9 Validating a Questionnaire on EFL Writers' Metacognitive Awareness of Writing Strategies in Multimedia Environments

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Introduction

With technological advances and infrastructure developments in this era, multimedia, including Internet technology, has been widely used in language teaching and learning. In the field of second/foreign language education, despite “the seemingly formidable task of academic writing” (Wei, Chen, and Adawu 2014, 60), recent years have witnessed the impact of computers as well as other digital devices on second/foreign language learners' writing development. On the one hand, multimedia tools bring great convenience to language learners in many aspects, and this means that learners can do automatic spelling and grammar checks, edit and revise their texts and search for online resources, among many other tasks. On the other hand, the increasing complexity of the multimedia contexts to which learners have access also leads to increasingly heavy cognitive load in their efforts to deal with multitudes of interactions in order to learn effectively. Such situations require that learners in this era be fully ready for meeting these challenges.

Azevedo (2009) posited that learners in contemporary learning environments may face added challenges arising from the use of multimedia tools. Successful learning, therefore, needs to involve “the use of numerous self-regulatory processes such as planning, knowledge activation, metacognitive monitoring and regulation, and reflection” (87). While the most available research in the field of second/foreign language education has investigated the beneficial effects of multimedia tools or increases in students' metacognitive awareness on their writing production independently, relatively few studies have focused on the relationships between students' metacognitive awareness of their EFL writing processes and their multimedia use; nor has any substantial study reported on the effects of students' metacognitive awareness and multimedia use on their EFL writing. Given the significant role of digital media in the learning of writing for language learners, there is an urgent need to investigate this intersection, especially in relation to Chinese EFL learners in universities (Wei, Chen, and Adawu 2014).

Understandably, recent years have seen an upsurge in the number of students with access to laptops and other digital devices for practising EFL

writing in Chinese universities. Teachers have also shown their enthusiasm for incorporating multimedia elements into their instructional practices in the classroom and beyond. However, despite the fact that digital media have been widely adopted as a tool for language teaching and learning, research has documented students' unfavourable perceptions of and attitudes towards multimedia-mediated contexts for learning EFL writing. Mind wandering (Xiao 2011), intensely cognitive overloading and a lack of technological skills (Xiong 2011) are just some aspects which might result in students developing poor EFL writing proficiency (Qin 2009; Yang 2016). It is believed that much of the ineffectiveness may lie in learners' lack of metacognition about EFL writing processes, a key aspect of which is their metacognitive knowledge about writing strategies. In the field of general psychology as well as educational psychology, metacognition has been well recognised as a crucial factor in affecting learner success (see, for example, Azevedo 2009; Elzarka et al. 2015; Flavell 1976, 1979). Its importance has also been widely supported by research in the field of second/foreign language education (see, for example, Ong 2014; Wenden 2002; Zhang 2010, 2016a; Zhang and Zhang 2013). Given the sheer size of China as well as the fact that the country is claimed to have the largest number of EFL learners (Zhang 2016b), it is imperative that Chinese EFL learners' metacognitive knowledge about writing strategies in multimedia-mediated environments be understood. To this end, we attempt to conceptualise, develop and validate a new questionnaire framed within metacognitive theory to evaluate Chinese EFL student writers' perceived use of metacognitive writing strategies.

Literature Review

The Role of Learner Metacognition in L2 Writing Strategy Research

A review of research in the field of educational psychology shows that the construct of metacognition has its origin in research on human cognitive development. So far, the literature has offered a myriad of definitions of the term, but as Zhang (2010) has noted, the core elements of metacognition still basically pertain to those of the American psychologist, John Flavell, who conceptualised the term with two dimensions through publications appearing in the late 1960s and early 1970s. In his well-refined framework, Flavell (1979) expounded that metacognition encompasses not only learners' knowledge about cognitive states and processes but also their control or execution. In relation to L2/EFL learning, Zhang (2010, 2013, 2016a) has resorted to scholars in the field of educational psychology (Azevedo 2009; Flavell 1979) and concurred with them that the control or executive aspects of metacognition are concerned with learners' metacognitive strategies or regulation in learning a second/foreign language, which

