54</td>
</tr>
<tr>
<td>M</td>
<td>50.17</td>
<td>70</td>
<td>6.78</td>
</tr>
<tr>
<td>E</td>
<td>120.67</td>
<td>175</td>
<td>6.73</td>
</tr>
<tr>
<td>Total</td>
<td>211.88</td>
<td>315</td>
<td>6.8</td>
</tr>
</tbody>
</table>

Note. PMS = Possible maximum score WT = Writing Test MK = Metacognitive knowledge MR = Metacognitive regulation DK = Declarative knowledge PK = Procedural knowledge CK = Conditional knowledge P = Planning M = Monitoring E = Evaluating.

### Table 2. Intercorrelation matrix of metacognitive parameters and writing achievement.

<table>
<thead>
<tr>
<th></th>
<th>WT</th>
<th>DK</th>
<th>PK</th>
<th>CK</th>
<th>P</th>
<th>M</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT</td>
<td>1</td>
<td>.31</td>
<td>.65</td>
<td>.47</td>
<td>.61</td>
<td>.61</td>
<td>.67</td>
</tr>
<tr>
<td>DK</td>
<td>.31</td>
<td>1</td>
<td>.28</td>
<td>.46</td>
<td>.46</td>
<td>.46</td>
<td>.29</td>
</tr>
<tr>
<td>PK</td>
<td>.65</td>
<td>.28</td>
<td>1</td>
<td>.38</td>
<td>.61</td>
<td>.65</td>
<td>.63</td>
</tr>
<tr>
<td>CK</td>
<td>.47</td>
<td>.46</td>
<td>.38</td>
<td>1</td>
<td>.43</td>
<td>.42</td>
<td>.43</td>
</tr>
<tr>
<td>P</td>
<td>.61</td>
<td>.46</td>
<td>.61</td>
<td>.43</td>
<td>1</td>
<td>.46</td>
<td>.42</td>
</tr>
<tr>
<td>M</td>
<td>.61</td>
<td>.28</td>
<td>.65</td>
<td>.42</td>
<td>.46</td>
<td>1</td>
<td>.41</td>
</tr>
<tr>
<td>E</td>
<td>.67</td>
<td>.29</td>
<td>.63</td>
<td>.43</td>
<td>.42</td>
<td>.41</td>
<td>1</td>
</tr>
</tbody>
</table>

### Table 3. Pearson product-moment correlation results.

<table>
<thead>
<tr>
<th>Test</th>
<th>WT</th>
<th>MK</th>
</tr>
</thead>
<tbody>
<tr>
<td>MK</td>
<td>.70</td>
<td>–</td>
</tr>
<tr>
<td>MR</td>
<td>.72</td>
<td>.80</td>
</tr>
</tbody>
</table>
performance. Metacognitive regulation displayed a slightly higher correlation of .72. However, when analyzing the Fisher r-to-z transformation, the correlation coefficient yielded a z value of 1.75, demonstrating no statistically significant difference in the strength with which these two variables were correlated with writing performance. The two components of metacognition were therefore strongly associated with writing performance.

Table 4 shows the results for the multiple regression analysis on each metacognitive parameter and writing performance. Planning ($\beta = .25$), monitoring ($\beta = .33$), evaluation ($\beta = .32$), and procedural knowledge ($\beta = .25$) were significant predictors of EFL students’ writing performance. However, declarative knowledge ($\beta = .03$) and conditional knowledge ($\beta = .02$) were less significant predictors of EFL writing.

Table 5 presents the results of multiple regression analysis, which determine the extent to which the independent variables of metacognitive knowledge and regulation could explain variance in the dependent variable of writing performance.

