WORKING MEMORY, LEARNING STYLES, READING STRATEGY USE AND READING PERFORMANCE IN CHINESE EFL TERTIARY LEARNERS

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ความสัมพันธ์ระหว่างความจำ รูปแบบการเรียนรู้ กลวิธีในการอ่าน และประสิทธิผลของการอ่านของนักศึกษาจีนที่เรียนภาษาอังกฤษในฐานะภาษาต่างประเทศ

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรดุษฎีบัณฑิต
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Suranaree University of Technology has approved this thesis submitted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

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การวิจัยครั้งนี้มีวัตถุประสงค์ เพื่อสำรวจความสัมพันธ์ระหว่างความจำเชิงปฏิบัติการ (WM) รูปแบบการเรียนรู้ (LS) กลวิธีการอ่าน (RS) และความสามารถทางการอ่าน (RP) ของนักศึกษาชาวจีนที่ไม่ได้เรียนภาษาอังกฤษเป็นวิชาเอก ผู้เข้าร่วมวิจัยประกอบด้วย นักศึกษาในมหาวิทยาลัยประเทศจีนที่ไม่ได้เรียนภาษาอังกฤษเป็นวิชาเอก จำนวน 245 คน เก็บรวมรวมข้อมูลจากแบบทดสอบความสามารถทางด้านความจำเชิงปฏิบัติการ (WMCT) แบบสอบถามการรับรู้เกี่ยวกับความชื่นชอบทางด้านรูปแบบการเรียนรู้ แบบสำรวจกลวิธีการอ่าน แบบทดสอบความเข้าใจทางการอ่าน และ เก็บรวมรวมข้อมูลจากการสัมภาษณ์แบบกึ่งรูปแบบ สถิติที่ใช้ในการวิเคราะห์ข้อมูลเชิงปริมาณ ได้แก่ สถิติพรรณนา (Descriptive statistics) การทดสอบค่าทีที่เป็นอิสระจากกัน (Independent-samples *t*-test) การวิเคราะห์ความแปรปรวนแบบทางเดียว (One-Way ANOVA) การหาค่าสัมประสิทธิ์สหสัมพันธ์แบบเพียร์สัน (Pearson's correlation coefficient (*r*)) และการวิเคราะห์การถดถอยพหุคูณ (Multiple regression analysis) ส่วนการวิเคราะห์ข้อมูลเชิงคุณภาพใช้วิธีการวิเคราะห์เนื้อหา (content analysis)

ผลการวิจัยชี้ให้เห็นว่า 1) ผู้ร่วมวิจัยทั้งหมดได้คะแนนจัดอยู่ในระดับปานกลางจากแบบทดสอบความสามารถทางด้านความจำเชิงปฏิบัติการ (WMCT) ความชื่นชอบรูปแบบการเรียนรู้ (Learning style) ของผู้ร่วมวิจัยมีการใช้ในระดับรองลงมา โดยแบ่งเป็น ชื่นชอบรูปแบบการเรียนรู้ด้วยการเคลื่อนไหวร่างกาย (Kinesthetic style) มากที่สุด และชื่นชอบรูปแบบการเรียนเป็นกลุ่ม (Group style) น้อยที่สุด ผู้ร่วมวิจัยรายงานว่าใช้กลวิธีการอ่านในระดับปานกลางจนถึงระดับสูงใน 3 ประเภท ประกอบด้วย การใช้กลวิธีการแก้ปัญหา (PROB) เป็นกลวิธีหลัก ตามด้วยกลวิธีการอ่านแบบองค์รวม (GLOB) และ กลวิธีการสนับสนุนการอ่าน (SUP) 2) พบว่า มีความแตกต่างกันอย่างมีนัยสำคัญระหว่างเพศชายและเพศหญิงในด้านความจำเชิงปฏิบัติการ (WM) รูปแบบการเรียนเป็นกลุ่ม (Group style) และ กลวิธีการสนับสนุนการอ่าน (SUP) และพบว่ามีความแตกต่างกันอย่างมีนัยสำคัญของคะแนนจากแบบทดสอบความสามารถทางด้านความจำเชิงปฏิบัติการ (WMCT) ระหว่างกลุ่มของนักศึกษาที่มีความสามารถทางการอ่านกลุ่มเก่ง ปานกลาง และอ่อน โดยนักศึกษากลุ่มความสามารถทางการอ่านกลุ่มอ่อนและกลุ่มเก่งนั้น มีความแตกต่างกัน

อย่างมีนัยสำคัญทางด้านรูปแบบการเรียนเป็นกลุ่ม (Group style) 3) พบความสัมพันธ์ในเชิงบวกอย่างมีนัยสำคัญระหว่างความจำเชิงปฏิบัติการ (WM) และรูปแบบการเรียนรู้ด้วยการเคลื่อนไหวร่างกาย (Kinesthetic/Individual style) นอกจากนี้ พบว่า มีความสัมพันธ์ในเชิงลบอย่างมีนัยสำคัญระหว่างความจำเชิงปฏิบัติการ (WM) และรูปแบบการเรียนเป็นกลุ่ม (Group style) หน่วยการวัดย่อยทั้งหมด 3 หน่วย ทางด้านกลวิธีการอ่าน (RS) มีความสัมพันธ์กันอย่างมีนัยสำคัญกับความจำเชิงปฏิบัติการ (WM) และยังมีความสัมพันธ์อย่างมีนัยสำคัญกับรูปแบบการเรียนรู้ด้วยการมองเห็น (Visual styles) รูปแบบการเรียนรู้ด้วยการสัมผัส (Tactile styles) และรูปแบบการเรียนรู้ด้วยการเคลื่อนไหวร่างกาย (Kinesthetic styles) 4) ความสามารถทางการอ่านของผู้เรียนสามารถทำนายได้โดยความจำเชิงปฏิบัติการ (WM) ด้วยความสามารถในการทำนายในระดับกลาง และยังสามารถทำนายได้ด้วยรูปแบการเรียนรู้ (LS) และกลวิธีการอ่าน (RS) ด้วยความสามารถในการทำนายอยู่ที่ระดับต่ำ 5) ผู้ร่วมวิจัยทั้ง 5 คู่เสมือน ได้มาจากผู้ที่เข้ารับการสัมภาษณ์ที่มีความสามารถทางด้านความจำเชิงปฏิบัติการ (WMC) ในระดับสูง จำนวน 8 คน และผู้ที่เข้ารับการสัมภาษณ์ที่มีความสามารถทางด้านความจำเชิงปฏิบัติการ (WMC) ในระดับต่ำ จำนวน 8 คน

ผลการวิจัยนี้ สนับสนุนอาจารย์และนักศึกษาในการพัฒนาความจำเชิงปฏิบัติการ (WM) กลวิธีการอ่าน (RS) และแม้แต่การพัฒนารูปแบการเรียนรู้ (LS) เพื่อปรับปรุงความสามารถทางการอ่านของนักศึกษาต่อไป

สาขาวิชาภาษาต่างประเทศ
ปีการศึกษา 2558

ลายมือชื่อนักศึกษา_____
ลายมือชื่ออาจารย์ที่ปรึกษา_____
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม_____

XIANGYANG ZHANG : WORKING MEMORY, LEARNING STYLES, READING STRATEGY USE AND READING PERFORMANCE IN CHINESE EFL TERTIARY LEARNERS. THESIS ADVISOR : PEERASAK SIRIYOTHIN, Ph.D., 268 PP.

WORKING MEMORY/LEARNING STYLES/READING STRATEGIES/READING PERFORMANCE

This study aimed at exploring the possible relationships between Chinese non-English major EFL undergraduates' working memory (WM), learning styles (LS), reading strategies (RS) and reading performance (RP). Participants were 245 non-English majors in a Chinese university. Data were collected from a working memory capacity test (WMCT), a Perceptual Learning Style Preference Questionnaire, a Survey of Reading Strategies, a reading comprehension test, and semi-structured interviews. Descriptive statistics, Independent-samples *t*-test, One-Way ANOVA, Pearson's correlation coefficient (*r*) and multiple regression analysis methods were employed to analyze the quantitative data, and content analysis method was utilized to analyze the qualitative data.

The findings indicate that: 1) Most participants achieved scores in the middle of the range for the WMCT. Participants' learning style preferences fell into a Minor-use range, with Kinesthetic and Group as their most and least favored learning styles separately. Participants reported a moderate to high use of the three categories of reading strategies, with Problem solving strategies (PROB) as their major choice followed by Global reading strategies (GLOB) and Support reading strategies (SUP).

2) There was a significant difference between males and females in WM, Group style and SUP. The high, moderate and low reading proficiency groups differed from each other significantly in their scores on the WMCT. There was a significant difference between the low and the high reading proficiency students in Group style. 3) There were significant positive correlations between WM and Kinesthetic/Individual style. There was a significant negative correlation between WM and Group style. All the three subscales of RS correlated significantly with WM, and with Visual, Tactile and Kinesthetic styles. 4) Students' reading performance could be predicted by their WM with medium predictive power, and by their LS and RS with low predictive power. 5) Five counterparts of themes were elicited from the 8 interviewees with high WMC and another 8 interviewees with low WMC.

These findings provide supportive evidence for teachers and students in the development of WM, RS and even LS so as to further improve students' English reading performance.

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LIST OF ABBREVIATIONS

CET-4	College English Test Band 4
CET-6	College English Test Band 6
EFL	English as a Foreign Language
ELLs	English Language Learners
FL	Foreign Language
IDs	Individual Differences
L1	First Language
L2	Second Language
LS	Learning Style
NNSs	Non-native Speakers
NSs	Native speakers
PLSPQ	Perceptual Learning Style Preference Questionnaire
RCT	Reading Comprehension Test
RS	Reading Strategy
SORS	Survey of Reading Strategies
WM	Working Memory
WMC	Working Memory Capacity
WMCT	Working Memory Capacity Test

CHAPTER 1

INTRODUCTION

This chapter provides an introduction and the background to the study. It begins with the significance of reading comprehension in English learning, and a general introduction of individual difference, followed by an introduction of the requirements of reading comprehension in college English teaching syllabi in China. After that, statement of the problem, purpose of the study, research questions, and significance of the study are presented. Finally, the terms used in this study are defined briefly.

1.1 Background to the Study

This section introduces the background to the study, including the importance of teaching and learning English as a second or foreign language, the significance of reading comprehension in English learning, an introduction of individual difference, and an introduction of the requirements of reading comprehension in college English teaching syllabi in China.

1.1.1 General Introduction of Reading

Along with globalization, English, as an international language of communication, plays an increasingly important role in many areas. The worldwide influence of English as lingua franca has put the importance of research in second (L2) and foreign language (FL) teaching and learning in a prominent position (Hinkel, 2011), and there is a dramatically continuing increasing number of L2 English learners

worldwide (Hinkel, 2005). In order to keep pace with the rapidly changing world, many people need to be able to read and comprehend multiple (e.g., printed and/or electronic) forms of information that surround them. In this circumstance, reading is not only a fundamental life skill, especially in the era of information explosion, but also as a primary goal of education as well as an important means of acquiring information and learning (Guo, 2001). Undoubtedly, the ability to read is an essential component of academic success. In the specific field of language teaching and learning, reading is an essential skill for learners of English, and with strengthened reading skills, learners of English are likely to make greater progress in other language learning fields (Anderson, 2003).

One important goal of reading is comprehension. From a cognitive point of view, comprehension is an internal process that requires interaction between readers and texts. Reading comprehension involves a complicated cognitive process. Readers need to concurrently process information in order to understand the context of reading (K. Chen, 2009). The ultimate goal of reading instruction is to comprehend diverse types of text (Halpern, 2009). In the realm of testing, comprehension is assessed through reading performance or reading achievement, terms that refer to how well students perform on a reading comprehension test designed to measure their understanding of written text (Halpern, 2009).

Much research on reading has been carried out from linguistic, psychological and cognitive perspectives. Reading activity involves the interaction between the human mind and written symbols, an attempt at communication between readers and writers, and so reflects the readers' prior knowledge, socio-cultural background knowledge, and cognitive characteristics (Guo, 2001). Just these factors coordinate to

enhance comprehension as reading has long been a topic of research in academia. While it has been much studied, the reading process remains inadequately understood, thus calling for more efforts of researchers to unveil its mystery.

1.1.2 General Introduction of Individual Differences

It is interesting to note that individual EFL students behave very differently when engaged in the act of reading. For example, some would prefer reading for detail, others for general meaning; some are good at reasoning, others are expert at remembering; some pay attention to vocabulary, others care for grammar. The great diversity among individuals may have as their source that they possess individual characteristics which influence their behaviors. Pawlak (2012) points out that it is acknowledged that the rate of L2/FL acquisition and the ultimate level of achievement are "to a large extent affected by individual variation among learners" (p. xix), which explains the fact that some individuals are highly successful and others are less. Dörnyei (2005) has given a definition of individual learner differences (IDs) as "dimensions of enduring personal characteristics that are assumed to apply to everybody and on which people differ by degree" (p. 4).

Individual differences (IDs) play a significant role in both L1 and L2/FL acquisition (Pawlak, 2012). The importance of IDs has been widely recognized in educational contexts and a great deal of research has been conducted on how to adapt instruction to the strengths, weaknesses, and preferences of the learners (Dörnyei, 2005). It is obvious that it is the interaction between them rather than the contribution of each single factor that eventually accounts for learning outcomes (Pawlak, 2012), thus these factors are very important in the process of L2 studying.

Since working memory, learning styles and reading strategies are the factors of interest in the investigation of the present study, we proceed to provide an overview of them.

The working memory capacity (WMC) of an individual differs from person to person (Ellis, 2008), and these differences account for some aspects of language comprehension (Just & Carpenter, 1992). Text comprehension places strong demands on working memory (Butcher & Kintsch, 2013). It is shown that working memory is related to reading comprehension abilities in English monolinguals and bilinguals, and learners of English (Mak, 2013). As one of the individual learner factors, working memory plays a particularly critical role in the comprehension processes during the reading of text (Osaka, Nishizaki, Komori, & Osaka, 2002). For example, during comprehension, incoming information is decoded perceptually, activated, reorganized, and generated or retrieved from long-term memory (Just & Carpenter, 1992; Osaka et al., 2002). In this sense, working memory is of importance in "storing the intermediate and final products of successive data, allowing the reader to integrate the contents and place the text words into context" (Osaka et al., 2002, p. 562).

Learning style, as one factor of individual learner differences, has been used to label a variety of phenomena of interest to researchers. Different individuals tend to have different preferences in accessing information by using their sensory organs, for instance, some would depend largely on their visual sense, some would prefer to accept information/stimuli with auditory sense, others would like to be involved in information physically, and still others would prefer to touch things by hands. These different styles also affect the different ways that learners use in learning. Learning styles reflect a

learner' preferences as to how to approach the learning tasks (Ellis, 2008), thus they are "broad preferences for going about the business of learning" (Ehrman, 1996, p. 49).

Reading is a strategic process during which a reader needs to use a number of reading skills to predict text information, select key information, organize and summarize information, monitor comprehension, restore comprehension breaks, and match up comprehension output with his/her goals (Grabe, 2009). As concluded by Halpern (2009), when performing reading comprehension strategies, readers should be metacognitively aware of the strategies that they use in comprehending the text, and skilled readers are able to reflect on their thinking and comprehension during reading.

1.1.3 Requirements of Reading Comprehension in College English Teaching Syllabi in China

English courses have been integrated into college syllabi as compulsory courses in China for more than thirty years, with reading taught as a core component of undergraduate courses.