involve their conscious monitoring of their cognitive processes to achieve specific goals. Learners' metacognitive awareness of strategy use enables them to participate actively in planning for learning tasks, monitoring their own learning processes and evaluating the utility and effectiveness of their strategies. This process manifests the dynamism of learners' metacognitive knowledge systems (Zhang 2010). Most often in metacognitive strategy research pertinent to L2 language learning development, Wenden's (1987, 1998, 1999) contribution has been widely recognised. Working within Flavell's (1979) model, Wenden developed a tripartite model of metacognition to assist in the understanding of students' metacognitive processing during L2 learning. Her model includes planning learning activities with one or more learning objectives in mind prior to learning, monitoring the learning process during learning, and evaluating the learning process after learning activities, highlighting the significant central role that learners' metacognition plays in L2 language development. Researchers have since adopted this classification and studied the three major variables in a more refined way towards obtaining a better understanding of learners' metacognitive processes in various language skill development, such as listening (Goh and Hu 2014), reading (Zhang 2010) and writing (Ruan 2014; Teng and Zhang 2016).

Since the time when writing began to be viewed as a process rather than merely a product, close attention has been given to the role of writing strategies in improving L2/EFL writing abilities in the field of second language education (Byrnes and Manchón 2014; Cohen 2011; Cumming 2001; Grabe and Kaplan 1996; Hinkel 2011; Hyland 2015). Because of the absence of an agreed-upon definition of what a language learning strategy is (Cohen and Griffiths 2015; Manchón, De Larios and Murphy 2007; Oxford 2017), metacognition, as a crucial factor in relation to self-regulated learning when planning and executing learner development programmes, has emerged as an important area of academic and pedagogical inquiry in L2/EFL writing (Zhang 2016a; Zhang and Zhang 2018). This scientific inquiry has produced ample research evidence on the critical role of metacognition in L2/EFL writing (De Silva and Graham 2015; Ruan 2014; Teng and Zhang 2016; Victori 1999; Wenden 1998). For example, Victori (1999) investigated the metacognitive processes of two effective and two less effective learners learning EFL writing. The findings show that there were substantial differences between the two effective and two less effective learners. Typically, these differences played out in their use of metacognitive strategies for planning, organising, evaluating and resourcing. De Silva and Graham's (2015) research produced evidence that supported their argument for effective metacognitive strategy-based intervention to guide language learners to make more effective use of metacognitive strategies across language proficiency levels in order to achieve their writing goals. Furthermore, within L2/EFL writing strategy research, more broadly considered, many studies have been undertaken to emphasise the importance of L2/EFL writers' metacognitive control over

successful orchestration of strategy deployment in computer-based learning environments (see, for example, An and Cao 2014; Graham and Perin 2007; Wei, Chen, and Adawu 2014). For example, evidence from Wei, Chen, and Adawu's (2014) study suggested that explicit metacognitive strategy-based instruction supported by multimedia technology during the administration of an L2 writing course helped beginning-level ESL students become better strategy users and more efficient L2 writers.

Increasingly, computer technology has become an essential component in education. Recent research evidence also suggests the significant influence of learners' metacognitive processes on their learning outcomes in computer-assisted learning environments (see Azevedo and Aleven 2013). As Azevedo and Aleven (2013) posited, "a deep understanding of the relations between self-regulation, metacognition, the design of the learning environment, and learning outcomes is therefore highly desirable from both a scientific and a practical perspective" (4). This is because learners' metacognition impacts their academic success in many ways, most of which have also been manifested in multimedia-mediated learning environments. For the purpose of our study, we used Wenden's tripartite model of metacognition as our theoretical framework in developing a questionnaire to investigate EFL learners' knowledge or awareness of the processes involved in L2 writing in multimedia environments. In doing so, we intended to establish a theory—practice nexus, drawing on empirical data, in the hope that L2 writing pedagogy could be better designed to cater to learner needs in an EFL context.

