

A Survey Study of Chinese College Engineering Students' Use of Metacognitive Strategies in English Writing*

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Abstract—Metacognitive strategy has been recognised as a crucial factor in language learning, and its role in English writing for Chinese learners still remains unknown. The present study investigates 215 Chinese college engineering students' use of metacognitive strategies through employing research methods of questionnaire survey and writing proficiency test. According to the results, it is found that selective attention and self-monitoring are used in writing quite often, while planning and self-evaluation are seldom used. Besides, the differences in the use of metacognitive strategies between freshmen and sophomores are not statistically significant. It is also found that engineering students of higher writing proficiency tend to employ metacognitive strategies in academic writing more frequently and effectively than those with poor writing skills. It is eventually suggested that metacognitive strategies should be imparted to the students, and that the training of metacognitive strategies should be integrated into classroom activities of English writing teaching.

Index Terms—metacognitive strategy, English writing, strategy-based instruction

I. INTRODUCTION

In the past decades, the educational concept of learner-centeredness and autonomous learning has been increasingly accepted in second/foreign language teaching practice. Thus, much attention has been paid to language learning strategies, and it is widely agreed that effective learning strategies can help them enhance language learning efficiency, improve learning quality, and cultivate autonomous learning ability (Chamot et al., 1999). Besides, what strategies learners are equipped with and how learning strategies are used by them exert great influence on learners' academic performance, and in other words, learning strategy is a significant factor to explain and predict learning outcome.

Since 1980s, learning strategies have been divided into different categories. According to the theoretical framework put forward by O'Malley & Chamot, learning strategies consist of metacognitive strategies, cognitive strategies and social strategies, among which metacognitive strategies concern the knowledge about cognitive process (O'Malley & Chamot, 1990). To be specific, metacognitive strategies include the following subcategories, such as beforehand planning, selective attention, self-monitoring, and self-evaluation and etc. They serve the function of adjusting or managing cognitive processes. Metacognitive strategies are essential for successful planning, monitoring and evaluation of learning activities, which play a significant role in improving learning quality.

Due to the great importance of metacognitive strategies in learning, metacognition and metacognitive strategies have attracted increasing attention and interest from applied linguists and language teachers. More and more researchers, scholars and teachers come to realize that learning strategies have considerable influence on the effectiveness and efficiency of learning. Based on such a consensus, they integrate the notion of metacognitive strategies into linguistic research and language education, the scope of which covers almost every aspect of second/foreign language teaching and learning.

Under this context, some scholars have introduced the concept of metacognition into second/foreign language writing pedagogy and several studies have been conducted on the relationship between metacognition and second/foreign language writing. According to the study carried out by Devine et al., the data collected from the subjects of the 20 freshmen indicated that there was a positive correlation between metacognitive strategy and writing performance. Moreover, it was pointed out that metacognition or metacognitive strategy played a more important role than linguistic competence in developing second language writing skills (Devine, Railey, & Boshoff, 1993). According to Kasper's (1998) research, which took 120 learners from different cultural backgrounds as the participants, it was found that there was a significant connection between metacognitive strategy and English writing score. Furthermore, it was also found

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that high level learners were more likely to be equipped with more metacognition than median level learners, and their differences were significant in the variable of strategy. Then, Victori (1999) conducted an investigation into 4 undergraduates majoring English and the research showed that the differences in metacognitive knowledge between learners could give rise to different writing proficiency levels. Recent studies have found that metacognitive strategies are frequently used in English writing, and they are very helpful for improving writing quality from various aspects, including content, organization, vocabulary and grammar.

In China, in the field of English teaching, scholars also pay increasing attention to the relationship between metacognition and English writing. Through a large-scale questionnaire survey of 1422 non-English majors from 61 colleges in China, Wu & Liu (2004) found that metacognition is made up of metacognitive strategy and metacognitive evaluation. Besides, they identified the factors constituting the two constructs. Then, the researchers carried out an investigation of 308 college students, and the findings indicated that there were four types of metacognitive strategies which could have influence on learners' writing performance, which were comprised of strategy of selecting lexical items, strategy of equally stressing structure, content and language, strategy of exercise and positive experience, and strategy of turning to others for revising composition. Despite previous studies on the use of metacognitive strategies in writing, so far there are still quite few empirical studies focusing on how Chinese students employ metacognitive strategies in their English writing. Owing to the fact that engineering students at the tertiary level are confronted many difficulties in English academic writing and that great importance has been attached to the cultivation of engineering students' comprehensive quality since the *Excellent Engineer Education and Training Program* was initiated throughout Chinese universities nationwide in 2010, the present study aims to conduct an investigation into college engineering students' metacognitive strategies in English writing (Xiao & Chen, 2015).