According to the "College English Curriculum Requirements" ("Requirements" hereafter) issued by the Ministry of Education (MOE) in July, 2007, the "Requirements" for undergraduate College English teaching are set at three levels, i.e., basic, intermediate, and higher requirements. All non-English majors are required to attain to one of the three levels of requirements after studying and practicing English at school. The basic requirement is a goal that all non-English major graduates must achieve; intermediate and higher requirements are respectively set for those who, having laid a good foundation of English, can afford time to learn more of the language. Reading comprehension skill is stated clearly in the "Requirements" below:

i) The basic requirements for reading: Students should be able to read, in the main, English texts on general topics at a speed of 70 wpm. With longer yet less difficult texts, the reading speed should be at 100 wpm. Students should be able to skim or scan reading materials. And with the help of dictionaries, they should be able to read English textbooks in their areas of specialty, and English newspapers and magazines on familiar topics, grasping the main ideas, and understanding major facts and relevant details. They should be able to understand texts of practical styles commonly used at work and in life. They are expected to be able to employ effective reading strategies while reading.

ii) Intermediate requirements for reading: Students should, in the main, be able to read essays on general topics in newspapers and magazines published in English-speaking countries at a speed of 70-90 wpm. With longer and moderate difficult texts for fast reading, the reading speed should be 120 wpm. When reading summary literature in their areas of specialty, students should be able to get a correct understanding of the main ideas, major facts and relevant details.

iii) Higher requirements for reading: Students should be able to read certain difficult texts, and understand their gist and details. They should be able to read English articles in newspapers and magazines published in English-speaking countries, and to read literature related to their areas of specialty without much difficulty. (MOE, 2007)

1.2 Statement of the Problem

In China now, there is a large number of people learning English as a foreign language. Reading has always been an important part of China's EFL programs. Among the skills of listening, speaking, reading and writing taught in China's English classes, reading is probably the most focused skill. Because reading comprehension is usually assessed in a large proportion of tests, it is integrated in the English curriculum at every level and given much attention. However, in general, Chinese students' English reading competence is far from satisfactory although much emphasis and time has been attached

to the English reading courses. In this case, it is necessary to examine the factors that may separately and/or jointly affect learners' reading performance.

However, so far in literature, research can only be found to investigate the relationships between working memory and reading performance, or between learning styles, reading strategies and reading performance. No empirical studies have been found to investigate the relationships between working memory, learning styles, reading strategies and reading performance. Apart from that, working memory is mainly studied in psychology, with much of the research about the impact of working memory on first language reading comprehension. In the second language learning area, although a few studies have been conducted in recent years, in general, related studies are insufficient in numbers.

This gap in the literature calls for the present study: the complexity of the reading process and the deficit of relevant empirical research have stimulated the researcher's interest for further investigation.

1.3 Purpose of the Study

The present study endeavors to investigate the interrelationships between Chinese college students' individual learning factors of working memory, learning styles, and reading strategies, exploring how they might affect reading comprehension, so as to inform reading instruction and cultivate reading comprehension ability, and further, to examine whether reading comprehension performance can be predicted by aspects of working memory, learning styles and reading strategies. Specifically, the purpose of the current study is:

1. to investigate the overall profiles of the Chinese non-English major EFL learners' working memory, learning styles and reading strategy use;

2. to examine whether there are significant differences with regard to the Chinese non-English major EFL learners' gender and level of English reading proficiency;

3. to explore the relationships between the Chinese non-English major EFL learners' working memory capacity, learning styles, and reading strategy use;

4. to find out whether the Chinese EFL learners' reading performance can be predicted by their working memory, learning styles and reading strategies; and

5. to probe what the differences, if any, exist between the Chinese non-English major EFL learners with high working memory capacity and those with low working memory capacity.

1.4 Research Questions

To this end, the current study seeks to answer the following specific research questions:

1. What are the overall profiles of the Chinese non-English major EFL learners' working memory, learning styles and reading strategy use?

2. Are there any significant differences in the Chinese non-English major EFL learners' working memory, learning styles and reading strategy use with regard to their gender and level of English reading proficiency?

3. What are the relationships between the Chinese non-English major EFL learners' working memory capacity, learning styles, and reading strategy use?

4. To what extent can the Chinese non-English major EFL learners' reading performance be predicted by their working memory, learning styles, and reading strategies?

5. What are the differences, if any, between the Chinese non-English major EFL learners with high working memory capacity and the learners with low working memory capacity?

1.5 Significance of the Study

The study promises significant contributions to the theoretical and practical implications for reading pedagogy.

First, this study employs multi-factors to elaborate the EFL learners' individual factors involved in the complicated reading process, to better understand the reading process, and to enrich the theory of reading. The significance of the study also lies in its potential for contributing to a deeper understanding of the L2/EFL reading process, thus suggesting directions for further research.

Secondly, the findings yielded in this study about the correlations between working memory, learning styles, and reading strategies will provide more evidence for the research of learners' individual differences.

Thirdly, although there is research on the relationship between working memory and reading performance, or research on the relationships between learning styles, reading strategies and reading performance, no research has been found to examine the relationships between working memory, learning styles, reading strategies and reading performance all at once. The primary significance of this study lies in that it may fill this gap in the research field.

Finally, the study is significant in that it may provide evidence and suggestions for both EFL instructors and EFL students about the nature and task of EFL reading comprehension, thus proposing a direct focus for teaching and learning. On the one hand, this study may provide evidence to instructors to realize that students' individual differences should be taken into consideration in their teaching. On the other hand, students can take advantage of the findings of the present study to recognize their individual differences so as to better discover their strengths not only in the learning of a foreign language but also extend to other learning fields.

In summary, throughout this study, an attempt will be made to gain more insights into the learners' individual differences and factors and their interrelationships in the reading process. Moreover, it is hoped to encourage further studies on these factors of the reading process.

1.6 Definitions of Key Terms

It is necessary to clarify key terms used throughout this study. The following list provides the terms that are frequently used in this present investigation. These terms and their definitions are:

- **College English Test Band 4 (CET-4) and Band 6 (CET-6)**

According to the website of "College English Test Band 4 and Band 6" (http://www.cet.edu.cn/), College English Tests are Chinese national English examinations authorized by the Ministry of Education (MOE). The purpose of the large-scale standardized tests is to objectively and accurately measure college students' practical English competence to provide advice for college English teaching. CET-4 and CET-6 exams are held twice every year in June and December. The tests are designed to assess

university non-English major students' English proficiency during their college years, based on the attainment targets set in the non-English major program.

The CET-4 and CET-6 have undergone several reforms and modifications since they were first administered in 1987. After several adjustments to the test paper structure, test content, types of testing items and test time, form December, 2013 and on, CET-4 and CET-6 are like this: The full scores of the two tests are 710, but there is not a pass score set for the tests. The candidates are examined on basic language knowledge such as phonetics, vocabulary, grammar which are reflected by the four item types of skills—listening comprehension (35% out of the total score), reading comprehension (35% out of the total score), a composition writing (15% out of the total score), and a passage translation (15% out of the total score). Only those examinees that have reached 425 or above in CET-4 are eligible to apply to take the CET-6 test. The reading comprehension part in the tests takes up most in quantities and marks in a whole paper, thus regarded to be the most important part of the tests.

The CET-4 and CET-6 are considered to be a standard to check college non-English major students' English levels to some extent. A large number of statistical data indicate that the tests are both high in reliability and validity. The two tests have gained social recognition, and have become one of the standards that personnel departments at all levels employ for college or university graduates.

- **English as a Foreign Language (EFL)**

In this study, EFL refers to learning English language in a foreign language context where English is neither widely used for communication, nor as the medium of instruction. Teaching and learning English in China, for example, illustrates English as a foreign language.

- **English Language Learners (ELLs)**

In this study, English language learners (ELLs) are individuals whose native language is Chinese, and whose English proficiency is still developing in the process of learning English.

- **Individual Differences (IDs)**

Individual differences are the characteristics as to which individuals may differ from each other by degree. In this study, working memory capacity, learning styles and reading strategies are individual differences among learners.

- **Learning Styles**

In this study, learning styles refer to learners' habitual ways of approaching learning tasks, including perceiving, processing, or reacting.

- **Level of English Reading Proficiency**

Generally, level of reading proficiency refers to a person's ability to understand reading material. In this study, it refers to how well a student can perform in the reading tests. In this study, a student's reading proficiency level can be distinguished by his/her scores in the reading comprehension test as "high", "moderate" or "low".

- **Non-English Major EFL Learners**

In the present study, non-English majors are the college and university students in China who are majoring in fields other than English, but who learn English as a compulsory course in the first year or the first two years in college or university.

- **Perceptual Learning Styles**

Perceptual learning styles refer to "the variations among learners in using one or more senses to understand, organize, and retain experience" (Reid, 1987, p. 89).

- **Reading**

In this study, reading is a complex process which involves the interaction between the reader and the text. The goal of reading is to make meaning from the text based on the reader's prior knowledge.

- **Reading Comprehension**

In this study, reading comprehension is the process of constructing meaning from print or electronic texts during which the reader interacts with the text.

- **Reading Strategies**

In this study, reading strategies are those consciously selected skills or steps by a reader to assist comprehension of a reading task.

- **Working Memory**

In this study, working memory refers to a brain system that involves in temporary storage and processing of information to facilitate complex mental activities such as comprehension, learning and reasoning. The two functions compete against each other constantly for the limited working memory space, resulting in a trade-off between them.

1.7 Summary

Chapter one begins with a description of background to the present study, followed by the statement of the problem, purpose of the study, research questions, and significance. This chapter concludes with brief definitions of the key operational terms used in this study. In the next chapter, a review of related literature concerning reading, working memory, learning styles and reading strategies will be elaborated.

CHAPTER 2

REVIEW OF RELATED LITERATURE

This chapter presents a review of the literature on reading, reading comprehension, working memory, learning styles and reading strategies, and previous research about them. It is organized under the following four main topics of significance to the present study: the nature of reading; reading comprehension; theories related to working memory, learning styles and reading strategies; and previous research of the relationships between working memory/learning styles/reading strategies and reading performance.

2.1 The Nature of Reading

In order to fully understand the reading process, it is necessary to discuss the nature of reading. Therefore, an account of views on reading is placed at the beginning of the literature review.

2.1.1 Definitions of Reading

Reading has been studied broadly across a wide range of different disciplines (Mebarki, 2011); therefore the definitions of reading have changed along with different views over time. According to Urquhart & Weir (1998), reading is "the process of receiving and interpreting information encoded in language form via the medium of print" (p. 22). In the opinion of Urquhart & Weir (1998), although the information can be of any kind, is encoded in language. According to McShane (2005), reading is "'a

complex system of deriving meaning from print' that requires an understanding of how speech sounds are related to print, decoding (word identification) skills, fluency, vocabulary and background knowledge, active comprehension strategies, and a motivation to read" (p. 7). In Koda's (2005) opinion, reading is "a multifaceted, complex construct in that it involves a number of component operations, each dependent on a wide range of competencies" (p. 57). And further, reading is "a complex, multifaceted pursuit requiring the continuous deployment and integration of multiple operations (Koda, 2005, p. 227).

The definitions of reading may vary from person to person, but they may share some commonalities that reading is a complex process which involves the interaction between the reader and the text. The goal of reading is that readers, with multiple background knowledge, gain meaning from the text. Reading is complex since psychological, cognitive and linguistic elements are involved in the process. It is interactive because the reader, no matter what kind of background he/she has, comprehends the text based on his/her own construction of the meaning. The goal of reading is meaning-making because the reader reads to comprehend what is attempted to be conveyed in the text.

2.1.2 The Processes of Reading

Based on the different purposes for reading and the varying processes of reading, Grabe (2009) holds that no single statement is going to capture the complexity of reading, so it is necessary to consider a more comprehensive definition of reading. He thus provides a more comprehensive definition from examining the processes of reading: Reading is a rapid, efficient, comprehending, interactive, strategic, flexible, purposeful, evaluative, learning and linguistic process. These processes are described as following:

● *Fluent reading is a rapid and efficient process.* Fluent reading is rapid in the sense that readers read most materials at the rate of about 250-300 wpm. Reading is efficient not only in terms of the overall reading rate, but also in terms of the ways that various processing skills work together smoothly. While reading, the readers coordinate rapid and automatic word recognition, syntactic parsing, meaning formation, text-comprehension building, inferencing, critical evaluation, and linkages to prior knowledge without effort and with all processes synchronizing in time.

● *Reading is centrally a comprehending process.* Comprehension is a central goal of reading. Readers read to understand what the writer intended to convey in writing, though they also do more. All cognitive processing involved in reading is related to this fundamental goal.

● *Reading is an interactive process.* Reading combines many cognitive processes working together at the same time. Reading is also an interaction between the reader and the writer. The text provides information that the writer wants the reader to understand. The reader also brings background knowledge to reading and actively constructs the meaning of the text by comprehending what the writer intends and by the interpreting with background knowledge.

● *Reading is a strategic process.* Readers take effort to use a number of the skills to anticipate text information, select key information, organize and mentally summarize information, monitor comprehension, repair comprehension breakdowns, and match comprehension output to reader goals.

● *Reading is a flexible and purposeful process.* The reader adjusts reading processes and goals when his/her purpose shifts, when comprehension is impeded, or when interest varies. Fluent readers keep the processes and purposes aligned with each other.

● *Reading is an evaluative process.* At one level, readers evaluate how well they are reading (or monitor their reading). Evaluation also occurs when readers decide how they should respond to a text.

● *Reading is a learning process.* Ongoing evaluations make reading a learning process. Readers make decisions about how to respond to the text during the evaluation process, in which situations, learning is expected.

● *Reading is a linguistic process.* The process of linguistic information is central to reading comprehension. It is impossible to comprehend without linguistic knowledge (morphological, syntactic, and semantic). (Grabe, 2009, pp. 14-16)

Grabe (2009) concludes that the processes provide "a reasonable functional account of *what* fluent readers do when encountering a text". From this point, these processes provide a good definition of reading although it seems complex. In a sense, these processes can be viewed as functional components of reading (Grabe, 2009).

2.2 Reading Comprehension

The key to reading is comprehension. Reading comprehension is a complicated cognitive process. A good knowledge of the mechanisms of reading comprehension may offer a better understanding of the reading comprehension process.

2.2.1 Definitions of Reading Comprehension

Comprehension has multiple definitions, e.g., it could be seen "as a process versus a product, as a sum of parts versus a whole or having varying degrees" (Koda, 2005, pp. 228-230). Alderson (2000) makes a distinction between the "process" and its result, the "product". The process means "'reading' proper", i.e., "the interaction between a reader and the text" (p. 3). It is assumed that during the "process", a reader looks at print, decipher the marks on the page, decode the meaning and the way they relate to each other, and the reader also think about what he is reading, and how useful the text is (Alderson, 2000).

The RAND Reading Study Group (RRSG, charged by the Office of Educational Research and Improvement of the U.S. Department of Education) defines reading comprehension as "the process of simultaneously extracting and constructing meaning through interaction and involvement with written language" (Snow, 2002, p. 11). The RAND definition states that the comprehension entails three elements: "*the reader* who is doing the comprehending", "*the text* that is to be comprehended", and "*the activity* in which comprehension is a part" (Snow, 2002, p. 11). The three elements are explained as:

> ● *The reader.* The reader brings to the act of reading his or her cognitive capabilities (attention, memory, critical analytic ability, inferencing, visualization); motivation (a purpose for reading, interest in the content, self-efficacy as a reader); knowledge (vocabulary and topic knowledge, linguistic and discourse knowledge, knowledge of comprehension strategies) and; experiences.
>
> ● *The text.* The features of any given text have a large impact on comprehension. While reading, the reader constructs various representations of the text that are important for comprehension, including the surface code (the exact wording of the text), the text base (idea units representing the meaning of the text), and the mental models (the way in which information is processed for meaning) that are embedded in the text. Electronic text presents particular challenges to comprehension (e.g., dealing with the non-linear nature of hypertext), but it also offers the potential to support comprehension by providing hyperlinks to definitions of difficult words or other supplementary material.
>
> ● *The reading activity.* It involves one or more purposes or tasks, some operations to process the text, and the outcomes of performing the activity, all of which occur within some specific context. (Snow, 2002, p. xiii-xv)

Snow and Sweet (2003) hold that the three elements of reading comprehension work simultaneously, rather than in isolation. Perfetti, Landi, and Oakhill (2005) believe

that comprehension would occur at the time that "the reader builds a mental representation of a text message" (p. 228). Across the various levels such as word level (lexical processes), sentence level (syntactic processes), and text level at which the comprehension occurs, "processes of word identification, parsing, referential mapping, and a variety of inference processes all contribute, interacting with the reader's conceptual knowledge, to produce a mental model of the text" (Perfetti et al., 2005, p. 228).