The Multimedia Context in EFL Learning in China

Although "China has the world's largest educational system with the largest number of learners of English" (Jin and Cortazzi 2006, 5; see also Zhang 2016b), learning EFL presents unique contextual challenges. Given its lack of authentic and meaningful practice opportunities outside of the foreign language classroom, English teaching and learning have always been one of the weakest links in the Chinese educational system, despite English being listed as a major subject from primary school onwards. In universities, the teaching of English to non-English majors is facilitated through College English (CE), a compulsory two-year course offered to hundreds of millions of university students. As of 2015, there were about 60,000 Chinese English teachers teaching CE to an estimated 26,000,000 undergraduates in 2,560 regular higher education institutions (Department of Higher Education of the Chinese Ministry of Education 2016). Due to the sheer number of university students required to take this course, English teaching and learning have always been the target of scrutiny in many academic as well as public forums. As a result, some critics have posited that "despite the great time and effort from both teachers and students, the average Chinese learners are still far from being skilled in English reading, speaking, listening or writing" (Hao and Yin 2015, 78).

In 2007, educational policy-makers in China initiated an intensive top-down reform. With the rapid development of computers and technological network applications in teaching and learning, the reform has a mandate for integrating multimedia technology into the English-teaching curriculum in classrooms. Pedagogical improvements through the use of technologies are expected to enhance the effective teaching and learning of English in Chinese universities. Following the new trend towards extensive applications of multimedia technologies, Chinese scholars have also shown a growing interest in Chinese EFL students' language learning strategies used in multimedia environments (see, for example, Chen 2016). Our review of the literature provides evidence of the beneficial effects of the role of multimedia technology support and the use of metacognitive strategies on EFL writing score gains. For example, Qiu (2014) reported that a new Internet-based read-write teaching method he had implemented had a more positive effect on the syntactic complexity of students' EFL writing than the traditional classroom training approach. He suggested that there was a need to utilise such technological tools to enrich students' learning experiences and facilitate their language learning strategies in order to produce positive language learning outcomes.

However, with specific reference to the metacognitive strategies that language learners use in multimedia-assisted EFL writing, with very few exceptions (see, for example, Chen 2016; Ma 2010), little research has been undertaken to investigate systematically how Chinese EFL learners orchestrate their metacognitive awareness about writing in multimedia environments and how such awareness would enhance their writing performance. Although a small body of literature directly indicates the important role of metacognition in helping solve the writing problems that Chinese EFL learners encounter when they write in multimedia environments, these reports are either successive assertions/iterations that lack empirical support (see, for example, Shang 2013) or investigations into the functions of different types of new technologies (such as emails, microblogs, Facebook, automated-writing-evaluation platforms) in facilitating EFL writing development. Such research studies offer extremely limited constructive and integrative insights into EFL learners' complex learning processes. Apparently, the amount of research on EFL writing learners in China is insufficient, which is disproportionate given that China boasts the largest number of EFL learners.

Fortunately, recent research interests have moved beyond the examination of mental processes to consider technologies used by second/foreign learners while they are writing. A closer examination of previous studies has revealed that the interaction between writers and external writing support is significant; yet these intricate relationships have not been fully explored, especially from a metacognitive perspective. Barr (2008) argued that even though "students [who are growing up in today's modern technological society] may be very computer literate, they do not necessarily know how to use computers for language learning" (108). This may cause the inefficient

use of multimedia tools, such as endlessly searching web sources. Therefore, there is a need to better understand the complex nature of EFL writers' metacognitive processes during writing in multimedia environments for improving their writing performance.