II. METHODOLOGY

A. Research Questions

The present study aims to answer the following research questions:

1. What are the general characteristics of Chinese college engineering students' use of metacognitive strategies in the process of English writing?
2. What are the differences in the use of metacognitive strategies in the process of English writing between engineering freshmen and sophomores? Are the differences statistically significant?
3. What are the differences in the use of metacognitive strategies in the process of English writing between college engineering students of high level writing proficiency and the ones of low level? Are the differences statistically significant?

B. Research Subjects

The present study selected 215 college engineering students as participants. All of the subjects are from the same university in central China, whose fields of study range from mechanical engineering to nuclear engineering, environmental engineering, and construction engineering. The subjects are made up of 168 males and 47 females, which objectively represent the gender proportion of engineering students at the tertiary level in China. The participants consist of 112 freshmen and 103 sophomores, with students of the two grades being comparable.

C. Research Instruments

The research instruments adopted in the present study include questionnaire and test paper of English writing.

Firstly, questionnaire survey was administered. The questionnaire is intended to investigate what metacognitive strategies are used in learners' English writing and how frequently the metacognitive strategies are used. The design of the questionnaire items are mainly based on the theoretical framework on metacognitive strategies in the study conducted by O'Malley & Chamot (1990) and the questionnaire developed by Lu (2006). There are altogether 27 items in the questionnaire, which cover 4 factors of metacognitive strategies, and to be specific, items (1, 2, 3, 4, 5, 6, 7, 8) aim to measure the use of planning in English writing, items (9, 10, 11, 12, 13, 14, 15) for selective attention, items (16, 17, 18, 19, 20, 21) for self-monitoring, and items (22, 23, 24, 25, 26, 27) for self-evaluation. All the items take the form of 5-points Likert scale, from "1" indicating that the strategy is never used in English writing to "5" indicating that the strategy is always used in English writing.

The proficiency test of English writing is also administered. All the subjects in the present study were required to write an argumentative composition of more than 150 words within 30 minutes during class time. Each test paper was graded by three experienced English teachers, with the mean of the three scores as the final score of the student's English writing.

D. Data Collection and Data Analysis

The questionnaire survey was conducted at the end of a semester, which took place during class time. Before the questionnaire was filled in, the researchers spent about two minutes telling the subjects the purpose of the survey and explaining how to respond to the questionnaire items. Then, the subjects completed the questionnaire paper by choosing between "1", "2", "3", "4", and "5" for each item, which indicates the frequency of using the metacognitive strategy in

the process of English writing. According to Oxford & Burry-Stock (1995), the mean of each strategy can be used to represent the frequency with which the subjects adopt the strategy. To be specific, the mean between 1.0 and 1.4 indicates that “the learner never uses the strategy”; the mean between 1.5 and 2.4 indicates that “the learner seldom uses the strategy”; the mean between 2.5 and 3.4 indicates that “the learner sometimes uses the strategy”; the mean between 3.5 and 4.4 indicates that “the learner often uses the strategy”; the mean between 4.5 and 5.0 indicates that “the learner always uses the strategy”.

After the completion of questionnaire survey, the subjects were required to take English writing test. Then, the researchers collected all the questionnaire papers and writing test papers. Moreover, obtained were all the data from questionnaire survey and the scores that the three teachers gave by grading students' writing test papers. After that, the data were put into the computer and then were statistically processed and analyzed through SPSS 18.0. The analytical procedures were as follows. Firstly, a descriptive analysis of all the data was carried out and some important descriptive statistics would be computed, e.g. the mean and standard deviation of each strategy. Secondly, the researchers statistically computed the mean of each factor of metacognitive strategies in the two grades of college engineering students and compared the means by conducting independent samples t-test. Thirdly, the researchers statistically computed the mean of each factor of metacognitive strategies in the two groups of college engineering students, one of high level writing proficiency and the other of low level, and compared the means by conducting independent samples t-test.

III. RESULTS AND DISCUSSION

A. General Characteristics of College Engineering Students' Use of Metacognitive Strategies in English Writing

Through a statistical analysis of the data from questionnaire survey, the present study has obtained the following descriptive statistics presented in Table 1, i.e. mean and standard deviation of each factor of metacognitive strategy, which sketch the general characteristics of college engineering students' use of metacognitive strategies in English writing.

TABLE 1
MEANS AND STANDARD DEVIATIONS OF THE FOUR FACTORS OF METACOGNITIVE STRATEGIES USED BY ENGINEERING STUDENTS

Factor of Metacognitive Strategy	Mean	Std. Deviation
Planning	2.36	.43
Selective Attention	3.67	.51
Self-Monitoring	3.58	.46
Self-Evaluation	2.39	.49

From Table 1, it can be seen that Chinese engineering students tend to use metacognitive strategies when they are engaged in English writing tasks, and meanwhile they adopt the four different types of metacognitive strategies with different frequencies.

