English as a foreign language writers' metacognitive strategy knowledge of writing and their writing performance in multimedia environments

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Abstract: This paper reports on an exploratory study that investigated the relationship between English as a foreign language (EFL) writers' reported metacognitive strategy knowledge and their English writing performance in multimedia environments in a Chinese tertiary context. A self-report questionnaire was used to collect data on 126 participants' metacognitive strategy knowledge and EFL writing scores. Mann-Whitney U Tests were conducted to explore differences between high (n = 65) and low (n = 61) EFL proficiency groups. Analysis of the data revealed that the participants' metacognitive strategy knowledge was correlated significantly with their writing performance. The high EFL-proficiency group reported having statistically significantly more metacognitive knowledge about three clusters of metacognitive strategies (planning, monitoring, and evaluating) than their low EFL-proficiency counterpart. These important findings point to pedagogical implications that there is a need to integrate metacognitive strategies into teaching and researching EFL writing.

Keywords: metacognitive strategy use; EFL writing; multimedia environments; high- and low-proficiency writers

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1. Introduction

Metacognition is now regarded as an essential component when we intend to understand learners and their learning process. It is also an important lens through which learning effectiveness can be observed in order for it to be enhanced. This is true not only in the field of educational psychology but also in the field of language education or applied linguistics. For English as a foreign language (EFL) writers, researchers have also increasingly pointed to the importance of metacognition in understanding and nurturing students' composing processes for developing their writing proficiency (e.g., Lee & Mak, 2018; Teng & Huang, 2019; Zhang, 2014, 2016). This is especially important in an era when second language (including EFL) writers are more likely to use computers and the Internet for improving language skills and writing performance in classrooms (Elzarka et al., 2015). In the last decade, language and literacy educators (e.g., Chien, 2012; Lai, 2009; Zhang & Qin, 2018) have also become immensely interested in language learners' metacognitive strategy knowledge about EFL writing in multimedia environments. In such studies on how students learn to write in EFL in multimedia environments, researchers found that successful language learners could make effective use of metacognitive strategies to develop writing competence and these strategies are teachable to the less successful learners (Chien, 2012; Lai, 2009). Language instructors can, therefore, assist the less successful learners' language learning process by helping them to develop appropriate strategies for improving their language proficiency.

As far as EFL students' writing in multimedia environments is concerned, most available research has reported on the beneficial effects of multimedia tools on students' writing improvement (e.g., Chen, 2016), and relatively few studies have focused on charting the patterns of relationships between students' metacognitive strategy knowledge and their writing performance; and this is particularly true in the Chinese EFL context; nor has any substantial study on the students' metacognitive strategy knowledge about writing in multimedia environments been reported. Research suggests that, notwithstanding the same multimedia-mediated writing environment, high- and low-achieving student writers write differently (Wang & Bai, 2017). The problems that prevent low-achieving writers from developing their competence need to be investigated. But unfortunately, there has been insufficient research in this regard. As an attempt to fill this research gap, we explored the relationships between EFL writers' metacognitive strategy knowledge about writing and their English writing performance in a multimedia environment, which consisted of use of an automated essay scoring (AES) system — *Pigaiwang*[1].

By comparing typical patterns of metacognitive strategy knowledge that different groups had, we aim to gain a deep understanding of the challenges facing low-achieving students in the same multimedia writing environments. It is hoped that part of

the findings will also help shed light on the issues related to how to teach EFL writing and deliver more effective writing teacher preparation programs.

2. Literature Review

2.1 Metacognitive Views on L2 Writing Processes

Metacognition is knowing about knowing, or cognition about cognition (Flavell, 1979). It is often referred to as "a range of beliefs, understandings, behaviours, and strategies for current and future actions that are most often dynamic and systematic" (Zhang, 2010, p. 322). The construct of metacognition has provided a new perspective on research into L1/L2 language research and education. Various researchers in the fields of psychology, educational psychology, and education in general have incorporated the concept into their own frameworks, carried out experimental research on metacognition, and made important contributions to metacognitive theoretical developments. Among those, of pertinence to this study, are studies describing the relationship between metacognition and academic language learning success. In the field of L2 language teaching and learning, studies addressing metacognitive issues tend to focus on examining how learners' use of metacognitive strategies was related to second/foreign language skills, such as listening (Goh, 2008; Goh, & Hu, 2014; Zhang & Goh, 2006), reading (Zhang, 2010), speaking (Lam, 2010), and writing (Bui & Kong, 2019; Chien, 2012; Ruan, 2014). This is because metacognitive strategies are understood to play a critical role in successful language learning through learners taking charge of their own learning by making decisions in their own favour (Wenden, 2002; Zhang, 2010, 2017).