2.2.2 Mechanisms of Reading Comprehension

As Grabe (2009, p. 16) states that the reading processes account for "*what* fluent readers do when encountering a text", he also suggests that for the purpose of better understanding of reading, it is necessary to know "*how* to read". Therefore, the mechanisms of reading comprehension need to be considered.

Gernsbacher (1991) takes a cognitive view of the processes and mechanisms involved in language comprehension. According to her "structure building framework", the goal of comprehension is to build a coherent, mental representation or structure of the information being comprehended. During the process, the reader needs to lay foundations for his/her mental structures at first. Then the reader develops his/her mental structures by mapping on information if that incoming information is coherent or related to previous information, or shifts and initiates a new substructure if the incoming information is less coherent or related. The result is that some substructures are involved in the reading process).

Koda (2005) claims that, "comprehension occurs when the reader extracts and integrates various information from the text and combines it with what is already known" (p. 4). Taking word recognition as an example, word recognition refers to "the processes of obtaining words' sounds and meanings, and decoding deals specifically with the

extraction of phonological information" (Koda, 2005, p. 29). Word recognition is the basic skill on which other dimensions of reading skills depend (Ehri & Wilce, 1983; Breznitz, 2006). Koda (2005) explains how word recognition efficiency facilitates text comprehension. Reading comprehension demands the construction of the text meaning. Since the reader is confined to the text information, comprehension can hardly be achieved if he/she builds the meaning that is unjustified by the text. To access sufficient information to construct the text meaning, the reader needs to possess skills of visual sampling. If the new information is insufficient or inaccurate, the comprehension will be impaired heavily (Koda, 2005).

2.2.3 Individual Differences of Readers

Studies on reading can be categorized into two general groups according to their foci, with one group focusing on the text and the other on the reader. The text group concentrates on the linguistic features of the text, including orthography, word formation, sentence structure, grammar, and cohesion of the discourse, etc., while the reader group focuses on individual differences among readers, including their characteristics (Guo, 2011).

Koda (2005) provides a simple answer to the question as to why individual differences of readers should be studied, that is, "virtually all reading competencies are subject to variation" (p. 181). In her opinion, research on individual differences can yield useful theoretical and practical findings. Theoretically, readers' insights into basic reading competencies can determine their specific contributions to reading capability. And the knowledge of the constitution of successful reading and the distinction between good and poor readers enable researchers to refine some reading models. Pedagogically, research into individual differences can provide useful information for instruction

where effective skills that are causally relevant to reading comprehension can be emphasized (Koda, 2005).

Ellis (2008) divides L2 learners' individual differences into four categories based on their abilities, propensities, cognition concerning L2 learning, and learner actions. Each category is sub-divided into one or several factors. For instance, intelligence, working memory, and language aptitude are factors categorized into abilities; learning style, motivation, anxiety, personality, and willingness to communicate belong to the category of propensities. Table 2.1 illustrates the categories.

As shown in Table 2.1, learners' working memory, learning styles and learning strategies are the individual factors that may influence learning outcomes. The present study thus takes an interest in examining the interrelationships between working memory, learning styles and reading strategies to see whether they may impact on the reading comprehension performance.

Table 2.1 Factors Responsible for Individual Differences in L2 Learning (Ellis, 2008, p.645)

Category	**Factors**
A Abilities	1 Intelligence 2 Working memory 3 Language aptitude
B Propensities	1 Learning style 2 Motivation 3 Anxiety 4 Personality 5 Willingness to communicate
C Learner cognitions about L2 learning	Learner beliefs
D Learner actions	Learning strategies

In conclusion, reading is generally accepted as an interactive process between the reader and the text. Readers bring their prior knowledge to construct meaning of the text. Reading comprehension entails three elements: the reader, the text and the reading activity that work simultaneously to achieve comprehension. Reading comprehension is essential to language learning, readers' individual differences may influence reading performance.

2.3 Theories Related to Working Memory, Learning Styles and Reading Strategies

This section reviews, summarizes and comments the theories related to working memory, learning styles and reading strategies.

2.3.1 Working Memory

As a factor of individual differences, working memory plays an important role in reading comprehension. This section reviews its definitions and models to provide basic understanding, discusses its role in reading comprehension to prove its importance, and suggests the measures of its capacity to serve the purpose of the present study.

2.3.1.1 Definitions of Working Memory

The concept of working memory (WM) has been broadly discussed, from its origin in cognitive psychology to many areas of cognitive science and neuroscience, and has been applied in education, psychiatry and paleoanthropology (Baddeley, 2010).

Baddeley (1992, 2010) defines the term "working memory" as a brain system or systems that are assumed to provide temporary storage and manipulation of the information necessary in order to keep things in mind while performing complex

tasks such as language comprehension, learning and reasoning. Later, Baddeley, Allen and Hitch (2011) use the term principally to refer to "a broad framework of interacting processes that involve the temporary storage and manipulation of information in the service of performing complex cognitive activities" (p. 1393). Osaka et al. (2002) conclude that working memory refers to "the immediate brain processes involved in the simultaneous storage and processing of information and plays an important role in complex cognition, such as language comprehension, learning, and reasoning" (p. 562).

From the above definitions, it can be summarized that working memory is a brain system, which can only temporarily store and process information. Working memory serves to facilitate complex mental activities. This conception of working memory lays a theoretical foundation for the present study. The two functions of WM, temporary storage function and the processing function, are reflected in the reading process in which the present study is interested.

2.3.1.2 Models of Working Memory

The concept of working memory was introduced to describe the cognitive ability of temporarily storing and manipulating information necessary when performing a wide range of complex cognitive tasks. A number of models have been proposed to explain this process. Shah and Miyake (1999) collected 10 influential models of working memory: 1) Baddeley and Logie's Multiple-Component Model; 2) Cowan's Embedded-Processes Model; 3) Engle, Kane and Tuholski's "Controlled Attention" Framework; 4) Lovett, Reder and Lebiere's ACT-R Model; 5) Kieras, Meyer, Mueller and Seymour's Executive-Process/Interactive-Control (EPIC) Model; 6) Young and Lewis' Soar Architecture; 7) Ericsson and Delaney's Long-Term Working Memory (LT-WM) Framework; 8) Barnard's Interactive Cognitive Subsystems (ICS) Model; 9)

Schneider's Controlled and Automatic Processing (CAP2) Architecture; and 10) O'Reilly, Braver and Cohen's Biologically Based Computational Model.

These models not only provide an overview of the theoretical development of working memory, but also offer rich sources for subsequent research.

2.3.1.2.1 Baddeley & Hitch's (1974) Three-Component Model

Although many models of working memory are proposed along with the theoretical development, the most original and well-known model of WM is the three-component model proposed by Baddeley and Hitch in 1974. Since the publication of their initial paper, as Baddeley (2000) claims, WM continues to be actively used within many areas of cognitive science, including mainstream cognitive psychology, neuropsychology, neuroimaging, developmental psychology and computational modeling.

The term "working memory" appears to have been first proposed by Miller, Galanter and Pribram (1960). Atkinson and Shiffrin (1968) applied the term "working memory" to a unitary short-term store. On the contrary, Baddeley and Hitch (1974) argued that the concept of a simple unitary short-term memory should be replaced by a more complex system comprising multiple components so as to emphasize its functional importance in cognitive processing (Baddeley, 2001; 2002). Baddeley and Hitch's (1974) three-component model of working memory has been discussed in a series of Baddeley's research works (e.g., 1992, 2000, 2001, 2002, 2003a). The following is the model proposed by Baddeley and Hitch (1974) while depicted in graphic by Baddeley (2001).

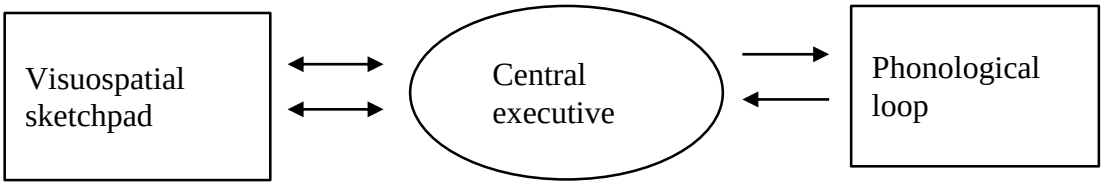

Figure 2.1 The Model of Working Memory Proposed by Baddeley and Hitch (1974)

As shown in Figure 2.1, the three-component system proposed by Baddeley and Hitch (1974) comprises a limited capacity attentional controller, the central executive, aided by two subsystems, one concerned with acoustic and verbal information—the phonological loop, and the other performing a similar function for visual and spatial information—the visuospatial sketchpad (Baddeley, 2001). Baddeley (2001, 2002, 2003a) explains the model in details:

> ● *The phonological loop*. The phonological (or articulatory) loop is assumed to comprise a store that holds memory traces for a couple of seconds, combined with a subvocal rehearsal process. This is capable of maintaining the items in memory using subvocal speech, which can also be used to convert nameable but visually presented stimuli, such as letters or words, into a phonological code. (Baddeley, 2002, pp. 5- 6)
>
> ● *The visuospatial sketchpad*. The visuospatial sketchpad (or scratchpad) is assumed to allow the temporary storage and manipulation of visual and spatial information (Baddeley, 2002, p. 6). [It] serves the function of integrating spatial, visual, and possibly kinesthetic information into a unified representation which may be temporarily stored and manipulated (Baddeley, 2003a, p. 200).
>
> ● *The central executive*. The central executive is assumed to provide an attentional control system, both for the subsystems of working memory and for other activities. [It is assumed that] much activity is controlled by well-learned habits and schemata, guided by environmental cues. (Baddeley, 2002, p. 6)

According to Baddeley (1992, 2000), the phonological loop is probably the simplest, the most extensively investigated and best developed component of the working memory model. It is assumed to comprise two components: one is a temporary phonological store that can hold acoustic or speech-based information for 1 or 2 seconds, i.e., auditory memory traces decay over a period of a few seconds, unless received by articulatory rehearsal. The other is an articulatory control process, somewhat analogous to inner speech. That is, the phonological loop serves as two functions: it can maintain material within the phonological store by subvocal repetition, and it can take visually presented material such as words or nameable pictures and register them in the phonological store by subvocalization.

Baddeley (2003b) suggests that executive processes are probably one of the major factors determining individual differences in working memory span. A working memory span task is employed in the current study to assess the participants' working memory capacity.

2.3.1.2.2 Baddeley's (2000) Multi-Component Model

Baddeley (2000) notes that since the publication of Baddeley and Hitch's (1974) paper, the concept of working memory has been actively used in many areas of cognitive science, including cognitive psychology, neuropsychology, neuroimaging, developmental psychology and computational modeling. But Baddeley also acknowledges that not all phenomena fit the model well. Therefore, Baddeley (2000) adds a fourth component of working memory, the "episodic buffer", to the initial three-component model. The new proposed episodic buffer is assumed to play an important role in feeding information into and retrieving information from episodic long-term memory (Baddeley, 2000). It is capable of binding together information from

a number of different sources into chunks or episodes, hence the term “episodic”; it is a buffer in the sense of providing a way of combining information from different modalities into a single multi-faceted code. Finally, it is assumed to underpin the capacity for conscious awareness (Baddeley, 2000, 2003b). It is explained in the following:

> ● *The episodic buffer* is assumed to be a limited-capacity temporary storage system that is capable of integrating information from a variety of sources. It is assumed to be controlled by the central executive, which is capable of retrieving information from the store in the form of conscious awareness, of reflecting on that information and, where necessary, manipulating and modifying it. (Baddeley, 2000, p. 421)

The episodic buffer is multidimensional. It allows a set of different subsystems, although they are based on different codes, to interact. The main function of the buffer is to combine the information derived from different sources together to form integrated chunks. Its capacity is assumed to be limited by the number of episodes or chunks that it can hold (Baddeley, Allen & Hitch, 2011).

As Figure 2.2 shows, the episodic buffer provides a temporary interface between the subsystems (i.e., phonological loop and the visuospatial sketchpad) and long-term memory. The buffer is a modeling space separated from long-term memory, but forms an important stage in long-term episodic learning. The shaded areas represent “crystallized” cognitive systems capable of accumulating long-term knowledge (e.g., language and semantic knowledge). The unshaded systems represent “fluid” capacities (e.g., attention and temporary storage) and are unchanged by learning, other than indirectly via the crystallized systems (Baddeley, 2000).

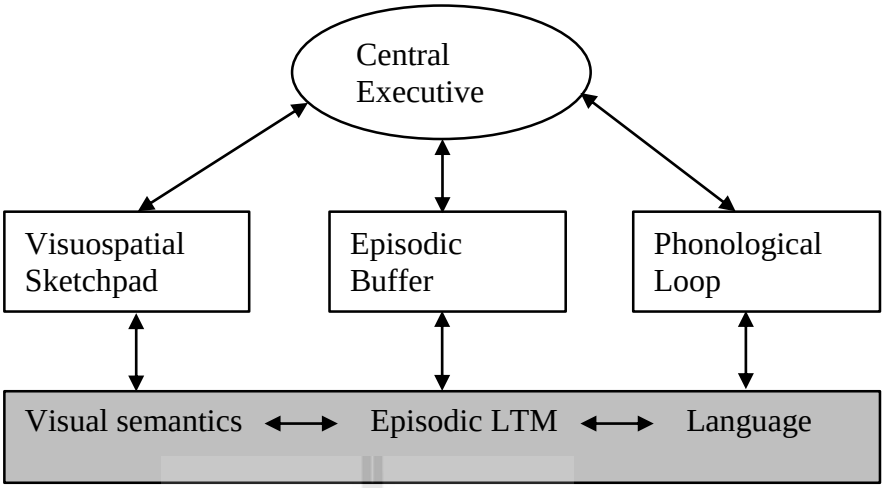

Figure 2.2 The Multi-Component Working Memory Model (Baddeley, 2000)

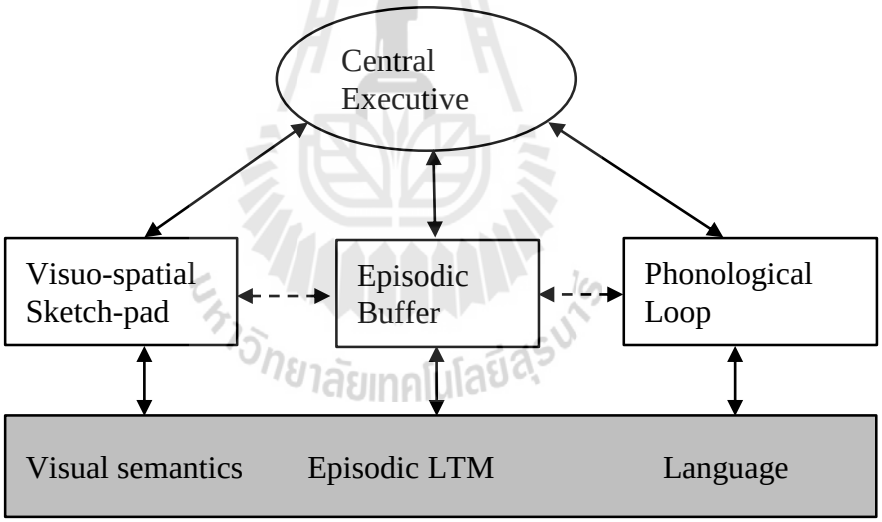

Figure 2.3 A Later Development of the Multi-Component Model (Baddeley, 2010)

Figure 2.3 shows a later development of the multi-component model (Baddeley, 2010). This revised model includes links to long-term memory and a fourth component, the episodic buffer that is accessible to conscious awareness. The differences between the initial model and the revised version lie in links between the other two subsystems (the phonological loop and the visuospatial sketchpad) and the

buffer. In the initial model, the links between the other two subsystems and the buffer are operated via the central executive. In the revised model, however, as shown by the dotted lines, it seems likely that there are also direct links between the subsystems and the buffer (Baddeley, 2007). The concept of episodic buffer has been useful in allowing the earlier three-component model to account for a much wider range of data, and to link in fruitful ways to other approaches to working memory (Baddeley, 2000; Baddeley, et al, 2011). The multi-component model has proved durable and has been widely used in psychology and neuroscience. One reason for the popularity of this theoretical framework is, as pointed out by Baddeley (2010), its "simplicity", for more theoretical development can be developed within the model without considering constant change.