On the one hand, after more than twelve years of formal education and about ten years of English learning, college engineering students have accumulated relevant metacognitive knowledge and they are also aware that metacognitive strategies are beneficial to improve their learning quality and efficiency. Despite several years of language learning and practice, writing is still one of the most awkward language skills for most Chinese college students, and engineering students are especially less proficient writers for they are usually burdened with a series of specialized courses and some other demanding courses, such as Advanced Mathematics, College Physics and so on. Anyway, just because of their lack of solid foundation in English writing skill, college engineering students gradually learn to adopt metacognitive strategies in the process of English writing. All the four types of metacognitive strategies, i.e. planning, selective attention, self-monitoring and self-evaluation are used with some frequencies when college engineering students are involved in English writing task.

On the other hand, among the four different types of metacognitive strategies, college engineering students use selective attention and self-monitoring much more frequently than planning and self-evaluation. Firstly, it can be seen that they use selective attention quite often (3.67) when engaged in English writing tasks. In other words, they often consciously assign attention to some important aspects of writing, for example, careful reading of the task requirement, the connection of previous background knowledge and composition content, accurate use of words, phrases, sentence patterns, punctuations, cohesive devices and topic sentence in each paragraph etc. Secondly, self-monitoring strategies are also often (3.58) used when engineering students carry out English academic writing. In other words, in the process of writing, the students can often consciously check up whether all the content is centered on the title of the composition, whether there is a topic sentence in each paragraph and other sentences in each paragraph develop its topic sentence, and whether the language items are correctly or properly used. They often accordingly make revisions. Besides, they often regulate their writing speed according to the time left for their writing tasks. Thirdly, planning is the least frequently used (2.36) among the four types of metacognitive strategies. In other words, they seldom make plans for improving their academic English writing or they also seldom make such preparations as accumulation of relevant words, phrases, sentence patterns and sample essays for reference before they conduct specific writing tasks. Finally,

self-evaluation is also seldom adopted (2.39) in engineering students' English writing. The students rarely evaluate their own compositions from different perspectives, such as task fulfillment, content, cohesion and coherence, vocabulary, and grammar. The students seldom have self-evaluation of the learning strategies adopted in the process of writing and they rarely sum up their strengths, weaknesses and approaches to making improvement.

B. Differences in the Use of Metacognitive Strategies in English Writing between Engineering Freshmen and Sophomores

The subjects participating in the present study consist of freshmen and sophomores. In order to examine whether there are significant differences in the use of metacognitive strategies between engineering freshmen and sophomores, the statistical analysis of independent samples T-test is implemented, and the results are presented in Table 2.

TABLE 2
INDEPENDENT SAMPLES T-TEST ON ENGINEERING FRESHMEN AND SOPHOMORES'
USE OF METACOGNITIVE STRATEGIES IN ENGLISH WRITING

Factor of Metacognitive Strategy	Mean		Std. Deviation		t	sig.(2-tailed)
	Freshmen	Sophomores	Freshmen	Sophomores		
Planning	2.32	2.40	.42	.49	-1.29	.187
Selective Attention	3.61	3.74	.52	.50	-1.87	.096
Self-Monitoring	3.63	3.53	.47	.52	1.48	.165
Self-Evaluation	2.35	2.43	.48	.47	-1.23	.201

From Table 2, it can be seen that the differences in learners' use of metacognitive strategies between freshmen and sophomores are quite slight. When engaged in English academic writing, the freshmen tend to use three types of metacognitive strategies less frequently than sophomores. Firstly, the mean of the frequency with which planning is used by freshmen is 2.32, lower than that of sophomores (2.40), but the difference is not statistically significant (with sig. being .187, larger than .05). Similarly, the frequencies with which freshmen and sophomores adopt selective attention and self-evaluation in the process of English writing are quite close, and the differences are not significant from the perspective of statistics. In terms of self-monitoring strategy, surprisingly, the freshmen use this type of metacognitive strategy more frequently than the sophomores, with the means of 3.63 versus 3.53. However, the differences in the use of self-monitoring strategy between the freshmen and sophomores are not statistically significant.