Metacognitive knowledge and regulation collectively accounted for 62% of the variance in writing test scores, indicating a strong association between metacognition and writing quality. To determine the unique contribution of each independent variable, a stepwise multiple regression analysis was performed. The analysis was based on the assumption that metacognitive knowledge is the fundamental component in determining a learner’s writing performance and that metacognitive regulation can refine a learner’s metacognitive knowledge and facilitate automaticity in producing intended written output. Results show that metacognitive knowledge accounted for 49% of the variance in writing performance when entered into the regression model at the first step ($F_{\text{change}} = 85.31, p < .01$). Metacognitive knowledge thus made a unique contribution to the model. When metacognitive regulation was entered into the equation, it added 13% to the variance already explained by metacognitive knowledge ($F_{\text{change}} = 28.11, p < .05$). With a statistically significant value at the .05 level, metacognitive regulation added a great deal to the variance already accounted for by metacognitive knowledge.

A new model was then built to determine the predictive power of metacognitive regulation in EFL writing performance and the extent of the prediction of writing performance added by metacognitive knowledge over and above that provided by metacognitive regulation. Metacognitive regulation was entered into the equation first, followed by metacognitive knowledge. Table 6 shows that the $R^2$ was 0.59 ($F = 82.68, p < .05$) when metacognitive regulation was added into the equation. The $R^2$ increased to 0.62 ($F_{\text{change}} = 9.12, p < .05$) after adding metacognitive knowledge into the equation; thus, metacognitive knowledge added 3% of the explained variance in EFL writing performance on top of the prediction provided by metacognitive regulation.

**Table 4.** Multiple regression analysis of each metacognition parameter for writing performance.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>$B$</th>
<th>$SE$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK</td>
<td>-.21</td>
<td>.13</td>
<td>.03</td>
</tr>
<tr>
<td>PK</td>
<td>-.15</td>
<td>.14</td>
<td>.25*</td>
</tr>
<tr>
<td>CK</td>
<td>.97</td>
<td>.12</td>
<td>.02</td>
</tr>
<tr>
<td>P</td>
<td>.87</td>
<td>.15</td>
<td>.25*</td>
</tr>
<tr>
<td>M</td>
<td>.81</td>
<td>.14</td>
<td>.33*</td>
</tr>
<tr>
<td>E</td>
<td>.82</td>
<td>.16</td>
<td>.32*</td>
</tr>
</tbody>
</table>

Note. $P < .05$.

**Table 5.** Multiple regression analysis results for metacognitive knowledge and metacognitive regulation.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Variables</th>
<th>$R^2$</th>
<th>$R^2$ Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both variables</td>
<td>MK and MR</td>
<td>.62*</td>
<td>.62*</td>
</tr>
<tr>
<td>Stepwise-step 1</td>
<td>MK</td>
<td>.49*</td>
<td>.49*</td>
</tr>
<tr>
<td>Stepwise-step 2</td>
<td>MR</td>
<td>.62*</td>
<td>.13*</td>
</tr>
</tbody>
</table>

Note: *indicates that the result is significant at $p < .05$. 
However, the role of metacognitive regulation was not distinct; results should be interpreted cautiously due to multicollinearity (i.e. the two variables of metacognitive knowledge and regulation were highly correlated in the multiple regression model). Hence, each component of metacognition can be taken as a reliable predictor of university students’ EFL writing performance and explains a significant portion of the variance in writing performance, supported by the intercorrelation (r = .80) in Table 3. Overall, Tables 5 and 6 indicate that metacognitive knowledge is a foundational component of metacognition in writing performance, with metacognitive regulation playing a more prominent role.

Discussion

The objective of this study was to examine metacognition and writing performance in Chinese university EFL learners. Our findings reveal a positive and significant relationship between metacognitive knowledge and regulation as well as between metacognition and writing performance, corroborating prior studies (Harris and Graham 2009; Pugalee 2001; Teng 2016). Based on these results, metacognition should provide a useful tool for developing writing-related skills and quality.