With reference to the development of writing skills, we observe that the vital role of metacognition in the writing process has also been widely acknowledged (e.g., Chien, 2012; De Silva & Graham, 2015; Ruan, 2014). De Silva and Graham (2015) argue, in particular, for the centrality of metacognitive strategy combinations for the effective execution of a writing activity. Understandably, L2 learners' metacognitive knowledge can help them take control of their language learning process in the way that they can plan, monitor, and evaluate their writing process (De Silva & Graham, 2015). Specifically, there are three writing stages that EFL writers go through in their composing process. First, before writing, writers with strong metacognitive knowledge may make some necessary preparations, such as planning the structure of the writing task, setting meaningful goals, or allocating appropriate writing time (Ong & Zhang, 2013). Second, during writing, writers may monitor the writing process, assess particular strategies to ensure that the writing goals will be achieved, or make necessary adjustments. Third, writers may evaluate their writing strategies, or rethink other aspects of the writing context that could impact the quality of their written products. In a nutshell, different types of metacognitive knowledge with various categories and subcategories that learners have contribute greatly to their writing performance.

2.2 Relationships between Metacognitive Strategy Knowledge and Language Proficiency

Much research has been conducted to investigate the relationships between students' reported use of metacognitive strategies and language learning achievement both in the traditional paper-and-pen writing (Bai, Hu, & Gu, 2014; Chien, 2012; Zhang, 2017) and the modern electronic writing environments (Wei, Chen, & Adawu, 2014). Of the several threads of empirical studies worldwide, the one that is most pertinent to the present study is research that compares metacognitive strategy knowledge of writers of different proficiency levels after the adoption of process-oriented approaches in writing research.

Since the time when writing started to be regarded as a process rather than merely a product, theoretical models of writing have proliferated to emphasize the role of writing strategy knowledge in improving L1 or L2 writing abilities in the fields of psychology, educational psychology, applied linguistics, and second language education (Bereiter & Scardamalia, 1987; Cohen & Griffiths, 2015; Cumming, 2001; Hayes & Flowers, 1980; Hyland, 2015; Zimmerman & Reisemberg, 1997). This line of research in L1 or L2 contexts shows that expert/skilled writers differ significantly from their novice/unskilled counterparts in their composing processes. For example, in a study which investigated the relationship between L2 learners' metacognitive abilities and writing performance, Victori (1999) found that there were significant differences in the metacognitive knowledge that successful and less successful L2 writers had. As the study suggests, the two "good" writers held a much broader and more complex view of their own approaches to writing than the two "poor" writers, revealing the clear relationship that exists between the writers' metacognitive knowledge and writing achievement. Based on the findings, Victori (1999) proposed that the students' metacognitive knowledge should be enhanced to enable them to complete writing tasks successfully. In the same vein, Baker (2011) clarified the distinction between more and less skilled writers' metacognitive knowledge of their composing process. She reported that skilled writers had a higher-order awareness of the writing process, which enabled them to better plan, monitor, and evaluate their self-directed learning following the writing task, whereas less skilled writers tended to focus on lower-order processes, dealing with some mechanical aspects of writing such as spelling, grammar, and punctuation. These less skilled writers did not even set goals for the writing tasks, which easily carried themselves off-track during the process of exploring ideas due to their surface-level concerns.

Despite the preponderance of studies in addressing the importance of writers' metacognitive knowledge, there is also research reporting that metacognitive strategy knowledge might have minimal impact on students' language achievement (e.g., Khaldieh, 2000; Lai, 2009; Magogwe & Oliver, 2007; Phillips, 1991). As a notable instance, Magogwe and Oliver (2007) investigated the relationship between Botswana students' reported use of their preferred language learning strategies and different proficiency levels of primary, secondary, and tertiary students. They found that this

relationship was actually a rather curvilinear one, where proficiency influenced strategy use at the primary level but not at the secondary or the tertiary level. Other researchers even found that, similar to successful learners, unsuccessful learners also actively applied a great number and variety of strategies, including metacognitive strategies. Students of high-proficiency did not invariably use more frequently more strategies (e.g., Chen, 1990; Khaldieh, 2000; Lai, 2009). A possible explanation for such claims may lie in the complex nature of the learning process or different learners' experiences, where advanced or high-proficiency learners may have experienced an automatization process in their use of language learning strategies and therefore did not report these processes as deliberate and conscious strategies. As Cohen (2012) explains, less effective learners may keep trying different strategies in their struggle for completing the learning/writing task to raise their frequency of using any kind of strategies. In contrast, high proficiency learners may use fewer consciously selected strategies to orchestrate their learning/writing task more effectively. Their higher metacognitive awareness has permeated into their learning process, making their learning more independent and autonomous.