Theoretical Framework for the Study

As writing increasingly occurs through the medium of computers in modern Chinese universities, it is worth identifying the distinctive ways in which students shape/reshape their writing strategies in multimedia environments. As an attempt to categorise and advance the plethora of established L2 writing models, we decided to investigate Chinese EFL learners' reported writing strategies in accordance with Wenden's (1998) metacognitive framework in the field of second language acquisition (SLA), which was briefly described at the beginning of this chapter. Specifically, we focus on metacognitive strategies, which are a significant component of her theoretical framework. The reasons for this focus are two-fold: First, a student with strong metacognitive awareness consciously undergoes planning and monitoring processes. He or she also reflects on the writing process, following a general chronological sequence when performing a writing task, whether it is in a traditional pen-and-paper writing context or in a computer-assisted writing environment. Such metacognitive awareness necessarily includes "the complex interaction of mediating cognitive, metacognitive, and social processes involved in students' learning of complex topics and domains" (Azevedo 2010, 193); second, such a metacognitive strategy framework is necessary when we need to consider not only variables of metacognitive language learning strategies (LLS), but also variables of the classroom learning environment and the interaction between writers and multimedia tools.

More specifically, there are three writing stages in which the EFL learner-writer writes in the multimedia environment. First, before writing, a writer with strong metacognitive awareness may make some necessary preparations in advance, such as planning the structure of the writing task, setting meaningful goals, or allocating appropriate writing time (Ong and Zhang 2013). Second, during writing, the writer may monitor the writing process, assess particular strategies to ensure that the writing goals will be achieved, or make some adjustments. Third, after writing, the writer may perform self-evaluation about the written product, evaluate his or her writing strategies, or rethink other aspects of the writing context that may impact the quality of his/her product. Built upon Wenden's (1998) metacognitive strategy framework in the field of SLA and Azevedo's (2010) emphasis on the importance of metacognition in multimedia learning environments, our study aimed to develop a questionnaire for tapping into Chinese EFL learners' metacognitive awareness of writing strategies when they are supported by multimedia technology.

The Current Study

Participants

A total of 400 year-two Chinese EFL students from an Eastern Chinese university were invited to respond to the Questionnaire on Language Learners’ Metacognitive Writing Strategies in Multimedia Environments (LLMWSIME), which will be described in some detail in the next section. Because year-two students had been invited by their English teachers to participate in an experimental teaching reform, in which they were required to write English compositions in multimedia environments, all the participants had some experience in multimedia-mediated English writing. The questionnaire was also administered with the deliberate purpose of maintaining a rough balance of arts and science student numbers. Our data cleaning resulted in 378 valid questionnaires for statistical analysis. Altogether, there were 156 male (41.27%) and 222 female (58.73%) participants. Their ages ranged from 19 to 22, with an average age of 20.53 ($M = 20.53$, $SD = 1.86$). Table 9.1 illustrates the participants’ background information.

Table 9.1 Background information of the participants.

Majors	N	Percent (%)
Physics	69	18.25
Maths	39	10.32
Fine Arts	20	5.29
Education	66	17.46
Economics	26	6.88
Civil Engineering	95	25.13
Electric Engineering	63	16.67

Development and Validation of the LLMWSIME

Questionnaire Development

Given that there were no existing questionnaires that directly assessed EFL learners’ metacognitive awareness about strategy use in writing in multimedia environments, we developed a 23-item writing strategies survey, the Questionnaire on Language Learners’ Metacognitive Writing Strategies in Multimedia Environments (LLMWSIME), as mentioned above. The LLMWSIME included two parts: participants’ demographic information, and their beliefs and views on L2 writing strategies in multimedia environments (Appendix A). The LLMWSIME drew upon a variety of sources (Amani 2014; Flavell 1979; Tsai 2009; Wenden 1998). Informed by Flavell’s (1979) theoretical taxonomies, Wenden (1998) proposed three essential metacognitive regulation strategies: planning, monitoring and evaluating as the basic

forms of metacognitive strategies in L2 writing. Given that Wenden's tripartite metacognitive strategy framework has been one of the most cited frameworks with respect to second/foreign language acquisition, our study also focused on these three dimensions to examine the challenges that Chinese EFL learners encounter when learning EFL writing in multimedia environments.