In terms of the first research question regarding the relationship between metacognition and writing, findings showed that the six parameters of metacognition were significantly correlated, as was each parameter and writing performance. The Pearson correlation coefficients indicated that procedural knowledge, planning, monitoring, and evaluating were more significantly correlated with writing. Thus, for this sample and the tests under discussion, planning, monitoring, and evaluating (as components of metacognitive regulation) were positively correlated with EFL learners’ writing performance. In comparison, only procedural knowledge (as a component of metacognitive knowledge) was highly correlated with learners’ writing performance. Significant correlations also emerged between each metacognition parameter; the correlations between planning, monitoring, evaluating, and procedural knowledge were remarkable. The multiple regression analysis revealed that planning ($\beta = .25$), monitoring ($\beta = .33$), evaluation ($\beta = .32$), and procedural knowledge ($\beta = .25$) were significant predictors of students’ writing performance. In addition, the high correlation between metacognitive regulation and metacognitive knowledge suggests that learners’ metacognitive knowledge and regulation were closely and positively associated. Metacognitive knowledge and regulation collectively predicted more than 60% of the variance in writing performance; hence, both components are important for successful writing performance. The development of these two components of metacognition is likely interconnected and interdependent, such that achievement in writing is linked to strong metacognition.

Procedural knowledge, referring to information about how to successfully apply various actions and strategies, seems to promote efficacious planning, monitoring, and evaluating of text production. Procedural knowledge has also been found to help learners create an environment conducive to writing. As shown in previous studies (Donovan and Smolkin 2006; Graham 2006), the developmental trajectory of metacognitive writing knowledge plays a critical role in writing development and performance. Graham (2006) argued that skilled writers are more knowledgeable about writing, whereas novice and struggling writers (e.g. those with low writing scores in this study) might lack knowledge about what constitutes good writing products and processes. Similar to findings related to metacognitive knowledge, the metacognitive regulatory skills with which writers manage the multiple facets of composing include planning (e.g. establishing rhetorical goals and tactics based on available resources), self-monitoring (e.g. determining whether writing goals are being met), and self-

### Table 6. Additional multiple regression analysis with MR and MK as independent variables.

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure</th>
<th>Variable</th>
<th>Status</th>
<th>$R^2$</th>
<th>$R^2$ Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forced entry</td>
<td>MR</td>
<td>in</td>
<td>.59*</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Forced entry</td>
<td>MK</td>
<td>in</td>
<td>.62*</td>
<td>.03*</td>
</tr>
</tbody>
</table>

Note. *Significant at 0.05.
evaluating (e.g. assessing the quality of text and proposed plans). These findings support the central role of self-regulation in writing (Teng and Huang 2018). When writers are more self-regulated (e.g. more organized and reflective in actively monitoring and evaluating the composition process), they are more skilled in writing (Teng 2016).

Overall, the main components of metacognition were independent but significantly correlated in many ways. This finding coincides with other studies (Brown and Kinshuk 2016; Sperling et al. 2002; Teng 2017a, 2017b). One possible explanation for the high correlation between metacognitive knowledge and metacognitive regulation might involve the partial construct overlap of the two measures. Metacognitive knowledge measures whether learners understand the essential elements, characteristics, and strategies for high-quality compositions, while metacognitive regulation measures whether learners have identified various self-regulation strategies for managing the multiple facets of composition. These elements might be inherently correlated; therefore, it is unsurprising that EFL students with a wide range of metacognitive skills were more likely to adopt appropriate strategies for writing or to modify their existing strategies, which afforded them more opportunities for better writing performance. This trend echoes findings in which metacognition was identified as a strong predictor of outstanding learning performance (Blankson and Blair 2016). Essentially, metacognition enables learners to regulate their cognitive skills, identify their strengths and weaknesses, and discover appropriate writing strategies.