Overall, research has validated that there is a positive relationship between language strategy knowledge and learning achievement (e.g. Teng & Zhang, 2016). Furthermore, considerable empirical research has provided evidence that learners' effective use of metacognitive strategies in operation before, during, and after their performance of a writing task is related to better performance in writing or language achievement (e.g., De Silva & Graham, 2015). The literature on Chinese tertiary students' metacognition about EFL writing, however, is scarce, particularly with regard to EFL writing in multimedia-mediated environments. Against such a background, we now move on to report our study on the relationship between students' metacognitive strategy knowledge and their writing performance.

2.3 Use of Multimedia in EFL Teaching and Learning in China

Last three decades has witnessed the booming growth of information technology all around the world. The Internet has become an integral part of our daily lives. In China, as of December 2017, the number of netizens has reached 772 million, and the Internet penetration rate reached 55.8%, which was 4.1 percentage points higher than the global average (51.7%) and 9.1 percentage points higher than the average level in Asia (46.7%) (Chinese Internet Network Information Center, CNNIC, 2018)[2].

With the exponential growth of information technology, multimedia, as a combination of text, graphics, animation, video and sound, has created a favorable context for reforming and exploring English language teaching models in the new age in China. Integrating multimedia technology into the English-teaching curriculum in classrooms has become a trend in Chinese universities, which is expected to enhance the effective teaching and learning of English in the tertiary classrooms.

Following the new trend towards extensive applications of multimedia technologies, Chinese researchers have also shown a growing interest in Chinese EFL

students' use of language learning strategies in multimedia environments. The literature on teaching language learning strategies to Chinese learners in multimedia environments shows that the use of metacognitive strategies is crucial to bring about learner development in such a complex context (Ma, 2010). Due to the fact that learners have to exert much greater efforts in the increasingly complex multimedia contexts in order to learn effectively, the process at the metacognitive level plays a crucial role in helping their self-regulation of learning; i.e. their awareness of, and cognitive control and regulation over, learning, can enhance their learning efficiency and self-efficacy (Zhang, 2008, p. 92). However, with very few exceptions (see, e.g., Chen, 2016), a systematic analysis of the relationship between students' metacognition and their EFL writing competence in multimedia environments can hardly be found. A large part of this research has been based on the idea of successive assertions/iterations that lack empirical support. Apparently, research on learners of EFL writing in China is insufficient, which is disproportionate given that China boasts of having the largest number of netizens (CNNIC, 2018).

3. The Current Study

3.1 Research questions

The aim of the present study is to explore the role of students' metacognitive strategy knowledge in relation to their English writing performance in multimedia environments in the Chinese ELT context. Drawing on a questionnaire-based study, the study set out to answer the following research questions:

(1) What are the relationships between EFL writers' metacognitive strategy knowledge and writing performance in multimedia environments?
(2) Are high- and low-achieving EFL writers different in their metacognitive strategy knowledge in multimedia environments?

3.2 Participants

Multimedia Writing is the title of the experimental credit-bearing course offered at the participating university. When the study was conducted, year-two students were invited by their English teachers to participate in an experimental teaching reform organized by the Department of College English Teaching at the university, in which *Pigaiwang,* one of the most commonly used online writing assistance platforms in Chinese universities, was introduced to student writers in class. The students were required to post their written products on *Pigaiwang*. This means that all the participants in this study had some experience in multimedia-mediated writing in English. Also, along with the experimental teaching reform, the instructors were engaged in curriculum reform by conducting multimedia-mediated writing instruction with the integration of *Pigaiwang* in classroom activities, aiming to contribute to student growth in the writing skills by means of modern technology.

Pigaiwang, as an automatic essay scoring system, provides a holistic score for each composition, real-time diagnostic feedback in terms of grammar, lexical usage, mechanics, style, and organization, and other important additional functions, such as plagiarism checking, deadline setting, peer review, sample composition sharing, instructor interacting, among others. The system is based on linguistic corpora specifically tailored to the analysis of L2 student writers and linked to cloud computing. It allows multiple submissions with each giving feedback, which in turn motivates students to produce final copies/versions and stimulates their interest in learning to revise effectively.

In this study, the students were asked to post their essays on the *Pigaiwang* writing platform. On the one hand, the students could make full use of the functions that the system provided. On the other, we, as the researchers, could collect their original writing texts which were stored at the platform. In this process, the *Pigaiwang* worked as a plagiarism checker (the similar function as *Turnitin* in western universities), serving as a safeguard to ensure the originality of the students' writing scripts.

Based on the convenience sampling (Creswell & Creswell, 2017), a total number of 300 students who were taking the *Multimedia Writing* course were invited to participate in this study. A questionnaire (see section 3.4 for detailed discussion) was administered to the 300 participants. Our data cleaning resulted in 286 valid questionnaires for the correlation analysis.