This model also provides a theoretical framework for the research design of the current study. The WM reading span task is performed in the current study, with a series of sentences which serve as visual stimuli presented, participants are charged with recalling sentence-final words whilst at the same time judging the reasonableness of the stimulus sentences. As mentioned above, WM is assumed to have two major features: storage and processing, this WM span task is thus designed to measure the storage and the processing abilities of the participants' WM capacity based on such conception.

2.3.1.2.3 Wen's (2015) Integrated Framework of WM in SLA

Baddeley and colleagues' models of WM, proposed based on L1, have been discussed in a large number of studies within many areas of cognitive science. In language acquisition field, WM has been found to play an important role in language learning (Wen, 2012). The relations between WM and L1 acquisition have been

examined in many research works. In recent years, an increasing number of empirical studies have also been conducted to explore the effects of WM on SLA. The view that WM may play an equal if not greater role in learning L2 or FL has been gradually as well as widely accepted (Wen, 2012, 2015). In order to provide a theoretical and methodological WM construct in SLA research, Wen (2015) proposes an integrated framework of WM for SLA.

As depicted in Figure 2.4, this integrated WM-SLA framework consists of three key aspects: 1) A working definition of WM in SLA. It adopts a definition as "the limited capacity of multiple mechanisms and processes implicated in L2 domains and activities" (Wen, 2015, p.52). This conception of WM has three characterizations. The first feature of WM is multiple components, which facilitates execution of complex cognitive activities/tasks. Another characterization is its limited capacity. A third characterization of WM is that it is closely linked to long-term memory (LTM) and sometimes even helps to make changes in LTM, thus rendering it a gateway to LTM (Wen, 2012). 2) The language-related WM components as well as their associated mechanisms and functions that are most relevant to the SLA process. This aspect suggests that it is better for studies of WM in SLA to focus only on those key WM components that are most directly implicated in the SLA process while not ignoring the effects of other possible WM components. Thus two WM components directly implicated in language learning and processing become most important. They are: the phonological component (PWM) that contains a phonological short-term store and an articulatory rehearsal mechanism, and the executive component (EWM) that includes attention-regulating and executive control functions as updating, shifting and inhibition. Other components, such as the visuospatial sketchpad or the episodic buffer,

however, are excluded from the frame because there is no evidence to prove their direct relevance to SLA (Wen, 2012, 2015). 3) The proposed assessment procedure for WM in SLA. This aspect is about how to measure WM in SLA appropriately. This framework suggests that the nonword repetition span task (simple WM span task) be used for measuring the PWM component, and the complex memory span tasks (such as the reading span task and its variants or the operation span task) for measuring the EWM component (Wen, 2012, 2015). Aside from the three aspects, the double-headed arrows in Figure 2.4 indicate a two-way interaction of information flow between WM and LTM.

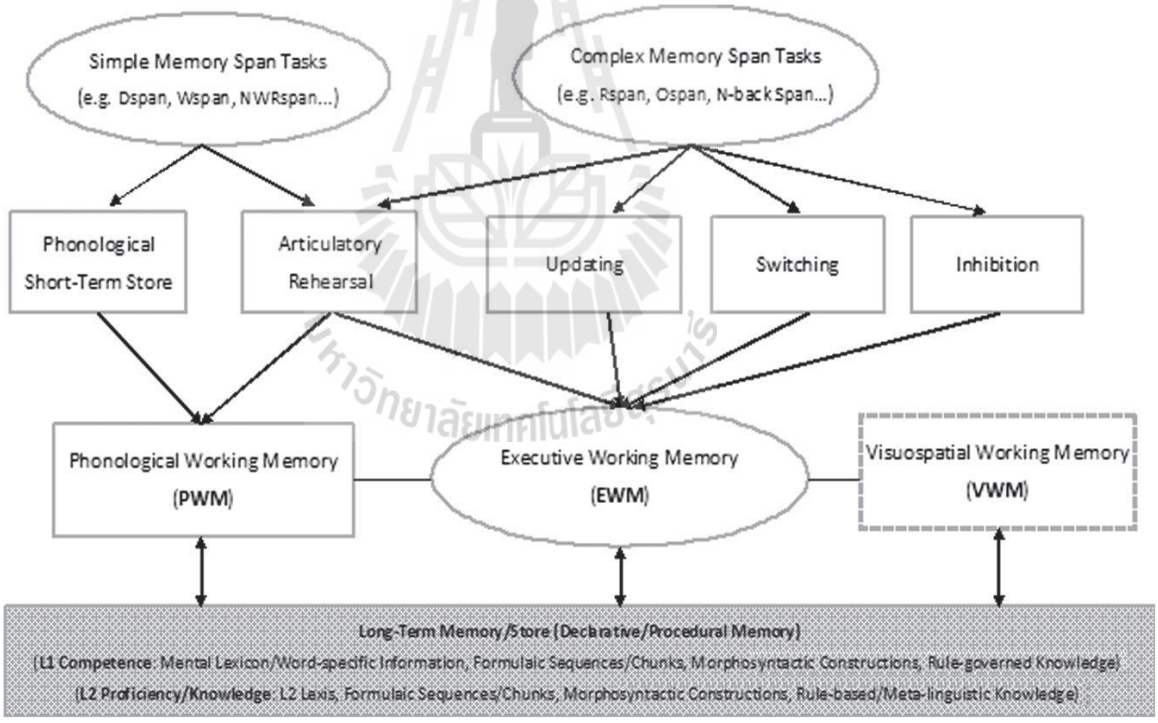

Figure 2.4 An Integrated Framework of WM in SLA (Wen, 2015, p. 51)

Wen (2015) claims that the integrated framework of WM for SLA is built on the theories of the WM construct and incorporates results from previous WM

and SLA studies. This model provides a theoretical framework of the WM construct in SLA and also offers suggestions as to how to measure WM in SLA appropriately. Comparing this framework with Baddeley's (2000), it is evident that the former is the development of the latter. Baddeley's (2000) model lays a foundation for the WM construct, based on which a variety of evidence, discussions and propositions come into being. It is hoped that more and more frameworks with stronger explanatory power will be proposed along with more advanced research.

2.3.1.3 The Distinctions between Working Memory and Short-term Memory/Long-term Memory

It is necessary to distinguish between short-term memory, working memory and long-term memory, which have different functions yet are confusing sometimes. From a comparative sense, working memory is defined as "the management, manipulation, and transformation of information drawn from short-term and long-term memory" (Dehn, 2008, p. 58). While, Leaver, Ehrman and Shekhtman (2005) refer short-term memory (STM) as "a holding tank of up to twenty seconds, in which information is rehearsed long enough to be sent off to long-term memory" (p. 45). For example, when listening to a teacher explaining an odd word, once the teacher moves on to something else, the information about the word will be forgotten unless it is moved to long-term or permanent memory (Leaver, Ehrman & Shekhtman, 2005).

STM is traditional, storage-oriented, and has been considered as a passive storage buffer, while WM is a more active part of the human processing system, a more processing-oriented construct, and is sometimes regarded as the "workspace" or "blackboard" of the mind in which the active processing and temporary storage of task-relevant information dynamically take place (Daneman & Carpenter, 1980; Shah &

Miyake, 1999). Jarrold and Towse (2006) also draw a distinction between STM and WM. From their perspective, STM refers to "an individual's ability to store or maintain information over a limited time period", while WM refers to "the ability to hold information in mind while manipulating, and integrating other information in the service of some cognitive goal" (p. 39). Therefore, the commonality between STM and WM is that they all have limited capacity. The difference between them is that STM only has the storage function, while the function of WM includes both storage and processing.

Long-term memory (LTM) refers to the process of storing and retrieving information (Souda, 2001). Buchner and Brandt (2003) distinguish WM from LTM as: the principal function of WM is to maintain information for immediate use. Due to WM's limited capacity in holding information, if the rehearsal process is absent, the information will be lost rapidly. On the contrary, LTM is assumed to be able to retrieve information after very long time, and it has large capacity (Buchner & Brandt, 2003).

According to Atkinson and Shriffrin's (1968) framework, memory includes three structural components: the sensory register, the STM, and the LTM. This framework discusses the functions of the memory components towards information, that is, the incoming information first enters the sensory register, lasting there for a very limited time before decaying and lost. The information that is attended to is passed onto STM. Information in STM delays and lost within around 30 seconds unless it is rehearsed and transferred into LTM.

2.3.1.4 The Importance of Working Memory

The concept of working memory has become very popular in almost all branches of psychology, including cognitive, clinical, social, developmental, and

educational psychology (Conway, Kane, Bunting, & Hambrick., 2005). It is assumed that WM is involved in many real-world activities, that is to say, it is a necessary construct for many daily activities in which information needs to be actively held in mind, manipulated, and integrated in memory (Jarrold & Towse, 2006).

WM plays an important role in performing cognitive tasks. In language learning field, the study on the relation between WM and L1/L2 learning has aroused the interest of many researchers (Mak, 2013). The present study endeavors to explore the relationships between WM and two other individual factors—learning styles and reading strategies for purpose of providing some implications to language instructors and learners.

2.3.1.5 Working Memory Capacity

It is widely acknowledged that WM has limited capacity. Cowan (2005) discusses working memory capacity (WMC) from a broad and a narrow sense: broadly, working memory capacity is merely the ability to remember things in an immediate-memory task; in a narrower sense, WMC means the amount of information held in mind at one time, similar to the individual's focus of attention.

The limited capacity of WM constrains some cognitive performance. Typically, individuals with greater WMC outperform those with less capacity in doing several important cognitive tasks such as reading/listening comprehension and reasoning (Conway, Jarrold, Kane, Miyake, & Towse, 2007).

2.3.1.6 The Role of Working Memory in Reading Comprehension

Working Memory is a central construct in cognitive psychology (Conway et al., 2007). It also has an important function in reading comprehension. Good readers are superior to poor readers "solely because they are faster" and therefore have "shorter

retention intervals between the reading of a critical word and recall" (Daneman & Carpenter, 1980, p. 457).

Wu (2006) elaborates how new information is integrated in the WM system when reading, that is, in the process of reading, each piece of incoming information must be held in working memory to establish the linkage of each gist/chunking (a small unit of information that can be stored in memory). For reading comprehension, the visual system performs at the first stage for the task of word recognition, decoding and meaning. When comprehending a long or complicated sentence, the reader needs to simultaneously keep the incoming information and to pay attention to other elements such as syntax, context, or other information. In doing so, the elements or other information can be linked to the incoming information to enable comprehending. If, however, as Wu (2006) argues, "if the information load is greater than a reader's capacity or the information is displaced by additional information, the brain cannot have enough time to link those gists/chunking, and comprehension suffers" (p. 43). Daneman and Carpenter (1980) explain the process as follows:

> In reading comprehension, the reader must store pragmatic, semantic, and syntactic information from the preceding text and use it in disambiguating, parsing, and integrating the subsequent text. Information can become part of working memory through several routes; it may be perceptually encoded from the text; it may be sufficiently activated so that it is retrieved from long-term memory; finally, it may be the output of a comprehension process. Information can be lost from working memory, since its capacity is assumed to be limited. (Daneman & Carpenter, 1980, p. 450)

Abundant evidence has proved that individual differences in WM are highly correlated with reading comprehension. In general, comprehenders with a low WMC are less effective than those with high WM spans (Snow, 2002).

2.3.1.7 Measures of Working Memory Capacity

Working memory capacity is considered as one of the main factors underlying individual differences in reading comprehension, and the relationship between verbal WMC and language comprehension abilities has been attached considerable interest (Waters, 1996).

WMC is usually measured by various span tasks, which can generally be divided into two span types: simple and complex. Simple span tasks intend to test an individual's capacity for retaining information over a brief time interval. Complex span tasks, however, aim to assess an individual's ability to retain information while performing some mental operations that compete for attention (Hitch, 2006, cited in Mak, 2013). Both types of measures, as suggested by Mak (2013), can test WM in verbal and visuospatial domains. In verbal simple span tasks (e.g., digit, letter, and word span), an individual is required to recall a series of items (e.g., numbers, letters, or words) in the correct order immediately after it is presented. The same procedure is applied to the visuospatial simple span tasks except that a sequence of spatial locations is presented visually rather than in auditory form (Mak, 2013). The complex span tasks such as reading span and operation span are shown to have a better predictive validity in measuring some complex cognitive behaviors (e.g., reasoning, reading comprehension, or problem solving) than do simple span tasks which are thought to just tap the capacity of a short-term store (Conway et al., 2007).

Daneman and Carpenter (1980) argue that traditional measures of short-term memory, like digit span and word span, are either not correlated or only weakly correlated with reading ability. Conway et al. (2005) comment that WM span tasks, such as counting span, operation span, and reading span, are widely used measures of

WMC, and they have proved to be both reliable and valid. According to Linck, Osthus, Koeth, and Bunting (2014), compared with simple span measures, complex span measures are stronger predictors of L2 outcomes, thus the executive control component of WM may play a larger role than STM when using an L2.

Daneman and Carpenter (1980) are the first to report data using complex span measures which they designed to examine individual differences in reading ability. Their measure, "reading span" task, is designed to tap both the processing and storage functions of WM. In the task, subjects are required to read aloud increasingly longer sequences of sentences and to recall the final word of the sentences in each sequence. A subject's WMC is defined as the longest list length at which he/she is able to recall the last words of the sentences on the majority of trials. Daneman and Carpenter (1980) found that this complex measure of working memory span correlates well with reading comprehension performance. They also claim that this reading span measure is a better predictor of language comprehension abilities than measures such as digit span. The Daneman-Carpenter WM span task has proved to be reliable (Jarrold & Towse, 2006).

A number of studies exploring the relationship between WMC and L2 reading have adapted Daneman and Carpenter's (1980) original reading span task to test the retention and processing ability of WM (Chun & Payne, 2004; Harrington & Sawyer, 1992; Leeser, 2007; Walter, 2004). In general, span tasks have been found to be valid (Conway et al., 2005) and reliable (Friedman & Miyake, 2004; Whitney, Arnett, Driver, & Budd, 2001) instruments of WM assessment in a variety of fields. This dual-task paradigm is based on the trade-off between the processing and storage functions of limited WM resources (Waters & Caplan, 1996).

In Conway et al.'s (2005) work, the reading span version is one in which the to-be-remembered word is different from the last word, or any word, in the sentences. Similar to Daneman and Carpenter's (1980) design, subjects still read the sentences aloud and judge whether the sentence is correct semantically or syntactically. The difference lies in that the unrelated word rather than the sentence-final word is required to recall. Conway et al. (2005) made this change based on the assumption that "individual differences in reading ability could lead to differences in the ability to generate the words at test on the basis of the gist of the sentence (rather than on the basis of episodic recall)" (p. 772).