According to the above results, it can be concluded that freshmen and sophomores use metacognitive strategies in English writing with similar frequencies. In other words, the learners do not make notable progress in the use of metacognitive strategies in the process of English writing though they spend more time learning English and they may acquire more language knowledge. The result that college engineering students' use of metacognitive strategies in English writing can not improve significantly can ascribe to the fact that the learners can not acquire metacognitive strategies naturally and that English teachers seldom impart metacognitive knowledge to the students and they also rarely integrate metacognitive strategy training into the cultivation of language skills. Thus, strategy-based instruction should be implemented in English writing teaching. Teachers should firstly give students lectures on metacognitive strategies, and acquaint the students with such strategies as planning, selective attention, self-monitoring, and self-evaluation. After that, the metacognitive strategy training should be further conducted in combination with specific writing tasks, and thus, students' knowledge of metacognitive strategies can be applied and strengthened in English writing. Through strategy training and strategy-integrated practice in English writing teaching, students are certain to use metacognitive strategies in English writing more flexibly and more effectively.

C. Differences in the Use of Metacognitive Strategies in English Writing between High-level and Low-level College Engineering Students

In order to examine whether there are significant statistical differences in the use of metacognitive strategies in English writing between engineering students of proficient writing skills and those of less proficient writing skills, the present study firstly selects those whose writing scores rank top 25% (i.e. the top 54 most proficient writers) as the high-level group and those whose writing scores rank bottom 25% (i.e. the bottom 54 least proficient writers) as the low-level group, and then the statistical analysis of independent samples T-test is implemented to compare the two groups' use of metacognitive strategies in English writing, and the results are presented in Table 3.

TABLE 3
INDEPENDENT SAMPLES T-TEST ON HIGH-LEVEL AND LOW-LEVEL COLLEGE ENGINEERING STUDENTS'
USE OF METACOGNITIVE STRATEGIES IN ENGLISH WRITING

Factor of Metacognitive Strategy	Mean		Std. Deviation		T	sig.(2-tailed)
	High-level	Low-level	High-level	Low-level		
Planning	2.62	2.19	.48	.42	7.01	0.00
Selective Attention	3.93	3.26	.52	.55	9.20	0.00
Self-Monitoring	3.87	3.42	.45	.43	7.51	0.00
Self-Evaluation	2.71	2.23	.46	.51	7.26	0.00

According to Table 3, it can be clearly seen that the engineering students whose writing skills are proficient use metacognitive strategies in English writing with significantly higher frequency than those who are less proficient

English writers. The four types of metacognitive strategies are employed with considerably different frequencies by the two groups of engineering students. To be specific, the frequencies with which planning, selective attention, self-monitoring, and self-evaluation are applied by successful engineering students are 2.62, 3.93, 3.87, and 2.71 respectively, while by contrast, their less proficient counterparts are at 2.19, 3.26, 3.42, and 2.23. Furthermore, the differences in the use of the four types of metacognitive strategies between the groups are statistically significant, with the sig. (2-tailed) being 0.00. From the results of independent samples T-test, it can be concluded that successful English writers tend to use metacognitive strategies in academic writing more frequently, flexibly, and effectively, while learners with low writing proficiency are likely to have poor performance in using metacognitive strategies. Therefore, in order to improve engineering students' writing proficiency and cultivate their writing skills, it is imperative that metacognitive strategies should be trained and integrated into English writing teaching and specific writing practice.

IV. CONCLUSIONS AND SUGGESTIONS

Through questionnaire survey and writing proficiency test, the present study investigates the use of metacognitive strategies in English academic English by engineering students at the tertiary level in China. The findings indicate that engineering students gradually develop awareness of metacognitive strategies and to some extent employ metacognitive strategies when engaged in English writing. Among the four types of metacognitive strategies, engineering students tend to use selective attention and self-monitoring more frequently and effectively, while planning and self-evaluation are applied with quite low frequencies. It is also found that the differences in the use of metacognitive strategies between the freshmen and the sophomores are not statistically significant, while engineering students of higher writing proficiency employ metacognitive strategies with higher frequencies than less proficient writers, and the differences between the two groups in the use of all the four types of metacognitive strategies, i.e. planning, selective attention, self-monitoring and self-evaluation, are statistically significant.

According to the findings of the present study and the effectiveness of metacognitive strategy training in the cultivation of language skills (Wang, 2014), it is strongly recommended that the training of metacognitive strategies should be implemented in the teaching of English writing for engineering students at the tertiary level in China. The strategy-based instruction can be conducted by taking the following two steps.

To begin with, English teachers should impart the knowledge of metacognitive strategies to engineering students and raise their metacognitive awareness, and in this way, the learners will increase their metacognitive knowledge and they will be acquainted with various types of metacognitive strategies, such as planning, selective attention, self-monitoring, and self-evaluation.

After the students have acquired sufficient knowledge of metacognitive strategies and have gained full understanding of them, the teachers are suggested to integrate the training of metacognitive strategies into classroom activities of English writing teaching. Only by combining metacognitive knowledge and specific writing tasks can the learners use metacognitive strategies flexibly and effectively.

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