What's more, to investigate any differences associated with EFL proficiency, the 286 questionnaire respondents were then asked to sit for a writing test (for details of the writing test, see 3.3.2). Based on their writing performance, they were further divided into two groups — a high EFL proficiency group and a low EFL proficiency group.

The grouping was based on their self-reported scores (see Part One in Appendix A) and their writing performance in the test. The self-reported score was the subject English score of the National College Entrance Examinations (NCEE, also known as *Gaokao* in China). A score of 90 was the cut-off score. The score in the writing test was gained by two experienced raters. A score of 60 was the cut-off point. A participant's EFL proficiency was based on the two test scores. Specifically, participants whose scores were above 130 in the NCEE and above 85 in the writing test were considered as high EFL-proficiency participants (n = 65); while those whose scores were below 90 in the NCEE and below 60 in the writing test were termed low EFL-proficiency participants (n = 61).

Altogether, data from 126 participants (the questionnaire data and the writing test data) were included for the comparison analysis. All of the participants were young adults of around 21 years of age (M = 20.78, SD = 2.43). However, there were significantly more female than male participants (76.3% female). The participants reported an average of 10 years of formal English language learning in school (M = 10.15, SD = 1.73).

3.3 Instruments

3.3.1 The Questionnaire

Framed within metacognition theory and drawn on empirical data, Zhang and Qin's (2018) questionnaire, *The Questionnaire on Language Learners' Metacognitive Writing Strategies in Multimedia Environments* (LLMWSLME) (see Appendix A), was proven to be a robust survey instrument with good construct validity and reliability. In their study, confirmatory factor analyses (CFAs) were employed to analyze the data collected from a large population of 378 participants, which confirmed a three-factor metacognitive structure with good internal consistency reliability: planning (Cronbach's α = .91), monitoring (Cronbach's α = .94), and evaluating (Cronbach's α = .88).

Given the similar context and as a confirmatory measurement tool, the LLMWSLME was employed in the current study to make comparisons and draw contrasts between students' use of metacognitive strategies in relation to their writing proficiencies. The participants spent on average 10-15 minutes in completing the questionnaire.

3.3.2 Writing Tests

Judging students' writing achievement by asking them to finish a written product has been a common practice in writing performance assessment. In order to evaluate participants' writing proficiency, we adopted a given-topic argumentative writing test selected from the College English Test (CET) bank. The reasons are twofold: First, the CET test is a nationally standardized examination of the largest scale to assess the English proficiency of non-English majors in China's colleges and universities. Its importance has been widely recognized by the university students in China, and it is generally accepted as the China's most widely used high-stakes English proficiency test; Second, the test has been carefully designed and developed by a team of testing experts in China. Its validity has been widely recognized, and it has been accepted as a reliable benchmark for English proficiency currently used in China's colleges and universities[3].

In contrast to the traditional administration of the CET test (Examinees sit an exam with strict time constraints with paper and pen), the participants in our study sat the writing tests in the Writing Lab by using the computers. They were required to produce an argumentative composition on a given topic with at least 150 words and post it on the *Pigaiwang* writing platform. Moreover, in the standard CET test, only 30 minutes was allowed for the writing task while the participants in this study were allowed to have 40 minutes to finish their compositions. This was to ensure the participants had enough time for the preparation of their writing tasks using modern technology, such as online information searching, online dictionary use, and the Microsoft word processor. The extra 10 minutes' preparation time was based on the studies of researchers who investigated the impact of planning on writing (e.g., Amani, 2014; Ellis, 2005; Ong, 2014; Ong & Zhang, 2010). The participants were also required to submit their compositions online immediately afterwards.

The assessment criteria of the written products were adapted from the "ESL Composition Profile" (Jacobs et al., 1981, p. 90). There are five components of writing performance: Content, organization, language use, vocabulary, and mechanics. Each component is weighted in the rating scheme as follows: Content (30 points), organization (20 points), vocabulary (20 points), language use (25 points), and mechanics (5 points). Two evaluators, who had expertise in second language acquisition, were first trained to use the marking rubric and then invited to evaluate the student compositions. Specifically, they rated the five traits independently and then the independent rating scores were added to work out a single average score. Because this study focused on the evaluation of the students' overall writing proficiency, the single score was collected to judge the students' writing achievement.