In creating the questionnaire items, we also consulted a few existing questionnaires aimed at investigating either language learners' general strategy use (see, for example, Amani 2014; Tsai 2009) or listening (Vandergrift et al. 2006; Zhang and Goh 2006). Among them, Amani's (2014) 20-item Metacognitive Strategy Questionnaire (MSQ) was the most relevant to our research. Taking into account teaching and situational suitability, 16 questions were substantively adopted for use in our study. Considering the contextual differences, some questions were rephrased to cater to multimedia environments. For example, statement No. 10 was "when I was writing, I tried to think about whether I was spelling some words correctly". Considering that writing occurs through the medium of computers in our study and that the auto-correcting of spelling errors is a feature commonly included in word processors, the question was adapted into a new question which represented our research focus: "when I was writing, I tried to focus my attention on choosing appropriate words and phrases" (Question 8).

In addition, drawing on the questionnaire devised by Tsai (2009) on metacognitive strategy use in the e-learning environment, we also considered some of his questions for inclusion in our questionnaire (Questions 4, 6, 7, 10 and 19). The final 23-item, 6-point Likert scale writing strategy questionnaire, the LLMWSIME, was generated.

All 23 questions are statements concerning EFL learners' writing processes when they are undertaking writing tasks; that is, before, during and after their actual writing activities. It needs to be pointed out, however, that a number of these writing strategies are not restricted to EFL writing in multimedia environments. They are both useful to EFL students writing with any digital device and EFL students writing on paper. The first seven questions relate specifically to planning strategies, with the next 12 questions related to monitoring strategies, and the next four questions related to evaluating strategies. Under each statement, there are six options on a Likert scale (1, 2, 3, 4, 5 and 6): 1 indicates strong disagreement, 2 indicates disagreement, 3 indicates slight disagreement, 4 indicates partial agreement, 5 indicates agreement and 6 indicates strong agreement. Given that participants from Asian cultures, such as Chinese, Korean and Japanese, tend to select the midpoint of a Likert scale more frequently than participants from Western cultures (Brown 2004), we designed the LLMWSIME on such a 6-point Likert scale to prevent participants from selecting the midpoint (neither disagree nor agree). In addition, given that all the participants were L1 Chinese speakers, we adopted the Chinese version of the questionnaire to ensure that each item could be easily and fully understood.

An internal reliability test of the LLMWSIME items showed that the Cronbach's alpha values for the strategy survey of each subscale were all above the .80 threshold value based on the sample size (Planning: $\alpha = .91$; Monitoring: $\alpha = .94$; Evaluating: $\alpha = .88$), which is in agreement with the internal consistency reliability statistic recommended by Cronbach (1951). This ensured that the LLMWSIME was a reliable instrument.

Data Analysis

The data collected through the LLMWSIME were subjected to confirmatory factor analyses (CFAs) through structural equation modelling (SEM) in order to examine the structure, function and essence of metacognitive strategies. CFA is a standard statistical technique for testing a theoretical model (Kline 2015). In this study, the maximum likelihood (ML) estimation method was used to evaluate three hypothesised models. The results from CFAs provided empirical evidence for the validity of the one-factor, second-order metacognitive strategy awareness inventory, as reported next.

Given the sensitivity of CFAs to missing values and outliers, the data were scrutinised to ensure that there were no such values among the 378 valid respondents. Following Kline (2015), we subjected our data to several essential omnibus fit statistical analyses to evaluate the model fit, including the Chi-square test (χ^2/df ratio), the root mean square error of approximation (RMSEA), the goodness of fit index (GFI), the comparative fit index (CFI) and the standardised root mean square residual (SRMR). Table 9.2 shows the benchmarks of each fit index to indicate an acceptable model fit.

The LLMWSIME Results

Descriptive Statistics

Descriptive statistical analyses showed that the mean scores of the 23 items ranged from 3.23 to 4.27 with standard deviations ranging from 1.072 to 1.318. The values for skewness were between $-.291$ and $.183$, while the values for kurtosis were between $-.718$ and $-.157$. These were far less than the cut-off values of $|3|$ and $|8|$ for skewness and kurtosis, respectively. This is one of the most important prerequisites for factor analysis. The initial data computation also revealed that the data demonstrated homogeneity of variance and satisfied the assumption of linearity. All of these computations

Table 9.2 Critical values of goodness-of-fit indices.