Our results also addressed the question of the distinct roles of metacognitive knowledge and regulation in predicting writing performance. Multiple regression analysis revealed that metacognitive regulation and knowledge each contributed significantly to predicting writing performance. Notably, metacognitive regulation added 13% of the explained variance in writing performance over and above the prediction from metacognitive knowledge. Therefore, metacognitive regulation, encompassing the self-regulatory skills of planning, monitoring, and evaluating, made a significant and unique contribution to predicting scores on writing performance beyond that provided by metacognitive knowledge. Conversely, although metacognitive knowledge contributed to predicting writing performance, it added only 3% of the explained variance over and above the prediction from metacognitive regulation. The significant correlation between metacognitive knowledge and metacognitive regulation ($r = .80$) thus raises the question of why metacognitive regulation performed better than metacognitive knowledge in the regression analyses. One explanation is that metacognitive regulation included more items (25 points) than metacognitive knowledge (20 points). In addition, when metacognitive regulation was divided into planning, monitoring, and evaluating, these sub-sections still yielded positive results in mediating writing performance. Furthermore, planning ($r = .61, p < .05$), monitoring ($r = .61, p < .05$), and evaluating ($r = .67, p < .05$) had the highest correlations with writing performance, demonstrating that scores on metacognitive regulation may be more significant predictors of writing performance. Potentially, learners may report regulatory behaviors in writing more easily compared with writing-related metacognitive knowledge. Another possible explanation for why metacognitive regulation fared better than metacognitive knowledge in the analysis was that the writing test was modeled on an IELTS test and was not discriminating enough at the higher end. More writing tests should therefore be used in future studies.

Armed with the above knowledge, one could argue that learners with stronger regulatory skills establish reasonable writing goals and plan their writing based on appropriate selection of writing strategies. With these skills in hand, learners can likely more easily determine whether the chosen writing strategies work well. They can then continue writing when their strategies are working and make adjustments until the strategies align with their writing goals. They can also monitor their writing performance and evaluate the final product. Learners with fewer regulatory skills may not set appropriate writing goals and thus fail to effectively plan, monitor, and evaluate their writing strategies (Harris and Graham 2009; Teng 2016). In this case, knowledge of metacognition may affect learners’ knowledge about themselves, the tasks at hand, and relevant strategies; by contrast, metacognitive regulation explains how strategies are selected, resources are allocated, and task performance is monitored and evaluated when writing. Hence, writing performance is a function of the
EFL learners’ regulatory skills. That said, EFL learners must develop a high level of metacognitive regulation when selecting writing strategies that may help them understand the nuances of writing.

**Conclusion and implications**

As argued in previous studies (Kim 2013; Negretti 2012; Teng 2016), metacognition is an important dimension related to writing. The present study demonstrated through empirical evidence that, for Chinese university EFL learners, dimensions of metacognitive knowledge and regulation are closely associated, and metacognitive regulation is a driving factor in the relationship between metacognition and writing performance. In addition, our findings revealed the important role of metacognitive regulation in mediating writing performance. These results indicate that to improve students’ writing performance, at least two components of metacognition warrant attention when developing university English curricula.

Results present the following implications. First, writing is strongly correlated with EFL learners’ metacognitive awareness of how writing proceeds and, most notably, in the self-regulation of performance. Thus, self-regulatory competence (i.e. adapting skills and strategies to suit learners’ needs and contextual conditions) should be emphasized among students to develop metacognitive awareness of what, how, and why certain choices apply in writing (Negretti 2012). Second, while developing and evaluating writing strategies, students must engage in critical thinking to incorporate multiple perspectives and monitor and regulate their writing processes. Developing metacognitive strategies for writing can be divided into three main aspects. Learners first need to plan appropriate resources for writing; then monitor their cognitive, behavioral, and affective processes while writing; and finally evaluate possible solutions to make informed decisions. It is important for instructors to communicate this process to university EFL learners to promote awareness of the benefits of attending to metacognitive regulatory skills for writing performance while encouraging students to do so effectively.

The limitations of this study involve methodological difficulties inherent in assessing metacognition. The developed MWQR measure may not have measured learners’ metacognitive knowledge and metacognitive regulation accurately due to characteristics of individuals taking the test; additionally, the output was based solely on participants’ self-reported academic writing routine. Future studies should triangulate data through a qualitative approach of observing learners’ behaviors longitudinally to obtain a full picture of learners’ metacognition (Händel, Artelt, and Weinert 2013). In addition, the scale of metacognition should cover more parameters (e.g. predicting, metacognitive control, and metacognitive experiences). The writing test should also include other types of exercises ranging from easy to difficult. Finally, learners with superior metacognitive skills may perform well in other language skills, e.g. learning words (Teng 2017b). This study did not examine the relationship between metacognition and proficiency in other English skills. Furthermore, other factors or variables (e.g. learners’ English proficiency level, aptitude, and attitudes toward English writing) may influence metacognition. Despite these limitations, the findings can serve as a reference for future research delineating the relationship between metacognition and EFL writing.