To guarantee the reliability of the rating, the two raters did pilot rating. From the 286 writing tests that had been stored on the Pigaiwang writing platform, 60 texts were randomly selected and scored by both raters. Given the heavy load of marking and limited time, in order to guarantee the marking quality, the 60 texts were numbered (wrote 1, 2, 3,...58, 59, 60 in each piece) and divided into two sets, each with 30 pieces. The two raters were asked to mark the first 30 texts with a marking sheet, had a rest, and then exchanged their own 30 texts to one another to give scores with another marking sheet. The first author collected all the marks and put them in order based on the previous numbering. Then he checked the reliability of their ratings by calculating a correlation coefficient for the total scores given by both raters. The coefficient was .95 (correlation r), indicating that the two raters achieved a high degree of agreement on their ratings. Finally, the remaining 226 papers were equally divided between the two raters and scored. The scores were collected by the first author for further analysis.

3.4 Data Analysis

Data collected from the LLMWSLME were checked and cleaned first. Missing responses and inconsistent patterns of responding were removed from the subsequent analyses. The data cleaning resulted in 286 valid questionnaires. A more strict assessment of the data set, such as normality, linearity, and homoscedasticity, was conducted before the analysis was performed.

Given that reliability of a measure can change from one study to another, measures of internal consistency were first run for the three factors constructed in the questionnaire. The overall and subscale reliability of the LLMWSLME (planning: α= .92; monitoring: α= .91; evaluating: α= .94; overall: α= .90) were confirmed to be consistent with previous findings. Further analyses were then divided into two main parts. The first part consisted of a Spearman's rho correlation test to evaluate the hypothesized relationship between students' metacognitive strategy knowledge and their EFL writing proficiency. After establishing the underlying trait of the relationship, a series of Mann-Whitney *U* Tests was undertaken to investigate potential differences in participants' EFL writing proficiency. Given that the LLMWSLME scores were ordinal data collected from the Likert scale, the Mann-Whitney *U* Test, as the "non-parametric alternative to the *t*-

test for independent samples" (Pallant, 2013, p. 227), is often used in psychometric analyses as a means for analysis of the significance between two different groups by comparing the median scores (Field, 2013). In order to avoid any Type 1 error, the Mann-Whitney *U* Tests with Bonferroni-adjusted alpha, $p < .002$ (.05/23), were performed in all subsequent analyses using IBM SPSS Statistics software (SPSS25.0).

4. Results

4.1 Relationships between Students' Metacognitive Strategy Knowledge and EFL Writing Proficiency

Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity. Two continuous variables were included in the calculation: One was the perceived metacognitive strategy knowledge as measured by the LLMWSLME; the other was the participants' EFL writing proficiency. As proposed by Cohen (1988), the guidelines for interpreting the strength of the relationship are: small ($r = .10$ to .29); medium ($r = .30$ to .49); large ($r = .50$ to 1.0).

It can be seen in Table 1 that a large positive correlation was found between the two variables ($r = .64$, n = 286, $p < .01$), indicating quite a strong relationship between metacognitive strategy knowledge and the participants' EFL writing proficiency. All the three subcategory strategies (planning, monitoring, and evaluating) bear a moderately to strongly positive correlation to students' EFL writing proficiency, with the correlation coefficient (r) ranging from .45 to .78 ($p < .01$). The results suggest that the more metacognitive strategy knowledge the students had, the higher EFL writing proficiency the students demonstrated.

Table 1. Spearman Correlations of Metacognitive Strategy Knowledge to Students' EFL Achievement (n = 286)

Dimensions	1	2	3	4	5
1. Average Writing Score	-	.64**	.69**	.45**	.78**
2. Overall metacognitive strategies		-	.77**	.76**	.82**
3. Planning			-	.48**	.56**
4. Monitoring				-	.67**
5. Evaluating					-

Note. ** = All correlations are significant at $p < .01$.

4.2 Differences in Metacognitive Strategy Knowledge between High- and Low-Writing Proficiency Groups

In order to compare high- and low- writing proficiency groups' metacognitive strategy knowledge in multimedia environments on the three subscales, the data were subjected to a series of Mann-Whitney *U* Tests again. The results showed that the participants with high or low EFL writing proficiency responded to the questionnaire statements of these three metacognitive strategy knowledge domains in a markedly different way. Overall, those high EFL achievers demonstrated more metacognitive strategy knowledge for accomplishing their multimedia-mediated writing tasks than their lower proficiency counterparts. The EFL writing proficiency difference yielded a medium to large effect on all the three subcategories of metacognitive strategy knowledge in terms of "planning" (r = .348), "monitoring" (r = .504), and "evaluating" (r = .533).

To control for family-wise error rate (i.e., a Type I error) when performing multiple Mann-Whitney *U* Tests, the Holm's sequential Bonferroni approach (Holm, 1979) with Bonferroni-adjusted alpha, $p < .002$ (.05/23), was adopted as the criteria for determining significance (see Appendix B for the results of the Mann-Whitney *U* Tests with selected r values).