When comparing Waters and Caplan's (1996) study, Turner and Engle's (1989) study with the original Daneman-Carpenter (1980) reading span task, some differences can be found. First, the original Daneman-Carpenter task asked subjects to read the sentences aloud, however, Waters and Caplan (1996) required subjects to make judgment about the acceptability of each sentence, while in Turner and Engle's (1989) study, subjects needed to verify whether the sentences were semantically or syntactically correct. Second, in the Daneman-Carpenter task, blank cards were inserted to mark the beginning and end of each set of sentences, whilst in the other two studies, new technology were utilized with an overhead transparency (Turner & Engle, 1989) or the computer (Waters & Caplan, 1996). Nowadays, the reading span task can be presented by the computer which the interval of processing time can be recorded with accuracy.

In summary, the previous studies lay the theoretical and practical foundations for the present study. In the present study, a reading span task aiming at

testing the WMC was designed based on the studies of Daneman and Carpenter (1980), Waters and Caplan's (1996), and others. The task was presented via the Internet.

2.3.1.8 Improving Working Memory Capacity

It is widely acknowledged that WMC plays a crucial role in reading comprehension (Daneman & Carpenter, 1980). Therefore, readers can develop their WMC to improve their reading proficiency.

Some studies endeavor to develop WMC by various approaches, such as AIT (short for auditory integration training, which is originally intended for children of dysphonetic dyslexia or auditory dyslexia to improve the learning difficulties), teaching memory strategies including information chunks, training executive control processes, and using computer-based programs.

For example, Ryan (2014) tried to develop WMC of English speaking adults with different learning preferences with an AIT. Ryan found that auditory, visual, and kinesthetic learning preferences had a higher increase of scores in working memory when subjected to AIT. A benefit of AIT lies in that it improved an individual's ability to learn by correcting information processing problems. The dissonance positively stimulated the brain and improved processing ability (Ryan, 2014). Ryan claimed her study likely confirmed the notion that sound therapies like AIT affects the working memory by increasing memory retention, encoding effectively, and processing information efficiently.

Other studies searched to improve general memory in daily life by teaching memory strategies such as rehearsal, information chunking, visual imagery, and verbal mediation strategies (Turley-Ames & Whitfield, 2003; Yohman et al., 1988, cited in Yuan, et al., 2006). Among the memory strategies, information chunks are

found to be important in WMC (Daneman & Carpenter, 1980; Oberauer, Süß, Wilhelm, & Sander, 2007; Osaka & Osaka, 1992). Baddeley (2007) elaborated chunking from the perspective of his theoretical model of working memory, i.e., the active chunking of previously unrelated items is assumed to occur within the episodic buffer—one of the WM subcomponents, employing the attentional capacity of the central executive to utilize prior learning, and to combine information from separate sources in novel ways. Daneman and Carpenter (1980) held that good readers might take advantage of their chunking efficiency in the comprehension test passages, that is, their chunks would correspond to the interrelations of clauses and sentences that form superordinate discourse units, such chunks might aid readers in the storage and retrieval of facts and themes. Osaka and Osaka (1992) found that high-span readers tried to visualize sentences and then chunked the targeted words into storage whilst the low-span readers did not. Oberauer et al. (2007) believed that the critical source of individual differences in WMC is the ability to provide direct access to several independent information elements (chunks) at the same time. This capacity relies on a mechanism that quickly establishes and dissolves temporary bindings between these chunks and positions in a cognitive coordinate system, or placeholders in a schema.

Still other studies suggest that systematic training of executive control processes can lead to improvement not only in performance on similar WM tasks (i.e., near transfer), but also on language processing tasks that place similar demands on executive control (i.e., far transfer) (Linck et al., 2014).

More recently, several computer-based commercial programs have been developed to train working memory, such as CogMed (which is widely used in schools and clinics), Jungle Memory (which is based on three different tasks), and Cognifit

(which is based on auditory, visual, and cross-modal working memory tasks) (Melby-Lervåg & Hulme, 2013). However, Melby-Lervåg and Hulme conclude that these memory training programs appear to produce short-term, specific training effects that do not generalize.

Taken together, the above mentioned studies provide instructors and learners with some effective methods to improve WMC.

2.3.2 Learning Styles

In addition to working memory, another individual factor of language learning on which the current study focuses is learning style.

2.3.2.1 Definitions of Styles

Various definitions, theoretical positions, models, interpretations and measures of learning styles exist (Cassidy, 2004), because a learning style involves many aspects as perception, cognition, conceptualization, effect, and behavior (Kinsella, 1995,). Keefe and Ferrell (1990) define learning styles as "the composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment" (p. 59). Reid (1995) sees learning styles as "an individual's natural, habitual, and preferred way(s) of absorbing, processing, and retaining new information and skills" (p. viii).

The terms learning style and cognitive style are found throughout the literature on learning. They are often used interchangeably, though some researchers make a distinction between them (Leaver, Ehrman & Shekhtman, 2005). Leaver, Ehrman and Shekhtman (2005) treat learning styles as a more general term as habitual patterns of perceiving, processing, or reacting to information, while see cognitive styles

as specifically preferred forms of activity to approach information. Witkin, Moore, Goodenough, and Cox (1977) characterize cognitive styles as individual differences in the way people perceive, think, solve problems, learn, and relate to others. Dörnyei (2005) regards cognitive styles as individuals' preferred and habitual modes of perceiving, remembering, organizing, processing, and representing information. Riding and Cheema (1991) point out that one main difference between cognitive and learning style is the number of style elements considered, i.e., cognitive style is a bipolar dimension, whilst learning style entails many elements and are usually not 'either-or' extremes.

Due to a lack of agreement in the literature about defining and classifying styles, it is necessary to include both learning styles and cognitive styles in the discussion of the present study.

2.3.2.2 The Development and Nature of Styles

The term "cognitive style" used by Allport in 1937 has been described as a person's typical or habitual mode of problem solving, thinking, perceiving and remembering (Riding & Cheema, 1991). According to Dörnyei (2005), research on cognitive styles can be traced back to the end of the 19th century when scholars noticed that some people had a predominantly verbal way of representing information in thought, whereas others were more visual or imaginal. After that, investigations on styles kept on, when Witkin and his colleagues initiated their study of field dependence-independence.

Between the early 1940s and the 1980s, investigators developed many instruments for assessment and created their own labels, leading to the development of a large number of style labels (Riding, 1997, pp. 29-30). Although an ever-increasing

number of cognitive style dimensions were identified during the following decades, some scholars claimed that most identified styles could be grouped into far fewer principal cognitive style dimensions (Dörnyei, 2005, p. 125). For example, Riding and Cheema (1991) found over 30 labels referred to as cognitive/learning styles, and later grouped them into two major cognitive style dimensions: the Wholist-Analytic and the Verbal-Imagery (Riding, 1997; Riding & Cheema, 1991).

Riding and Cheema (1991) assert that cognitive/learning styles have been viewed in three main ways, either as a structure (content), or as a process, or as both:

> If "cognitive style is viewed as a structure, then the focus is on its stability over time; as such, style is a 'given' in a training or an educational setting. Once the style in the setting is identified, the training material can be adapted or 'matched' to the individual's cognitive style. However, if cognitive style is viewed as a process, then the focus is on how it changes; as such, trainers may even try to foster that change. Style areas can be built upon and can be used to compensate for or strengthen weaknesses. Style is seen as dynamic, not 'frozen forever'. For others, cognitive style is viewed as both process and structure. It may be relatively stable, not changeable like liquid with no form of its own, yet at the same time always in flux. In this view, style structure is continually modified as new events influence it directly or indirectly." (Riding & Cheema, 1991, pp. 194-195)

- **Curry's Onion Model**

Based on the psychometric evidence, reviews of the instruments and extensive discussion with instrument developers, Curry (1983) proposed an onion metaphor that some of the existing models of learning styles be organized into "strata resembling layers of an onion".

According to Curry (1983), the outermost layer of the hypothetical learning style 'onion' and the most observable style is described as "Instructional

Preference", which refers to the individual's choice of environment in which to learn. This layer interacts most directly with learning environments, learner expectations, teacher expectations and other external features, thus it is the least stable and the most easily influenced level of measurement (Curry, 1983, p. 8). Examples of instruments of measures of this style include Rezler and Rezmovic's (1981) "Learning Reference Inventory", Reichmann and Grasha's (1974) "Students Learning Style Scale", and Friedman and Stritter's (1976) research (Curry, 1983; Cassidy, 2004).

The middle layer of the learning style "onion" is referred to as "Information Processing Style" and is considered as the individual's intellectual approach to assimilating information following the information processing model. This processing does not directly involve the environment, so it is more stable than "Instructional Preference" but is still modifiable by learning strategies (Curry, 1983, p. 8). Measures of this layer include Kolb's (1976) "Learning Style Inventory", Tamir and Cohen's (1980) "Cognitive Preference Inventory" and Schmeck et al.'s (1977) "Inventory of Learning Processes" (Curry, 1983; Cassidy, 2004).

The third and innermost layer of the learning style onion is "Cognitive Personality Style", conceived as the individual's approach to adapting and assimilating information. This layer is a robust component. It does not interact directly with the environment, but is an underlying and relatively permanent personality dimension expressed indirectly and apparent only when an individual's behaviour is observed in learning (Curry, 1983; Riding & Cheema, 1991, p. 195). Witkin's (1961) "Embedded Figures Test", Myers's (1962) "Myers-Briggs Type Indicator", and Kagan's (1965) "Matching Familiar Figures Test" are the examples of instruments for measurement (Curry, 1983; Cassidy, 2004).

Rayner and Riding (1997) acknowledge the value of Curry's (1983) three-layer "onion" model as it relates models in the cognition- and learning-centred tradition, and this model explains the formation of individual learning behavior (Rayner & Riding, 1997).

2.3.2.3 Some Models and Measures of Learning Styles

A variety of models concerning styles have been put forward. Reid (1995) presents a comprehensive categorization of learning styles by dividing learning-style research into three major categories: cognitive learning styles (e.g., field independent-dependent, analytic/global, reflective/impulsive, Kolb's experiential learning model), sensory learning styles (e.g., perceptual learning styles, environmental styles, sociological styles), and personality learning styles (also affective/temperament styles) (e.g., Myers-Briggs temperament styles, tolerance of ambiguity styles) (Reid, 1995). The following discussed models are among the many models in the Reid (1995) categorization.

2.3.2.3.1 Witkin's Field Dependence-Independence (FD/I) Model and Embedded Figures Test (EFT) Measure

Among cognitive and learning styles, Witkin's field dependence/independence has been the most extensively investigated model (Hainer, 1987).

Psychological research on FD/I was originally based on visual perception on which people could be categorized in terms of the degree to which they were dependent on the structure of the prevailing visual field: Field-dependent people are highly dependent on this field without paying attention to inconspicuous things around them; Field-independent people on the other hand are free of the influence of

the whole field (Dörnyei, 2005). Witkin, et al. (1977) listed the essential characteristics of cognitive styles. First, cognitive styles are concerned with the form rather than the content of cognitive activity. They refer to individual differences in how people perceive, think, solve problems, learn, relate to others, etc. Second, cognitive styles are pervasive dimensions. Third, they are stable over time. Fourth, they are bipolar with regard to value judgments. This characteristic distinguishes cognitive styles from intelligence and other ability dimensions.

Leaver, Ehrman and Shekhtman (2005) argue that the concepts of FD/I were initially related to mathematics before applied to foreign language learning. In FL learning, FI means being able to automaticly select something of importance or interest for focus. FD is construed as the absence of field independence. Leaver, Ehrman and Shekhtman (2005) offer examples to see how FI and FD influence language learning. For the study of plural forms, a FI learner may instinctively notice plural forms when encountering them, without consciously searching for them. He/She may also unconsciously select new plural forms from those encountered and then organizing them for more easily handling. A FD learner, however, may rely on textbook, teacher, or syllabus to organize these forms.

Witkin, et al. (1977) developed several tests to measure FD/I cognitive style. Their earliest work is concerned with how people locate the upright in space. The early work on FD/I is based on three situations: Rod-and-frame test, Body-adjustment test, and Embedded-Figures Test. In the first two situations a subject's score is the amount of tilt of rod or body, in degrees, when these items are reported to be straight. In the embedded-figures situation the score is the time taken to locate the simple figure in the complex design (Witkin, et al., 1977). In the further test, Group

Embedded Figures Test, developed by Oltman, Raskin and Witkin (1971) to facilitate group testing for cognitive style, subjects are asked to locate a previously seen simple figure embedded within a larger, more complex figure. The scores are based on the total numbers of simple forms correctly traced. Individuals with low scores are field dependent, those achieve high scores are field-independent (Wooldridge & Haimes-Bartolf, 2008).

FD/I is typically measured by means of the Embedded Figures Test (EFT) or its group version, the Group Embedded Figures Test (GEFT), which requires subjects to attempt to discern simple geometric figures from more complicated pattern (Dörnyei, 2005). Riding (2000) argues, FI individuals are assumed to be able to complete tasks more quickly than FD ones; however, the overall test score is more like an ability score which ranges from bad to good than a bipolar cognitive style score.

2.3.2.3.2 Riding's Wholist-Analytic/Verbal-Imagery Model and Cognitive Styles Analysis (CSA) Measure

Riding (1997) summarizes the two basic dimensions of cognitive style as: 1) The Wholist-Analytic Style dimension of whether an individual tends to process information in wholes or parts; 2) The Verbal-Imagery Style dimension of whether an individual is inclined to represent information during thinking verbally or in mental pictures.

The Wholist-Analytic dimension of cognitive style describes the habitual way in which an individual organizes and structures information: Wholists will retain a global or overall view of information; Analytics will deconstruct information to its component parts. The Verbal-Imagery dimension reflects an individual's habitual mode of representation of information in memory during thinking. Verbalisers consider

the information they read, see or listen to, in words or verbal associations; Imagers experience fluent spontaneous and frequent pictorial mental pictures (Riding, 1994; Riding & Sadler-Smith, 1997).

When combined to language learning, wholists are more sensitive to the "whole picture" than to the details, whilst analytics see the situation as a collection of parts on which they often focus. As Dörnyei (2005) elaborates, wholists perform well when the title of a reading passage is presented before the passage because the title can give them an overall thematic orientation. By contrast, analytics are good at seeing similarities and detecting differences, and also good at separating out a situation into its parts, so they can approach to the core of the problems quickly. Rezaei and Katz (2004) suggest an implication for instruction as that wholists need help in seeing the structure and sections of learning material, and also need help of dividing the whole into its parts, whereas analytics require a unifying overview to be offered to integrate the sections into a whole view. Therefore, targeted instructions are required to facilitate their different style traits.

Verbal-Imagery Style dimension determines "whether individuals are outgoing and inclined to represent information during thinking verbally or whether they are more inward and tend to think in mental pictures or images" (Dörnyei, 2005, p.127). Verbalizers are good at dealing with verbal information, and they "tend to focus outward and prefer a stimulating environment". By contrast, imagers are good at handing visual or spatial information and "tend to be more passive with an inward focus, content with a static environment" (Dörnyei, 2005, pp.127-129).

Riding and colleagues developed an instrument "Cognitive Styles Analysis" (CSA) to measure the two dimensions of cognitive style. Riding et al. (1989)

devise a computer presented test of verbaliser-imager cognitive style (Riding & Cheema, 1991). The computer presented CSA directly assesses both ends of the Wholist-Analytic and Verbal-Imagery dimensions. An individual's cognitive style may be assessed quickly, easily, and directly using the CSA (Riding, 1997, p. 32; Riding & Sadler-Smith, 1997). Judging from Curry's onion model, the CSA would be placed in the innermost level (Riding, 1997), i.e., the "Cognitive Personality Style".