χ^2/df	RMSEA	SRMR	GFI	CFI
< 3.0	< .06	< .08	> .90	> .90

ensured that the requirement of normality for CFA was satisfied. Appendix B provides the detailed descriptive statistics of the multimedia-mediated EFL writers' metacognitive strategy scale.

Evaluating a Three-Factor Correlated Model of EFL Writers' Strategies for Metacognition

Regarding the empirical results from a series of CFAs, comparisons of plausible models are often highly recommended (Kline 2015). In our study, three model comparisons were evaluated by resorting to the values mentioned above. The first was a three-factor uncorrelated model (*Model 1*); the second was a three-factor, second-order correlated model (*Model 2*); and the third was a 1-higher-order factor with 3-second-order subcategories correlated model (*Model 3*). The results of the first round CFA ($\chi^2 = 1098.47$; $df = 370$; $p < .001$; $\chi^2/df = 2.968$; RMSEA = .10; SRMR = .096; GFI = .887; CFI = .844) suggested that these model fit indices were not satisfactory (*Model 1*). We then attempted to add additional paths to improve the overall model fit, suggesting some correlations among the three subcategories. However, the second-round results ($\chi^2 = 398.07$; $df = 211$; $p < .001$; $\chi^2/df = 1.887$; RMSEA = .058; SRMR = .087; GFI = .877; CFI = .891) were still not completely satisfactory (*Model 2*).

Given the cross-loadings of the three subcategories, the CFA was rerun on a further hypothesised model (*Model 3*). The results indicated a single common factor, metacognitive strategies, as a higher order, which was able to account for the three subcategories. The results of the fit indices for this modified model showed improved fit, and all indices reached the appropriate cut-off levels ($\chi^2 = 323.630$; $df = 157$; $p < .001$; $\chi^2/df = 2.061$; RMSEA = .054; SRMR = .049; GFI = .996; CFI = .953). Therefore, this one-factor, second-order model was retained as the final model (see Figure 9.1).

Discussion

The primary purpose of this study was to develop and validate a questionnaire for measuring EFL writers' metacognitive awareness of writing strategies when they were writing in multimedia environments. To this end, we developed and validated the LLMWSIME. The CFAs on the 23-item questionnaire produced a three-factor solution in terms of planning, monitoring and evaluating. The model was then constructed and illustrated by the three core domains of metacognitive awareness of writing strategies. As revealed in the results, students' metacognitive awareness was orchestrated through a repertoire of general and specific writing strategies that they knew for tackling EFL writing tasks with the assistance of multimedia tools. Those strategies were further divided into three types—namely, metacognitive planning, metacognitive monitoring and metacognitive evaluating. All three subcategories clustered under a single common latent factor, which was sufficient enough to account for the three subcategories. In reference

Figure 9.1 One-factor, second-order model of EFL multimedia-mediated writing strategies ($N = 378$).

Note. MCS = Metacognitive Strategies; McP = Metacognitive Planning; McM = Metacognitive Monitoring; McE = Metacognitive Evaluating.

to the metacognitive theoretical framework presented in this chapter, we think that this factor fell nicely into the category of metacognitive strategies. Given the additional paths to the SEM (*Model 3*), which indicated the close correlations among different specific writing strategies, the detailed components can be summarised as follows:

The first factor (planning) was composed of six writing strategies: global discourse planning (Item 1 and 2), local lexical planning (Item 3), goal setting (Item 4), time management (Item 5), reading preparation (Item 6) and online planning (Item 7). In examining these six strategies, we found that Chinese EFL learners tended to plan ahead and organise their thoughts and materials to ensure a good foundation for producing an effective piece of writing. Understandably, this is particularly important in learning EFL writing in multimedia environments. In complex multimedia learning environments, learners tend to enjoy a high-level of autonomy in accessing online learning materials. Those who are well-prepared would normally be the ones with strong metacognitive awareness about their writing and clear goals to complete their writing tasks. The use of these strategies in this study corroborates these observations. Additionally, our results as shown by the participants above also lend support to findings from previous studies, which focused on the functions of guided planning regardless of differences in writing contexts or environments (e.g. paper-and-pen writing or computer-aided writing; L1 writing or L2 writing) (Adams et al. 2014; Amani 2014; Ellis and Yuan 2004; Ong and Zhang 2013).