In the planning strategy subscale, the results showed that on the whole the EFL writing proficiency difference produced a medium effect on this strategy cluster (r = .348) . Among the seven strategies, the high- EFL writing proficiency students reported a higher level of knowledge of planning strategies than their low-proficiency counterparts on five items. Except for a small effect on "choosing language features" (r = .116), a medium effect on "organizing paragraphs" (r = .310), "making an outline" (r = .338), "setting up goals" (r = .386), and "allocating writing time" (r = .303) in the cluster is evident. The two groups, however, did not differ significantly in terms of "doing reading preparation" ($p > .002$), and "planning to use related online resources" ($p > .002$).

In the monitoring strategy subscale, high-EFL writing proficiency group reported having stronger metacognitive strategy knowledge relating to the writing process than their lower-proficiency counterparts did. The EFL writing proficiency difference generated a medium to large effect sizes on the nine strategies. High-EFL writing proficiency students showed a stronger knowledge of these nine strategies, with "focusing on revision" (r = .516) as their prime choice, followed by "checking organizations" (r = .513), and "checking contents" (r = .511), producing large effect sizes. The high-EFL writing proficiency participants also reported a stronger tendency of knowing other monitoring strategies when writing, with medium effect sizes. These include "choosing appropriate words and phrases" (r = .317), "developing arguments" (r = .347), "monitoring revising process" (r = .328), "adjusting time management" (r = .327), and "focusing on cohesion and coherence" (r = .337). Furthermore, as indicated by the r value, a Mann-Whitney *U* Test revealed a small significant difference on the item "focusing on grammar mistakes" of both groups (r = .133). No group difference was found on the items "focusing on cosmetic language problems" ($p > .002$), "seeking help" ($p > .002$) and "removing distractions" ($p > .002$).

On the metacognitive strategy knowledge subcategory of "self-evaluating", those high EFL writing proficiency participants also demonstrated more metacognitive strategy knowledge for accomplishing their multimedia-mediated writing tasks than their low EFL writing proficiency peers. The EFL writing proficiency difference yielded a large effect on all the four items of self-evaluating strategies: "revising language problems" (r = .514), "reviewing organization" (r = .521), "self-assessment" (r = .611), and "self-expectation" (r = .721). On item 23, both groups differed the most in their perceptions of "self-expectation", with the largest effect size (r = .721).

5. Discussion

Results from this part of the study seem to corroborate what was observed about learners of different language proficiency levels from the majority of previous studies on language learning strategies (e.g., Amani, 2014; Bai, Hu, & Gu, 2014; Chien, 2012; De Silva & Graham, 2015; Lai, 2009; Zhang, 2017; Zhang, Aryadoust, & Zhang, 2016). These studies suggest the importance of metacognition by stating that more proficient learners reported more metacognitive strategy knowledge than their lower proficiency peers. In other words, compared to low-EFL writing proficiency participants, high-EFL writing proficiency students were more aware of and focused more on the global levels when performing a writing task in multimedia environments, undergoing planning, monitoring and evaluating processes. Congruent with previous studies (e.g., Mei, Brown, & Teo, 2017; Wei, Chen, & Adawu, 2014), this kind of students' metacognitive knowledge indicates that high-EFL writing proficiency students might be more conscious of what they do in the complex multimedia writing context because they were more aware of the key role that metacognition would play in their writing process, especially in helping them make decisions on improving their writing performance.

Despite the optimism that multimedia sources such as *Pigaiwang* would be a great tool for better learning for all the students, findings of this study has demonstrated that even in the same writing context, learners of different language proficiency levels showed different learning outcomes. The high-proficiency learners showed a more expert way to use such tools more efficiently to facilitate their learning. Specifically, findings of this study has enriched our understanding of EFL students' metacognitive strategy knowledge about writing in multimedia environments in three aspects.

Firstly, planning has always been regarded as a fundamental skill of high-achieving student writers. When the Mann-Whitney U Test was conducted to see if there were any significant differences in the cluster of planning strategies in our study, we found that high-EFL writing proficiency students generally had a clearer understanding of a series of planning strategies than their lower-achieving counterparts. It seems that the high- EFL writing proficiency students were better-prepared than their low-achieving peers from the very beginning of writing. Similar to the results reported in previous studies (e.g., Ellis & Yuan, 2004; Ong, 2014), our study also found that high-EFL writing proficiency students devoted more time and attention to making organized

plans before writing, including creating a strong outline, setting a clear writing goal, and allocating writing time appropriately.