Riding and Rayner (1998) emphasize several positive features of the CSA: 1) it is objectively scored, the respondents are not aware of the real focus of the assessment; 2) both ends of the style continuums are assessed, which makes it distinct from measuring abilities; 3) it involves limited and simple language, it can be applied across age and proficiency groups; and 4) the computerized format is context-free, it can be used across situations and cultures (Dörnyei, 2005).

As regard to the reliability of the CSA, Peterson, Deary and Austin's (2003) study finds that when the CSA is doubled in length, the wholist-analytic dimension of cognitive style preference becomes more stable and reliable than the present form (cited in Dörnyei, 2005).

2.3.2.3.3 Kolb's Experiential Learning Model and Learning Style Inventory (LSI) Measure

The experiential learning theory proposed by Kolb (1984; Kolb Boyatzis, & Mainemelis, 2001) has been widely approved by researchers and practitioners (Dörnyei, 2005). Kolb (1981) believes that learning is a four-staged circle, and effective learners need four different kinds of abilities: Concrete Experience abilities (CE), Reflective Observation abilities (RO), Abstract Conceptualization abilities (AC), and Active Experimentation abilities (AE). That is, the experiential

learning theory model describes “two dialectically related modes of grasping experience”—CE and AC and, “two dialectically related modes of transforming experience”—RO and AE (Kolb et al., 2001, p.228). As illustrated in Figure 2.5, in the four-stage learning cycle, “immediate or concrete experiences are the basis for observations and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn. These implications can be actively tested and serve as guides in creating new experiences” (Kolb et al., 2001, p.228). This learning cycle will vary by individuals’ learning style and learning context (Kolb & Kolb, 2005).

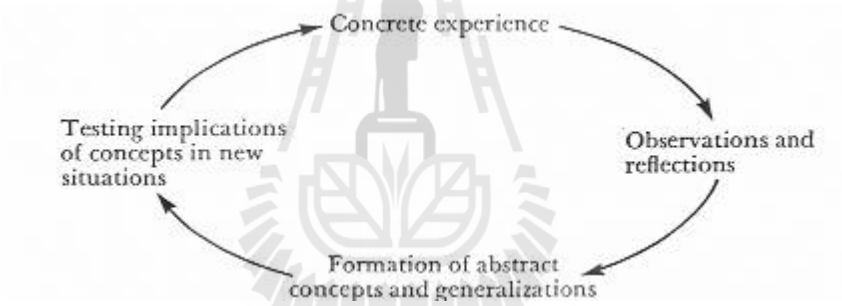

Figure 2.5 The Experiential Learning Model (Kolb, 1981, p. 235)

In 1971, Kolb developed a self-descriptive inventory—the Learning Style Inventory (LSI) to measure differences in learning styles along with the two basic dimensions of abstract-concrete and active-reflective. Research on the instrument has identified four learning styles of how people prefer to learn: Diverging, Assimilating, Converging, and Accommodating (Kolb, 1981; Kolb et al., 2001).

- *Diverging*. The Diverging style’s dominant learning abilities are Concrete Experience (CE) and Reflective Observation (RO). People with a Diverging learning style perform better in situations that call for generation of ideas, such as a

"brainstorming" session, and they are best at viewing concrete situations from many different points of view. In learning, Divergers prefer to work in groups, listening with an open mind and receiving personalized feedback (Kolb, 1981, p. 238; Kolb et al., 2001, p. 230).

● *Converging*. The Converging style's dominant learning abilities are AC and AE. Individuals with a Converging learning style are best at finding practical uses for ideas and theories. They have the ability to find solutions to problems and make decisions. In learning, Convergers prefer to experiment with new ideas, simulations, laboratory assignments, and practical applications (Kolb, 1981, p. 238; Kolb et al., 2001, p.230).

● *Assimilating*. The Assimilating style's dominant learning abilities are AC and RO. Individuals with this learning style are best at understanding a wide range of information and putting into concise, logical form. In learning, Assimilators prefer readings, lectures, exploring analytical models, and having time to think things through (Kolb, 1981, p. 238; Kolb et al., 2001, p.230).

● *Accommodating*. The Accommodating style's dominant learning abilities are CE and AE. Accommodators' greatest strength lies in doing things, in carrying out plans and experiments and becoming involved in new experiences. In learning, Accommodators prefer to work with others to get assignments done, to set goals, to do field work, and to test out different approaches to completing a project (Kolb, 1981, p. 238; Kolb et al., 2001, pp. 230-231).

Kolb and Kolb (2005) review the five versions of the LSI: Learning Style Inventory-Version 1 (Kolb 1971; Kolb 1976), Learning Style Inventory-Version 2 (Kolb, 1985), Learning Style Inventory-Version 2a (Kolb, 1993), Kolb Learning Style Inventory-Version 3 (Kolb, 1999), Kolb Learning Style Inventory-Version 3.1 (Kolb, 2005). Kolb and Kolb (2005) give an explanation of the KLSI 3.1 version and offer some evidence about its reliability and validity. They report Cronbach's alpha coefficients for

seven different studies of the KLSI 3.1. The results suggest that the KLSI 3.1 scales show good internal consistency reliability across a number of different populations. For the test-retest reliability check of KLSI 3.1 version, test-retest correlation coefficients range from moderate to excellent (Kolb & Kolb, 2005).

2.3.2.3.4 Reid's Perceptual Learning Style Preference Questionnaire (PLSPQ)

The term "perceptual learning styles" describes "the variations among learners in using one or more senses to understand, organize, and retain experience" (Reid, 1987, p. 89).

Before Reid's (1987) study was conducted, no published research had reported the perceptual learning style preferences of non-native speakers of English (NNSs). Reid (1987) proposed a self-reporting questionnaire designed to determine the perceptual learning styles of ESL students. The questionnaire was administered to 1,234 ESL students in 39 intensive English language programs and to 154 native-speaking (NS) university students in the U.S. to identify the relationships of learning style preferences to variables as language background, major field of study, level of education, TOEFL score, age, sex, length of time studying in the U.S.

To design her Perceptual Learning Style Preference Questionnaire (PLSPQ), Reid consulted second language experts to ensure that the statements were clear and unbiased. The survey has undergone several statistical checks from reliable and valid aspects. She used the split-half method to assess the reliability of the instrument. Using Pearson's product-moment correlation, Reid and her consultant checked the inter-correlation between each pair of statements in each construct; then, using the split-half method, they correlated each statement with the other statements in

the construct. After that, using the split-half method again, they examined the correlation coefficients for the interrelatedness of the statements in each of the six constructs (Reid, 1990). In discussing the statistical properties of the survey, Reid (1990) describes two pilot tests and the resulting reliabilities of the scales.

Reid's PLSPQ (1987) has aroused considerable interest and has been used in a number of studies on investigating learning styles. This self-report questionnaire helps learners identify the way they learn best—the way they prefer to learn (Peacock, 2001). The 30 items cover six learning style preferences, with five randomly distributed statements for each preference. The following gives an example statement from the PLSPQ for the learners of each style:

- *Visual major learning style preference*. You learn well from seeing words in books, on the chalkboard, and in workbooks. You remember and understand information and instructions better if you read them. You don't need as much oral explanation as an auditory learner, and you can often learn alone, with a book. You should take notes of lectures and oral directions if you want to remember the information.

- *Auditory major learning style preference*. You learn from *hearing words* spoken and from oral explanations. You may remember information by reading aloud or moving your lips as you read, especially when you are learning new material. You benefit from hearing audio tapes, lectures, and class discussion. You benefit from making tapes to listen to, by teaching other students, and by conversing with your teacher.

- K*inesthetic major learning style preference*. You learn best by experience, by being involved physically in classroom experiences. You remember information well when you actively participate in activities, field trips, and role-playing in the classroom. A combination of stimuli—for example, an audio tape combined with an activity—will help you understand new material.

- *Tactile major learning style preference*. You learn best when you have the opportunity to do "hands-on" experiences with materials. That is, working on

experiments in a laboratory, handling and building models, and touching and working with materials provide you with the most successful learning situation. Writing notes or instructions can help you remember information, and physical involvement in class related activities may help you understand new information.

- *Group major learning style preference*. You learn more easily when you study with at least one other student, and you will be more successful completing work well when you work with others. You value group interaction and class work with other students, and you remember information better when you work with two or three classmates. The stimulation you receive from group work helps you learn and understand new information.

- *Individual major learning style preference*. You learn best when you work alone. You think better when you study alone, and you remember information you learn by yourself. You understand new material best when you learn it alone, and you make better progress in learning when you work by yourself. (Reid, 2005, pp. 205-207)

Reid's (1984) research provides baseline data on perceptual learning style preferences. Before Reid's (1984) work, little was known about the learning styles of ESL students, and ESL teachers lacked awareness of the style differences that distinguished ESL students from each other and from native English speakers (NESs) (Stebbins, 1995). Dörnyei (2005) believes that Reid's PLSPQ (1995, originally developed in 1984) was the first learning style measure conducted in the L2 field for students at the university level. Since the items do not mention any subject matter, it is not L2-specific (Dörnyei, 2005, and it also can be applied to other language contexts.

However, Peacock (2001) points out one problem with the PLSPQ—it does not give concrete examples of activities for each style, thus may lead to uncertainty about the categories. For example, "doing something in class" and "work

with others" are too vague. Learner perceptions are influenced by the cultural and educational context, which may affect the comparison of results from different places. To make it more specific, Peacock (2001) provides a clearer description of the activities of each category that he believes his students would do in classes. He believes that his students probably associated the activities with each style, as "*Visual*—reading teacher handouts; *Auditory*—listening to the teacher speak; *Kinesthetic*—role-play; *Tactile*—constructing something, e.g. taking notes; *Group*—discussion of a given topic in threes; *Individual*—working alone and silently on a textbook task" (Peacock, 2001, p.7).

Even though no single questionnaire inventory is perfect, the present study adopts Reid's (1984) PLSPQ as an instrument to investigate the participants' learning style preferences in their study of English, because, first, the instrument is designed to measure ESL/EFL university students, which suits the exploratory nature of the current study. Second, it is the most widely used learning style instrument for non-native speakers of English (DeCapua & Wintergerst, 2005). Third, it has been modified based on non-native speaker informants' suggestions and reviewed by U.S. consultants in the fields of linguistics, education, and cross-cultural studies (Reid, 1987). Cheng (1997) conducted a pilot study to investigate the reliabilities of the PLSPQ delivered in Chinese, and the Cronbach's alpha (α) was .81, indicating a reasonably dependable measure of learning styles. Finally, as Dörnyei (2005) suggests, it is very user-friendly, with a self-scoring sheet and an explanation of learning style preferences as well as practical suggestions for learners.

So far, several influential models of learning styles are discussed. These labels focus on individuals' characteristics from different aspects. Some categories overlap or even contrast with each other due to different terminology the

researchers choose (Reid, 1995), thus it is not surprised to find that an individual may belong to a double strongly preferred style groups. Although "the complexity and fragmentation has consequently made learning styles research less accessible and practical for classroom use", as argued by Reid (1995, p. viii), the research into learning styles still deserves much effort. As Ehrman (1996) claims, "learning style mismatches are at the root of many learning difficulties" (p. 50), thus it is suggested that teachers and learners match their styles to teaching and learning activities and to each other. Dörnyei (2005) believes that the style harmony of some kind would benefit teachers and learners in many respects. It is generally assumed that teaching approach concerning the impact of various style characteristics on learning could "reduce or even remove many mismatches and can thus enhance learning effectiveness" (Dörnyei, 2005, p. 154).

In summary, the aforementioned models and corresponding measures provide rich sources for the learning-style research. Researchers thus can select the model that is suitable for their research inquiries to test, refine it, and then provide more evidence to the style family.

2.3.3 Reading Strategies

So far, working memory and learning styles, two factors out of learners' individual differences on which the present study focuses, have been discussed; still another important factor of learners' individual differences in ESL/EFL learning is the learning strategies used by ESL/EFL learners.

2.3.3.1 A Brief Introduction to Language Learning Strategies

Before focusing on reading strategies, it is necessary to introduce language learning strategies, as the former is one part of the latter when considering different

learning skills. According to Sheorey and Mokhtari (2001), it is generally agreed that the relationship between language proficiency and reading ability is reciprocal, and an individual's high levels of overall competence is often accompanied with the improvement in reading ability.

2.3.3.1.1 Definitions of Language Learning Strategies

Among numerous definitions of language learning strategies, Oxford (1990) and O'Malley-Chamot (1990) definitions have been widely cited and discussed. Oxford (1990) has defined learning strategies as "specific actions taken by the learner to make learning easier, faster, more enjoyable, more self-directed, more effective, and more transferrable to new situations" (p. 8). O'Malley and Chamot (1990) offer a definition that focuses on the application of learning strategies to second language acquisition by ESL or EFL students as "the special thought or behaviors that individuals use to help them comprehend, learn, or retain new information" (p. 1).

2.3.3.1.2 Classifications of Language Learning Strategies

The classification of learning strategies varies considerably according to different criteria.

Oxford (1990) presents a strategy system that differs from others in that it is "more comprehensive and detailed; it is more systematic in linking individual strategies, as well as strategy groups, with each of the four language skills (listening, reading, speaking and writing), and it uses less technical terminology" (p. 14). Oxford (1990) has classified two major classes of L2 learning strategies: direct and indirect. Language learning strategies that directly involve the target language are called *direct strategies*. Those *indirect strategies* support and manage language learning without directly involving the target language (Oxford, 1990). The two classes are

subdivided into six groups: memory, cognitive, and compensation under the direct class; metacognitive, affective, and social under the indirect class. These strategies have their different functions. *Memory strategies* "help students store and retrieve new information". *Cognitive strategies* "enable learners to understand and produce new language by many different means". *Compensation strategies* "allow learners to use the language despite their often large gaps in knowledge" (Oxford, 1990, p. 37). Metacognitive strategies "allow learners to control their own cognition". Affective strategies "help to regulate emotions, motivations, and attitudes". Social strategies "help students learn through interaction with others" (Oxford, 1990, p. 135). Further, the six groups are subdivided into a total 19 strategy sets: 1) Memory strategies, e.g. creating mental linkages, applying images and sound, reviewing well, employing action. 2) Cognitive strategies, e.g. practicing, receiving and sending messages, analyzing and reasoning, creating structure for input and output. 3) Compensation strategies, e.g. guessing intelligently, overcoming limitations in speaking and writing. 4) Metacognitive strategies, e.g. centering learning, arranging and planning learning, evaluating learning. 5) Affective strategies, e.g. lowing anxiety, encouraging oneself, taking emotional temperature. 6) Social strategies, e.g. asking questions, cooperating with others, empathizing with others (Oxford, 1990).

O'Malley and Chamot's (1990) taxonomies have been offered based on their own study using retrospective interviews to identify strategies in second language acquisition but with native English-speaking students learning foreign languages. Their classification of language learning strategies includes three categories: metacognitive, cognitive, and social/affective. The three categories and their corresponding functions are described below:

● *Metacognitive strategies* are higher order executive skills that may entail planning for, monitoring, or evaluating the success of a learning activity, e.g., organizational planning, delayed production.

● *Cognitive strategies* operate directly on incoming information, manipulating it in ways that enhance learning, e.g., rehearsal, translation, note taking, substitution, contextualization.

● *Social/affective strategies* represent a broad grouping that involves either interaction with another person or ideational control over affect, e.g., self-talk. (O'Malley and Chamot, 1990, pp. 44-45)

2.3.3.2 Definitions of Reading Strategies

The reading strategy is an important part of language learning strategies. Grabe (2009) views reading as a strategic process in which readers take effort to use a number of the skills to predict text information, select key information, organize and mentally summarize information, monitor comprehension, repair comprehension breakdowns, and match comprehension output to reader goals.