**Disclosure statement**

No potential conflict of interest was reported by the author.

**Notes on contributor**

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References


Appendices

Appendix 1. A multi-method technique in eliciting responses for the development of survey items

Look at these writing exercises (without doing them)

1. Write a setting based on the most beautiful place you’ve ever seen.
2. Write some sentences about yourself.
3. Reconstruct an argument text after some class oral work on the topic of school education.
4. Write down a list of memories. Try to be as specific as possible. Then go back and try to figure out why each memory is important.
5. Check your own writing and try to make your finished writing as free of mistakes as possible.

Now talk about your answers for the following questions:
• What are your strengths and weaknesses for such exercises? (declarative metacognitive knowledge)
• Are you aware of what strategies are needed for such exercises? (procedural metacognitive knowledge)
• How do you motivate yourself to learn what you need for such exercises? (conditional metacognitive knowledge)

Look at this exercise (without doing the exercise)
Write some comments for a book you have read.
Now talk about your answers for the following questions:

• How will you plan the content of the essay before writing? Quote some. (Metacognitive planning skill)

Now do this exercise
Write some comments for a book you have read.
Now talk about your answers for the following questions:

• How did you monitor the performance of this writing task? (Metacognitive monitoring skill)
• How did you evaluate your performance of this writing task? For example, how well you wrote according to your plans, and how well you corrected the errors. (Metacognitive evaluation skill)
• What strategies do you use pre, during and after the writing process?

Appendix 2. Metacognitive writing strategies questionnaire (MWSQ) (Sample items)

Directions: Thank you very much for taking part in this survey about writing strategies. This is not a test, so there are no ‘right’ or ‘wrong’ answers, only personal opinions which we value. Please give your answers sincerely as only this will guarantee the success of the investigation. Thank you for your cooperation. Following are a number of statements with which some people agree and others disagree. Please indicate your own opinion after each statement by circling the number that best describes the extent to which you agree or disagree with the statement.

1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = Neutral, 5 = slightly agree, 6 = agree, 7 = strongly agree

For example, if you ‘strongly agree’ that ‘I like English writing’, please circle ‘7’:

<table>
<thead>
<tr>
<th>I like English writing</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>

Part I. How do you rate the ways that you proceed in the preliminary stage before writing?
1. I read related articles to help me plan for my writing. (P) 1 2 3 4 5 6 7
2. I know my strength and weakness for my writing. (DK) 1 2 3 4 5 6 7
3. I have explicit purposes for each writing topic. (PK) 1 2 3 4 5 6 7
4. I can use effective writing strategies when the topic is familiar to me. (CK) 1 2 3 4 5 6 7

Part II. How do you rate the ways of proceeding during writing?
1. I ask myself if I have met the goals for my writing. (M) 1 2 3 4 5 6 7
2. I know what I should monitor during writing. (DK) 1 2 3 4 5 6 7
3. I find myself automatically using some effective strategies to monitor my writing. (PK) 1 2 3 4 5 6 7
4. I can motivate myself to monitor my writing when it is necessary. (CK) 1 2 3 4 5 6 7

Part III. How do you rate the ways of proceeding in the revising stage after writing?
1. I evaluate my mastery of knowledge and skills after writing. (E) 1 2 3 4 5 6 7
2. I have a specific purpose for my evaluation. (PK) 1 2 3 4 5 6 7
3. I know what I should do to revise and check my writing. (DK) 1 2 3 4 5 6 7
4. I can motivate myself to evaluate when it is necessary. (CK) 1 2 3 4 5 6 7

Note. The above items are sample items. The survey included 45 items. Among them, P = Planning (6 items); M = Monitoring (9 items); E = Evaluating (10 items); DK = Declarative knowledge (8 items); PK = Procedural knowledge (5 items); CK = Conditional knowledge (7 items)