Secondly, regarding monitoring as a cluster of online strategies, noticeable differences were also found between the two groups. Findings show that high-EFL writing proficiency students, by virtue of their stronger language proficiency, tended to regulate and manage their thoughts and actions on a more global level of the written text when dealing with writing tasks. Within the category of monitoring strategies, 9 of the 12 strategies (75%) were significantly different between the two groups. This suggests that high-EFL writing proficiency students' ability in on-line decision-making facilitated their understanding of the writing process and expectations. They tended to focus more on controlling their own writing process by revising the content, organization, and grammar of their writing in order to produce high-quality written texts.

Finally, regarding evaluating strategies, the data seemed to further indicate that in order to meet the writing objectives, high-EFL writing proficiency students tended to continue practicing using more efficient strategies to revise the writing draft and yield a refined text shown in both the content and the organization. They had clearer metacognitive knowledge of how to evaluate their writing process and weigh their expectations of themselves until they acquired the skills necessary for self-regulated, independent, or autonomous learning. Such a phenomenon is in tandem with many earlier studies (e.g., Barkaoui, 2007; Magogwe & Oliver, 2007; Teng, 2019; Victori, 1999). As pointed out by Barkaoui (2007), low-achieving writers might stop writing when they finished the first draft. High-achieving writers, on the contrary, regarded writing as "a recursive process that permeates the whole writing endeavour" (p. 89).

6. Conclusion

The present study was set up to explore how EFL learners' metacognitive strategy knowledge might be related to their writing performance in multimedia environments. By examining the relationships, the study suggests that the students' EFL writing proficiency was a critical factor and their writing performance in multimedia-mediated environments was closely correlated with their metacognitive strategy knowledge, particularly with regard to their self-evaluation of the writing process, which provided additional validation for the questionnaire. In addition, the findings of the study produces some evidence that lends further support to pedagogical initiatives that language instructors can assist the less successful writers' language learning process by helping them develop metacognitive strategies for improving their language proficiency.

However, this study is not without limitations. First, due to the inherent limitation of the questionnaire as a research instrument, data collected can only be considered as students' own perceptions in a particular context, which may be inherently insufficient in revealing the mechanisms behind strategic writing. Second, items presented in the

questionnaire are generally orchestrated in the multimedia environments, which may prevent the generalizability of our findings to other populations, such as students who tend to favour writing by hand rather than typing on a computer. Third, the lack of options for some other factors (e.g. students' aptitudes and attitudes towards EFL writing) might not fully elucidate the students' writing performance. Therefore, it is hoped that futures studies might need to consider conducting in-depth analyses using multiple methods for data collection (e.g., interviews, think-aloud, journals, classroom observation) and tap into additional aspects (e.g. students' aptitudes and attitudes towards EFL writing) in order to yield more trustworthy findings.

Notes

1. According to its official website (http://www.pigai.org/), Pigaiwang has attracted more than one million users from over 1,000 Chinese universities, including top university users like Tsinghua University, Nanjing University, Fudan University, Shanghai Jiaotong University, among others.
2. Note: http://cnnic.com.cn/IDR/ReportDownloads/
3. See the CET website (http://www.cet.edu.cn/).

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Appendix A

Part one: Questionnaire about Yourself

1. Are you a □ male or □ female?

2. How old are you? _____

3. What is your major? _____

4. How many years have you been studying English?
   I have been studying English for _____ years.

5. Could you please tell me your English subject score of the National College Entrance Exams (NCEE, also known as *Gaokao*)?
   My English score in NCEE is_____.

6. Could you please tell me your writing test score of the last semester's final examination?
   My writing test score is _____.

Part Two: The Questionnaire on Language Learners' Metacognitive Writing Strategies in Multimedia Environments (LLMWSIME)

Directions

Listed below are statements about what you may or may not do when you are engaged in multimedia-mediated writing in English. After reading each statement, think about your own experience and then please show how much you agree or disagree with these statements in your own writing task by ticking the number that matches your answer. The numbers mean the following:

1= strongly disagree
2= disagree
3= slightly disagree
4= partly agree
5= agree
6= strongly agree

Before I started writing in the multimedia environment,

No.	To what extent do you agree with the following statements?	Please tick (√)
1	I had a plan in my mind for how I was going to structure each paragraph in my essay.	1 2 3 4 5 6
2	I made an outline, including a list of the key points of views that I want to include in my essay.	1 2 3 4 5 6
3	I planned what language features I was going to use in my essay with reference to the writing topic.	1 2 3 4 5 6
4	I thought about the goal I wanted to achieve in my writing (e.g. to use a new word or a new sentence structure I have learned, to avoid a mistake I had made before, or to get a high score, etc.).	1 2 3 4 5 6
5	I thought about how much time I should spend on each part of the essay.	1 2 3 4 5 6
6	I collected relevant materials based on the writing topic, doing some reading preparation.	1 2 3 4 5 6
7	I planned the use of online materials, aiming at the efficient use of network resources.	1 2 3 4 5 6