Many descriptions and definitions of reading strategies have been proposed from different perspectives. Cook and Mayer (1983) define a reading strategy as "a behavior that a reader engages in at the time of reading and that is related to some goal" (p. 90). Cohen (1990) sees reading strategies as "those mental processes that readers consciously choose to use in accomplishing reading tasks" (p. 83). Anderson (1991) considers reading strategies as "deliberate, cognitive steps that readers can take to assist in acquiring, storing and retrieving new information" (p. 460). Graesser (2007) states that, "a reading comprehension strategy is a cognitive or behavioral action that is enacted under particular contextual conditions, with the goal of improving some aspect of comprehension" (p. 7). According to Afflerbach, Pearson, & Paris (2008), reading

strategies are “deliberate, goal-directed attempts to control and modify the reader’s efforts to decode text, understand words, and construct meanings of text” (p. 368).

It is noted that the definitions vary from each other. This is largely due to the way the term has been used in different contexts, such as L1, L2 or FL learning (Cohen, 1998). However, the consensus is that reading strategies are either conscious or unconscious, either explicit or implicit, either mental or physical behaviors used by a reader to attain a specific goal for reading (Luo, 2010).

2.3.3.3 Reading Strategies Categorization

Just as there are many definitions of reading strategies, various classifications have been suggested from different perspectives based on different studies.

Anderson (1991) groups 47 reading strategies into five categories based on data gathered from think-aloud protocol: supervising (e.g., formulating a question), supporting (e.g., skipping unknown words), paragraphing (e.g. translating a word or a phrase into L1), establishing (e.g., using background knowledge), and test-taking (e.g., guessing without any particular considerations) strategies. Reading strategies can be categorized as either global or local according to the part of the text on which they focus (Block, 1986; Young & Oxford, 1997). They can be classified according to the period of time they are used concerning a reading task: pre-/before-, while-/during-, and post-/after-reading (Luo, 2010; Saricoban, 2002; Ozek, 2006). Based on Oxford (1990) and O’Malley-Chamot (1990) ways of classification and, using interviews, think-aloud and learning logs, Cheng (2003) groups reading strategies of Chinese EFL graduate students for academic purpose into four categories: metacognitive, cognitive, social and affective.

2.3.3.3.1 Sheorey and Mokhtari (2001) Reading Strategies Categorization

Based on recognition of the role of metacognitive awareness in reading comprehension, Sheorey and Mokhtari (2001) conduct a study to examine differences in the reported use of reading strategies of native and non-native English speakers when reading academic materials. Metacognitive awareness which means planning and consciously executing appropriate actions to achieve a particular goal, is considered to be a critical element of proficient, strategic reading. The data for Sheorey and Mokhtari's (2001) study were collected through the Survey of Reading Strategies (SORS), which is intended specifically to discover the reading strategies purportedly used by post-secondary students who are native and non-native speakers of English. The instrument is based on the Metacognitive-Awareness-of-Reading-Strategies Inventory (MARSI), which was originally developed by Mokhtari (1998-2000) as a tool for measuring native English speaking students' awareness and use of reading strategies while reading academic or school-related materials. Reading strategies are grouped into three broad categories in their study:

1. *Metacognitive strategies*: those intentional, carefully planned techniques by which learners monitor or manage their reading, including having a purpose in mind, previewing the text as to its length and organization, or using typographical aids and tables and figures (10 items).

2. *Cognitive strategies*: the actions and procedures readers use while working directly with the text. These are localized, focused techniques used when problems develop in understanding textual information. Examples include adjusting one's speed of reading when the material becomes difficult or easy, guessing the meaning of unknown words, and re-reading the text for improved comprehension (12 items).

3. *Support strategies*: basically support mechanisms intended to aid the reader in comprehending the text such as using a dictionary, taking notes, or underlining or highlighting the text to better comprehend it (6 items). (Sheorey & Mokhtari, 2001, p. 436)

2.3.3.3.2 Mokhtari and Reichard (2002) Reading Strategies Categorization

Mokhtari and Reichard (2002) developed a new self-report instrument, the Metacognitive Awareness of Reading Strategies Inventory (MARSI), which is designed to assess adolescent and adult readers' metacognitive awareness and perceived use of reading strategies while reading academic or school-related materials. There are three strategy subscales or factors: global reading strategies, problem-solving strategies, and support reading strategies. These three types of strategies interact with each other and have an important influence on text comprehension. They are described as follows:

1. *Global Reading Strategies* contain 13 items and represent a set of reading strategies oriented toward a global analysis of text. These strategies can be thought of as generalized, intentional reading strategies aim at setting the stage for the reading act (e.g., setting purpose for reading, making predictions).

2. *Problem-Solving Strategies* contain 8 items that appear to be oriented around strategies for solving problems when text becomes difficult to read. Such strategies are localized, focused problem-solving or repair strategies used when problems develop in understanding textual information (e.g., checking one's understanding on encountering conflicting information or rereading for better understanding).

3. *Support Reading Strategies* contain 9 items and primarily involve use of outside reference materials, taking notes, and other practical strategies that might be described as functional or support strategies. Strategies such as these serve a useful function for some of the students who seem to invoke them as needed. These strategies

provide the support mechanisms aimed at sustaining responses to reading (e.g., use of reference materials such as dictionaries and other support systems). (Mokhtari & Reichard, 2002, pp. 252-253)

2.3.3.3.3 Mokhtari and Sheorey (2002) Reading Strategies Categorization

Mokhtari & Sheorey (2002) developed a Survey of Reading Strategies (SORS) focused on measuring adolescent and adult ESL students' metacognitive awareness and perceived use of reading strategies while reading academic materials such as textbooks. The SORS is based on Mokhtari & Reichard's (2002) Metacognitive Awareness of Reading Strategies Inventory (MARSI) as a tool for measuring native English speaking students' awareness and perceived use of reading strategies while reading academic or school-related materials. Reading strategies in this SORS were classified into three subscales as global reading strategies, problem solving strategies and support strategies (Mokhtari & Sheorey, 2002):

1. *Global Reading Strategies* (GLOB) are those intentional, carefully planned techniques by which learners monitor or manage their reading, such as having a purpose in mind, previewing the text as to its length and organization, or using typographical aids and tables and figures (13items).

2. *Problem Solving Strategies* (PROB) are the actions and procedures that readers use while working directly with the text. These are localized, focused techniques used when problems develop in understanding textual information; examples include adjusting one's speed of reading when the material becomes difficult or easy, guessing the meaning of unknown words, and rereading the text to improve comprehension (8 items).

3. *Support Reading Strategies* (SUP) are basic support mechanisms intended to aid the reader in comprehending the text such as using a dictionary, taking notes, underlining, or highlighting textual information (9 items). (Mokhtari & Sheorey, 2002, p. 4)

From the evolution of Sheorey and Mokhtari (2001), Mokhtari and Reichard (2002), and Mokhtari and Sheorey (2002) taxonomies of reading strategies, it can be seen that the researchers have adapted and modified the terms to best describe the characteristics of each scale, and to meet different research purposes.

In summary, the aforementioned classifications have shown how previous research classifies reading strategies based on theories, research purposes, and research interest, etc. Mokhtari and Sheorey's (2002) classification of reading strategies is adopted in the present study to measure the participants' reading strategy use.

2.3.3.4 Measurements of Reading Strategies

A self-report inventory is commonly utilized to measure readers' reading strategy use, and several instruments are available to LI or L2 readers. Among them, an inventory that shows great promise is the Survey of Reading Strategies (SORS), developed by Mokhtari and reported in Sheorey and Mokhtari (2001) and Mokhtari and Sheorey (2002) (Anderson, 2005). The SORS was developed to be used with adolescent and adult students for whom English is a second or foreign language. The SORS is based on the Metacognitive Awareness of Reading Strategies Inventory (MARSI), originally developed by Mokhtari and Reichard (2002) as a tool for measuring native English speaking students' awareness and perceived use of reading strategies while reading academic or school-related materials. Mokhtari and Sheorey (2002) made some basic yet important revisions of the MARSI, including the wording of several items to make them easily comprehensible to ESL students; adding two key strategies clearly not used by L1 readers but often invoked by L2 learners; and removing two items which do not specifically constitute reading strategies. The revised instrument was field-tested on ESL students and the internal reliability of .89 or better, indicating a relatively high

degree of consistency in measuring awareness and perceived use of reading strategies among non-native students of English (Mokhtari & Sheorey, 2002).

To sum up, as mentioned above, the 30-item instrument SORS focuses on metacognitive reading strategies used by L2 learners engaged in reading school-related academic materials in English by measuring three categories of reading strategies: global, problem solving and support strategies. The present study adopts Mokhtari and Sheorey's (2002) SORS to measure the participants' reading strategy use. The SORS is fairly easy to read and administer, and can be administered individually or to groups of ESL students (Mokhtari & Sheorey, 2002).

2.4 Previous Research into Working Memory/Learning Styles/Reading Strategies and Reading Performance

The three major dimensions of individual differences—working memory, learning styles and reading strategies are widely examined by researchers from different research fields as psychological, linguistic, and cognitive fields. The previous studies concerning the relationships between these three factors are reviewed in the following.

2.4.1 Previous Research into Relationship between Working Memory and Reading Performance

As one of the main factors that may affect learning outcomes, working memory has aroused the interest of researchers in the psychological field. In the language learning field, the research on the relationship between working memory and reading has commenced since Daneman and Carpenter (1980) developed the reading span tasks (RST) to measure working memory capacity. Their work has paved the way for later

studies. For example, their reading span tasks were revised by Waters and Caplan (1996), and further modified and adapted by more researchers.

Daneman and Carpenter (1980) examined WMC of spoken and written verbal material to determine the relation between reading span and listening span and their correlations with reading and listening comprehension. They devised a so called "reading span test" to tax both the processing and storage functions of WM, during which task the 20 Carnegie-Mellon University undergraduates who were all native English speakers were required to read aloud 60 unrelated sentences at their own pace and then immediately recalled the last word of each sentence. They found that the reading span correlated with the three reading comprehension measures, including the verbal Scholastic Aptitude Test (SAT) and tests involving fact retrieval and pronominal reference. Besides, this study also revealed that the reading span task was related to WMC, thus it was widely employed later to test readers' WMC.

Osaka and Osaka (1992) conducted a study to examine the relationships between WMC in L1 and L2 by comparing reading spans for Japanese and for English among Japanese students. They used three reading span tests: English reading span test (ESL version), Japanese reading span test (Japanese version), and Daneman and Carpenter's reading span test (CMU version). The results showed that the higher the span, the more language independent the reader tended to be, therefore, in general, the working memory efficiency reflected by reading span test is language independent. The results also suggested that if a student had a high reading span in L1, he/she would be able to develop a high reading span in L2 as well. On the contrary, if a student had a lower reading span in the native language, the chances of him/her to develop a high span was rare, as measured by L2 reading span test.

A meta-analysis research carried out by Daneman and Merikle (1996) was to compare the predictive power of WM measures developed by Daneman and Carpenter (1980) with the predictive power of other measures of WM. The results confirmed that Daneman and Carpenter's (1980) span tasks (e.g., reading span, listening span) that tapped the combined processing and storage of WMC were better predictors of comprehension than were measures (e.g., word span, digit span) that tapped only the storage capacity. The results also showed that math process together with storage measures of WM were good predictors of comprehension.

Waters and Caplan's (1996) study investigated the relationship between different measures of WMC and reading comprehension ability. Their reading span test was based on Daneman and Carpenter's (1980) and Waters, Caplan and Hildebrandt's (1987) studies. The majority of the subjects were 94 McGill University undergraduates in Canada who were tested on measures of receptive vocabulary, reading vocabulary, reading comprehension, and reading rate. The study found that the sentence processing function of the sentence span tasks could best predict reading performance, with a small independent contribution of the recall function. However, sentence span tasks were reliable only by measurements being made of both their sentence processing and recall components, and the predictive value of these tasks for reading comprehension abilities lay in the overlap of operations rather than in limitations in verbal WM that applied to both.

To find out whether the development of L2 verbal WM linked to the transfer of reading comprehension skill (and hence structure-building skill) from L1 to L2, Walter (2004) investigated 41 native speakers from a middle school and an upper school in France who were divided into two groups—the lower-intermediate group and the

upper-intermediate group. It was founded that the transfer of mental structure-building skill was associated with the level of success in L2 reading comprehension. And a link was established between the development of verbal WM in L2 and success in L2 reading comprehension. Moreover, the correction between WM scores and comprehension scores corresponded well to the lower-intermediated group's experiencing high demands on their L2 WM in doing summary completion tasks.

Chun and Payne's (2004) study was carried out with 13 undergraduate native English speakers enrolled in a second-year German language course at a university in the US. The authors intended to investigate executive function and phonological working memory capacity (PWMC) of L2 learners, and to correlate these cognitive capacities with their look-up behavior. The PWMC, a nonword repetition task to measure temporary storage and maintenance of sound information, usually requires subjects to listen to some sets of pseudo-words and then repeat orally each nonword in order at the end of each set. Different from the traditional nonword repetition, Chun and Payne modified the test to become an online-presented recognition-based PWMC task. They found that, when reading an L2 text, L2 learners had a strong tendency to look up English translations of words if provided with multimedia annotations, that there was a robust relationship between phonological WM and look-up behavior, and that learners with low PWMC looked up on average three times more words than their high PWMC counterparts. However, it should be noted that the phonological WM span task in Chun and Payne' (2004) study was actually a phonological STM task which only measured the storage component of WM, without considering the processing function of WM, therefore, it is suggested that both the two components should be integrated into the WM span tasks when measuring WMC.

Friedman and Miyake (2004) studied the reading span test and its predictive power of reading comprehension with 168 native-English speaking undergraduates in USA who were grouped as the experimenter-administered and the participant-administered. They concluded that for the experimenter-administered group, reading span scores significantly predicted reading comprehension and verbal SAT scores. However, for the experimenter-administered group, adding the sentence processing times to recall scores did not improve correlations with comprehension.

By performing L2 reading span task, Leeser (2007) examined how topic familiarity and WMC would affect L2 adult beginning Spanish learners' reading comprehension. The results showed that topic familiarity significantly affected passage comprehension, form recognition and tense identification. Besides, a significant effect for WM on the comprehension recalls was only based on the familiarity with passage topics. This study offers implications that WMC has some influence on learners' comprehension and processing grammatical form, however, significant influence lies in previous knowledge about the topics.

Some studies about the relationship between WM and EFL reading comprehension were conducted in Chinese context. For example, Ma and Wang (2011) examined the effects of language aptitude and WM on Chinese EFL learners' reading comprehension with 64 second-year English-majors in a Shanghai university in China. They used Carroll and Sapon' (1999) Modern Language Aptitude Test (MLAT) to measure language aptitude. For WM measure, their reading span test was a modification of Waters and Caplan's (1996) revised version of Daneman and Carpenter's (1980) reading span task which measured the subjects' processing and storing components of WM. The stimuli were 70 unrelated English declarative

sentences, in length from 5 to 9 words, half of which were unreasonable, with each sentence ending in a different word. The sentences were arranged randomly in 5 sets, with span size 2, 3, 4, or 5. During the duration time between each two sentences span of 3 sec, subjects judged the reasonableness by checking “Yes” or “No” on the answer sheet. And they wrote the final word of each sentence on the answer sheet after each set of sentences disappeared. A subject was given a score of 1 point if judging a sentence correctly or if correctly recalling a final word, and the subjects’ reading span was the mean of the two scores. The findings revealed that language aptitude and WM were significantly correlated with reading comprehension. Apart from that, the performance of the higher and the lower EFL proficiency groups were predicted by different components of language aptitude, such as associative memory and grammatical sensitivity. Ma and Wang (2011) argued that WM can be integrated to language aptitude to better predict reading proficiency.