The second factor (monitoring) included seven writing strategies, such as selective attention to lexis (Item 8), textual-level processing (Items 9, 12, 16 and 18), lexical-level processing (Items 13, 14 and 15), marking and alerting (Item 10), time adjustment (Item 11), dictionary use (Item 17) and self-regulation from distraction (Item 19). Such a pattern of reported use of strategies indicates that Chinese university EFL learners tended to use multiple strategies to metacognitively manage their writing processes in completing writing tasks by resorting to multimedia tools. This echoes findings of prior research on the role of monitoring in sustaining or increasing L2 writing efforts (see, for example, Tsai 2009), suggesting that there are a set of complex and efficient interactions between L2 writing processes and multimedia-supported learning environments.

The third factor (evaluating) contained two writing strategies: (1) self-assessment of language use related to writing quality (Item 20), organisation (Item 21) and content (Item 22), and (2) self-reflection on writing for future development (Item 23). Previous research (see, for example, Travers, Morisano, and Locke 2015) has addressed the ability of self-reflection as a core motivation to improve learning outcomes. However, such an ability was often absent among many EFL learners at Chinese universities. Chinese scholars such as Cai (2011) pointed out that Chinese university EFL learners' awareness of assessment was heavily dependent upon their teachers' feedback and that they themselves needed to be self-reflective of their learning, which is an important component of learner metacognition. With the

increasing use of multimedia tools in EFL classrooms in China, our study found that the use of evaluating strategies was a significant feature shared by these participants, who used multimedia tools in writing. These strategies clustered around the third factor, and students' reported use of this cluster of strategies might help them boost their willingness to be self-reflective in their learning of EFL writing. We can speculate that as they become more consciously aware of how to reflect on the work they have just done, they will probably use these processes more flexibly to efficiently improve the quality of their writing as well as language proficiency; and consequently, they will become more independent writers. The existence of such a factor may offer further insights into the role of students' metacognitive awareness of helpful strategies, such as self-evaluation and self-reflection in expediting students' learning of EFL writing in university settings, which are well-equipped with modern technology for facilitating language learning and teaching.

Conclusion

The study was designed to investigate Chinese EFL learners' metacognitive awareness of writing strategies in multimedia environments through the development of a new survey instrument, the LLMWSIME. In line with the theoretical understanding of L2 writing processes, the data collected through the LLMWSIME resulted in a three-factor metacognitive structure, which included advanced planning before writing, elaborate monitoring during writing and prompt evaluating after writing. The LLMWSIME developed based on this three-factor model was also proven to be robust, with good construct validity and reliability.

Given that the LLMWSIME appears to be a reliable diagnostic instrument, methodologically, we believe there is potential for its use by other researchers in similar contexts around the world who are interested in investigating EFL writers' awareness, or reported use, of writing strategies in multimedia-supported learning environments. Our findings also have pedagogical implications for multimedia-supported language teaching and learning, especially EFL writing in similar contexts. Given the complexity of multimedia teaching and learning by virtue of abundant online resources, how EFL teachers and learners handle their own teaching and learning in interaction with multimedia tools to facilitate writing improvement has always been an important issue. The existence of the three factors as discussed above suggests that Chinese EFL students have developed an extensive metacognitive knowledge of writing strategies and have understood how to deploy them in their writing process more flexibly in multimedia environments. From the perspectives of teaching and learning, it might be more enlightening for teachers to implement a metacognitively oriented pedagogy to promote EFL learners' strategy use. As a first step, teachers may need to raise EFL learners' metacognitive awareness through modelling specific metacognitive strategies that involve EFL students in planning, monitoring and evaluating their own writing, which will in turn strengthen their competence to achieve

advanced-level writing abilities in the long run (Elzarka et al. 2015; Hinkel 2011; Zhang 2016a).