When I was writing in the multimedia environment,

No.	To what extent do you agree with the following statements?	Please tick (√)
8	I tried to focus my attention on choosing appropriate words and phrases.	1 2 3 4 5 6
9	I tried to think about whether the arguments followed the instruction of the essay.	1 2 3 4 5 6
10	I tried to mark the places in the composition with different colours on the computer screen that I thought required revision. I wouldn't revise them until I had completed my writing because I wouldn't like to break into my thoughts.	1 2 3 4 5 6
11	I tried to think about how much time I had remaining, adjusting my time arrangements to ensure completion of the writing task.	1 2 3 4 5 6
12	I tried to think about how to connect different parts of my essay (e.g. using transitional words).	1 2 3 4 5 6
13	I tried to think about whether I was using the correct grammar (e.g. tenses, prepositions, etc.).	1 2 3 4 5 6
14	I tried to think about whether I was using appropriate punctuation as well as the letter case.	1 2 3 4 5 6
15	I tried to modify the mistakes, following the prompts on the	1 2 3 4 5 6

	computer screen.	
16	I tried to think about how many arguments I should have in the essay.	1 2 3 4 5 6
17	I tried to seek help from an online dictionary if I did not know how to express my own opinions.	1 2 3 4 5 6
18	I tried to think about what parts my essay should have.	1 2 3 4 5 6
19	I tried to monitor my writing actively, focusing my attention on the current writing task to avoid being distracted by other irrelevant information.	1 2 3 4 5 6

After I finished writing in the multimedia environment,

No.	To what extent do you agree with the following statements?	Please tick (√)
20	I reread my essay and made sure that the language of my essay was clear.	1 2 3 4 5 6
21	I reread my essay and made sure that the organisation was easy to follow.	1 2 3 4 5 6
22	I reread my essay and made sure that I had covered the content fully before I submitted to my teacher.	1 2 3 4 5 6
23	I thought back to how I write, and about what I might do differently to improve my English writing next time.	1 2 3 4 5 6

Appendix B

Mann-Whitney U Tests: Metacognitive Strategy Knowledge between EFL High-proficiency (n=65) and Low-proficiency Participants (n=61)

Variables		Mean Rank		Mann-Whitney U	Z	*p*	r
		High	Low				
Planning	Organizing paragraphs	85.49	65.11	2066.5	-3.475	.000**	.310
	Making an outline	79.42	73.94	2668.0	-3.792	.000**	.338
	Choosing language features	83.94	66.81	2191.5	-1.305	.000**	.116
	Setting up goals	83.03	69.05	2346.0	-4.337	.000**	.386
	Allocating writing time	79.70	72.85	2609.5	-3.404	.001**	.303
	Doing reading preparation	72.34	73.33	2564.5	-1.015	.010	
	Planning to use related online resources	79.78	77.11	2786.0	-.986	.009	
	OVERALL	78.75	71.46	2517.5	-3.905	.000**	**.348**
Monitoring	Choosing appropriate words and phrases	80.92	71.46	2759.5	-3.556	.001**	.317
	Developing arguments	81.79	70.41	2808.0	-3.898	.000**	.347
	Monitoring revising process	84.02	67.92	2803.0	-3.685	.000**	.328
	Adjusting time arrangement	83.68	68.31	2502.5	-3.667	.000**	.327
	Focusing on cohesion and coherence	80.40	70.06	2447.0	-3.779	.000**	.337
	Focusing on grammar mistakes	86.94	66.90	2266.5	-1.497	.000**	.133
	Focusing on cosmetic language problems	82.87	76.93	2369.5	-.944	.045	
	Focusing on revision	79.44	70.56	2294.0	-5.796	.000**	.516
	Checking contents	79.87	69.99	2560.0	-5.737	.000**	.511
	Seeking help	78.63	74.07	2191.5	-1.206	.011	
	Checking organizations	84.73	67.11	2413.5	-5.753	.000**	.513
	Removing distractions	85.28	76.55	2078.5	-1.604	.010	
	OVERALL	86.10	65.54	2097.5	-5.652	.000**	**.504**
Evaluating	Revising language problems	79.67	72.89	2441.0	-5.771	.000**	.514
	Reviewing organization	84.86	69.96	2208.5	-5.849	.000**	.521
	Self- assessment	88.01	69.63	2198.5	-6.862	.000**	.611
	Self-expectation	84.26	70.27	2433.0	-8.099	.000**	.721
	OVERALL	88.34	71.21	2066.1	-5.985	.000**	**.533**

Note. This table reports effect size (r-value) with Bonferroni