The questionnaire-based study is not exempt from limitations. First, for a questionnaire-based study, our sample size was rather small. This prevents the generalizability of our findings to other populations, such as younger students or students who are reluctant to use computers for EFL writing. A future study with a large sample size is therefore recommended. Second, the measurement of students' awareness of metacognitive strategies was based on self-reported data. Using the LLMWSIME as the sole source of data may fail to provide multi-faceted information. A future study with multiple methods for data collection (e.g. interviews, think-aloud, student reflection journals, among others) would compensate for this shortcoming (see Forbes 2018, this volume; Knospe 2018, this volume, for examples of other methodological approaches to investigating learners' metacognition about writing). Also, some issues related to individual differences (e.g. gender, different English proficiency levels, different electronic literacies, or different social-cultural contexts) were not taken into consideration. Further studies into the role of these factors would be worthwhile.

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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. Where are you from? (Please select)
 - ☐ East China ☐ Central China ☐ Northeast China ☐ North China
 - ☐ Northwest China ☐ South China ☐ Southwest China

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

No.	<i>To what extent do you agree with the following statements?</i>	<i>Please tick (√)</i>
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.	<i>To what extent do you agree with the following statements?</i>	<i>Please tick (√)</i>
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 computer screen.	1 2 3 4 5 6
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.	<i>To what extent do you agree with the following statements?</i>	<i>Please tick (✓)</i>
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

Descriptive Analysis of the EFL Writer Metacognitive Strategy Scale (23 items)

<i>Metacognitive Strategies</i>	<i>Items</i>	<i>Mean</i>	<i>SD</i>	<i>Skewness</i>	<i>Kurtosis</i>
Planning	Q1: Planning the paragraph structure	4.25	1.318	-.183	-.585
	Q2: Planning to make an outline	4.05	1.315	-.107	-.611
	Q3: Planning language features	3.91	1.202	-.163	-.538
	Q4: Setting up goals	3.99	1.207	-.246	-.292
	Q5: Planning time allocation	3.92	1.205	-.215	-.255
	Q6: Planning to do reading preparation	3.23	1.072	-.129	-.646
	Q7: Planning efficient use of online resources	3.88	1.209	.168	-.591
Monitoring	Q8: Self-monitoring on choosing words and phrases carefully	4.03	1.188	-.249	-.157
	Q9: Self-monitoring on writing topic development	3.81	1.207	-.203	-.666
	Q10: Self-monitoring on making revising decisions	3.28	1.177	-.201	-.521
	Q11: Self-monitoring on time arrangement	3.99	1.270	-.201	-.226
	Q12: Self-monitoring on coherence	4.05	1.167	-.248	-.255
	Q13: Self-monitoring on grammar	3.96	1.186	-.291	-.238
	Q14: Self-monitoring on cosmetic language problems	3.28	1.212	.183	-.534
	Q15: Self-monitoring on revision	3.95	1.239	-.249	-.444
	Q16: Self-monitoring on contents	4.22	1.167	-.218	-.284
	Q17: Self-monitoring on seeking help	3.98	1.208	-.281	-.462
	Q18: Self-monitoring on organisation	3.41	1.299	.124	-.684
	Q19: Self-monitoring on avoiding distractions	3.87	1.265	-.069	-.718

(Continued)

<i>Metacognitive Items Strategies</i>		<i>Mean</i>	<i>SD</i>	<i>Skewness</i>	<i>Kurtosis</i>
Evaluating	Q20: Self-evaluating the language	4.27	1.286	-.289	-.200
	Q21: Self-evaluating the organisation	4.18	1.288	-.242	-.292
	Q22: Self-evaluating the content	3.79	1.281	-.081	-.589
	Q23: Self-evaluating future improvement	3.87	1.191	-.159	-.603