Shibasaki, Tokimoto, Ono, Inoue, and Tamaoka’s (2015) study that conducted on Japanese high school students revealed that general L2 reading could be significantly predicted by their L2 WM, L2 grammatical knowledge, and L2 vocabulary knowledge. Moreover, general L2 reading, along with L1 literacy, significantly predicted L2 reading on a specific topic.

When summarizing the above reviewed studies, it can be found that the reading span task (RST) designed by Daneman and Carpenter (1980) has been used in a large number of research works to measure both processing and storage functions of WM during reading process. In Daneman and Carpenter’s (1980) research, the reading span score shows a significant correlation with reading comprehension scores. Furthermore, the span task correlates with the measures of reading comprehension and, WMC is the

source of the correlation and hence, an important source of individual differences in reading. In the RST, a good reader has more WMC to store information during text reading.

Daneman and Carpenter's (1980) model of RST taxing both processing and storage has been widely adapted in exploring the relationships between WMC and reading comprehension (Alptekin & Erçetin, 2011). To explore the relationship between WMC and L1 and/or L2 reading, Waters and Caplan (1996), Osaka and Osaka (1992), Chun and Payne (2004), Walter (2004), Friedman and Miyake (2004), Alptekin and Erçetin (2009, 2011) adapted and modified Daneman and Carpenter's (1980) model of RST. Walter (2004), Leeser (2007), Ma and Wang (2011) conducted the RST based on Waters and Caplan's (1996) modification of the Daneman-Carpenter (1980) reading span measure. In general, research findings showed a strong relationship between RST and reading comprehension. The instruments of span tasks were proved to be both valid (Conway et al., 2005) and reliable (Friedman & Miyake, 2004; Conway et al., 2005; Alptekin & Erçetin, 2011) in assessing WMC.

One effort of the current study is to test whether the Chinese EFL learners' reading performance can be predicted by their WM; therefore, the relationship between RST and reading performance is assessed. The design of the RST is based on the research designs of Daneman and Carpenter (1980), Waters and Caplan (1996), as they are well-reputed and valued tests by a large number of researchers together with the study by Ma and Wang (2011) which was conducted in a Chinese context.

2.4.2 Previous Research into the Relationship between Learning Styles and Reading Strategies

Language learning styles and strategies are two of the main factors that help determine how—and how well—learners learn a second or foreign language (Oxford, 2003). Most research was conducted on the relationship between learning styles and learning strategies. Only Tsai (2012) investigated the relationships between cognitive learning styles and strategy use in EFL reading.

Su (1995) carried out a study with 369 Chinese university EFL students to investigate the relationships between the students' major learning strategy/style preferences and Chinese culture. The results revealed that there were significant relationships between Chinese university students' English learning strategies and their favored styles.

Similar in exploring the relationships between learning strategies, styles, and cultural beliefs, while different in culture background, Takanashi's (1999) research was conducted with British and Japanese university students, of whom 80 native English speaking students learning Japanese at five British universities, and 344 native Japanese speaking students learning English at a Japanese national university. Takanashi found significant correlations among strategies, styles, and cultural beliefs for each subject group and between the two subject groups. The results were in line with Su's (1995) findings that showing significant relationships between Chinese university students' English learning strategies and styles.

Another study conducted with Chinese students was carried out by Chang (2003) who used Reid (1984) Perceptual Learning Style Preference Questionnaire (PLSPQ) and Oxford (1989) Strategy Inventory for Language Learning (SILL) to investigate and

compare the differences and interactions in the preferred learning strategies and learning styles of traditional and nontraditional 843 EFL college students in Taiwan. (Traditional students were those who received higher education immediately after completing high school and participate full-time in formal learning in higher education; nontraditional students were those adults who attended a higher institution while maintaining a job). It was found that a main effect on each SILL strategy was based on gender and type of student. Besides, there was a significant interaction effect between gender and type of student. In addition, female traditional students used metacognitive strategies more than male traditional students and traditional female students used metacognitive strategies more than nontraditional female students.

Tabanlıoğlu's (2003) research focused on the relationship between learning styles and language learning strategies of 54 (32 of them were males and 22 were females) Turkish pre-intermediate EAP (English for Academic Purposes) students. As a result, the students' major learning styles were found to be auditory and individual. Moreover, significant gender difference was found in the preference of tactile style. Most students reported using cognitive strategies. However, males and females did not show significant difference in the usage for learning strategies. This study revealed significant relationships between visual learning styles and affective strategies, between individual learning styles and compensation strategies, between auditory styles and memory/cognitive/affective/social strategies.

In his doctorate thesis, Hou (2009) reported the findings of the perceptual learning style preferences and language learning strategies that 388 first year Taiwanese EFL students most frequently used, the relationships between the two variables, and the relationships between each of them and English achievement.

The findings showed that Taiwanese EFL students most preferred group and auditory learning styles. They showed a medium overall strategy use and used memory and compensation strategies most frequently. More importantly, there was a positive correlation between perceptual learning style preferences and the use of learning strategies. Furthermore, there appeared a positive correlation between students' overall language learning strategy use and their reading performance, whereas an insignificant negative relationship between overall learning styles preferences and reading performance. Additionally, gender, major and perceptual learning style preferences were significant predictors of language learning strategy use.

More recent studies conducted on the relation between learning styles on learning strategy use with Chinese students including Weng's (2012) and Tsai's (2012) work. The subjects in both studies were Taiwanese undergraduate students. Weng (2012) found that three learning styles (visual, auditory and kinesthetic) did not influence all the six types of learning strategies (memory, cognitive, compensation, metacognitive, affective and social). However, the learning styles only influenced social strategies use. Apart from that, auditory learners used more social strategies than visual learners. Moreover, high language proficiency learners appeared to use more learning strategies than did low language proficiency learners.

Using different instruments, Tsai (2012) investigated the correlations among EFL skilled readers and less-skilled readers' learning styles, motivation and strategy use. The findings indicate significant differences between skilled and less-skilled readers on motivation and reading strategy use. Motivation and reading strategies strongly correlated with reading comprehension, but there was no correlation between learning styles and reading performance. In addition, learning styles, motivation and

reading strategies were intercorrelated with each other, and reading strategies correlated highly with learning styles and motivation.

Still there are studies administered in other EFL contexts about the relationship between learning styles and strategies. Baghban (2012) reported a significant relationship between learning styles and learning strategies used by Iranian students. Besides, learning strategies had a significant impact on learning styles. As to the relations between the categories of the two variables, it was found that cognitive, metacognitive, and most of all affective strategies correlated highly with auditory style. Also, metacognitive and most of all memory and social strategies correlated strongly with kinesthetic style. Nevertheless, visual style did not show any correlation with learning strategies.

Nosratinia, Mojri, & Sarabchian (2014) carried out another study in Iran to find out the degree of relationship between Iranian EFL learners' learning styles and their preferences in using specific language learning strategies. They found a significant strong relationship between EFL learners' affective strategy and visual style (r = .85) and auditory style (r = .81), and between metacognitive strategy and visual style (r = .80).

To sum up, these studies exploring the relationship between learning styles and learning strategies were mainly conducted in the university context, and participants were mostly EFL university students, with the one exception that Takanashi' study (1999) also included JFL (learning Japanese as a foreign language) students.

In these studies, the participants were usually divided according to gender, major of study, and level of language proficiency. As to the variables, participants' gender, major and perceptual learning style preferences significantly predicted their language learning strategy use (Hou, 2009). Other variables such as length of English

study (Su, 1995), motivation (Tsai, 2012), months of stay in target countries (Takanashi, 1999) were also integrated in some of the studies.

The results of these studies indicate that there were significant relations between learning styles and learning strategies (Su, 1995; Takanashi, 1999; Hou, 2009; Baghban, 2012). The more learning styles students preferred, the more learning strategies they used (Hou, 2009). Tsai (2012) found that learning styles, motivation and reading strategies were intercorrelated with each other, while reading strategies were highly correlated with learning styles and motivation; And Reading comprehension was strongly correlated with motivation and reading strategies, but no correlation was found between learning styles and reading performance (Tsai, 2012).

The previous studies offer some enlightenment to the design of the present study. First, the majority of the research was carried out to investigate the relation between learning styles and learning strategies rather than between learning styles and reading strategies, especially in the Chinese context. This explains the inadequacy of previous studies and leads to the conclusion that the present study is necessary. Second, one of the purposes of the present study is to examine whether there are significant differences in terms of the learners' gender and level of English reading proficiency, the findings in the previous studies can be compared with that of the present study, thus providing implications for further research of a similar nature.

2.4.3 Previous Research into the Relationship between Reading strategies and Reading Performance

Among the numerous studies on the relationship between reading strategies and reading performance, the revision only focuses on research works performing the instruments of Survey of Reading Strategies (SORS) designed by Sheorey and

Mokhtari (2001), Mokhtari and Sheorey (2002), and the Metacognitive Awareness of Reading Strategies Inventory (MARSI) developed by Mokhtari and Reichard's (2002), since the SORS instrument is adopted in the present study to collect data of the participants' reading strategy use.

The landmark study on reading strategies was conducted by Sheorey and Mokhtari (2001), who examined reading strategies used by the subjects when reading academic materials. Their subjects were 302 college students studying at two universities in the U.S., among whom 150 were native-English-speaking U.S. students and 152 ESL students. The results discovered that the ESL group reported using support reading strategies significantly higher than did the U.S. group. Aside from that, both groups attached the same order of importance to the categories as cognitive, metacognitive, and support strategies. Besides, as compared with lower-reading-ability students, high-reading-ability students reported higher use of metacognitive and cognitive reading strategies. The females in the U.S. group showed greater awareness of reading strategies than males.

Al-Nujaidi's (2003) doctoral dissertation investigated on EFL first-year university students in Saudi Arabia, and found a significant yet weak correlation between their reading comprehension and means of overall strategy use (r = .19). Similarly, significant weak correlations were found between the reading scores and the means of the subscales of reading strategies, with correlation coefficients as: global reading strategies (r = .24), problem solving reading strategies (r = .20), and support reading strategies (r = .12).

Anderson (2004) reported findings on the relationship between reported strategy use and self-rated reading ability with 396 learners of English (260 were studying English

as a foreign language in San José, Costa Rica., 136 learners were studying in an ESL environment in Utah, USA.), that is, there was a significant relationship between reported strategy use and self-rated reading ability, specifically, the higher the self-assessed English reading ability, the higher the use of metacognitive reading strategies.

An investigation implemented by Wu (2005) with 204 first or second year EFL Taiwanese college students showed that the students' English proficiency had an impact on their use of metacognitive reading strategies, in which more proficient readers used more overall metacognitive reading strategies than less proficient readers while reading texts in English. Besides, their gender, academic major, and the type of higher educational institution they attended affected their use of metacognitive reading strategies when reading Chinese and English texts.

Malcolm's (2009) research examined reading strategy awareness among some Arab medical students, finding that low initial English proficiency students and first year students reported using more translating reading strategy, while upper year students used more metacognitive strategies.

Zhang and Wu (2009) conducted a study with senior high school students in mainland China to investigate metacognitive awareness and reading strategy use. Their findings showed that the students reported using overall reading strategies highly frequently. Students showed a moderate to high use of the three categories of strategies, with problem solving strategies as their major choice, followed by global strategies and support strategies. Apart from the high-, intermediate-, and low-proficiency students' differences in strategy choice, correlation was found between using global strategies and higher English achievements.

Poole (2009) investigated on 352 (117 males, 235 females) low to intermediate Colombian university students, and discovered a significant gender difference as that females' overall strategy use was significantly higher than males', as was their strategy use on two (i.e., problem-solving and support strategies) of the three SORS subscales and on eight individual strategies. Males' overall strategy use and almost half of their individual strategies use were moderate. On the country, females' overall strategy use and their use of half of the strategies were high.

A study conducted with Indian ESL university students by Madhumathi and Ghosh (2012) investigated the relationships between their reading strategy use and their reading comprehension achievement, and further identified whether there existed gender difference in using strategies. The findings revealed that, in general, the students' reading strategy use moderately correlated with their reading comprehension achievement. Furthermore, the high proficiency students outperformed the middle and the low proficiency students in using strategies. Additionally, female students reported using significantly more strategies than males.

In order to explore the relationship between Iranian EFL learners' reading strategy use and their reading achievement, Kamran (2013) investigated 114 EFL students including high school, university and graduate students in Iran. The investigation yielded such results: there was a significant positive relationship between participants' overall/global/problem-solving reading strategy use and their reading comprehension scores. Moreover, overall reading strategy use had a low predictive power of reading comprehension scores. As one of the three subscales of reading strategies, global reading strategy use was the only one to predict reading comprehension scores.

Tobing's (2013) doctoral study with high school students in Indonesia found that the students' overall use of reading strategies significantly correlated with their reading comprehension ability, but with a small predictive power. Nevertheless, no significant relationship existed between the subscales of reading strategies and reading comprehension.

In sum, the selected previous studies indicate that gender and reading proficiency are commonly used variables to assess reading strategy use between different groups. Taking gender into consideration, females' overall strategy use was significantly higher than males' (Poole, 2009). In the U.S. group, the females show greater awareness of reading strategies than males (Sheorey & Mokhtari, 2001). There is a significant difference in the use of strategy by gender, in which the female students reported using more strategies than male students (Madhumathi & Ghosh, 2012).

With regard to reading proficiency, high-reading-ability students showed comparable degrees of higher reported usage for metacognitive and cognitive reading strategies than lower-reading-ability students (Sheorey & Mokhtari, 2001). More proficient readers used more overall metacognitive reading strategies than less proficient readers while reading texts in English (Wu, 2005). Students of low initial English proficiency and those in their first year reported translating more, while upper year students translated less and used more metacognitive strategies (Malcolm, 2009). The high-, intermediate-, and low-proficiency students were different in strategy choice, and the effective use of global strategies was found to be correlated with the students' higher English achievements (Zhang & Wu, 2009).

The findings of the studies show that there was a significant relationship between reported strategy use and self-rated reading ability (Anderson, 2004). There

was a statistically significant and positive relationship between participants' overall and also global and problem-solving reading strategy use and their reading comprehension test scores, but no statistically significant relationship was found between participants' support reading strategy use and their reading comprehension test scores (Kamran, 2013). While for the Indian group, their reading strategy use moderately correlated with their reading comprehension achievement (Madhumathi & Ghosh, 2012).

The relationship between reading strategies and reading performance has been well examined in research. A significant relationship was found between the two variables. Although much research has been performed, the relationships between reading strategies and reading performance and also other variables of working memory, learning styles in combination with one another have never been conducted so far. The present study thus finds it necessary to explore the relationships between working memory/learning styles/reading strategy use and reading performance.

2.5 Summary

This chapter provides an overall profile of the theories and studies related to the research field in literature. The introduction of theories and studies on reading are presented at first, followed by an introduction of working memory, learning styles and reading strategies, with definitions, models, categorizations and measures offered. After that, the previous research works on the relationships between working memory/learning styles/reading strategies and reading performance are discussed. On the background of this chapter, the next chapter will focus on the research methodology designed for the present study.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter provides a description of the research methodology. The research design is presented at first, followed by the conceptual framework, the description of the participants, the instruments used, the procedures for data gathering, and the data analysis methods. In the end, validity as well as reliability checks for the research instruments and the pilot study is elaborated.

3.1 Research Design

Methodologically, the current study is a mixed study of both quantitative and qualitative study. From the quantitative aspect, the current study measured the correlations between the three independent variables: the participants' working memory capacity, learning styles and reading strategy use. According to Creswell (2012), correlational research provides an opportunity "to predict scores and explain the relationship among variables" (p. 338). Researchers use "the correlation statistical test to describe and measure the degree of association (or relationship) between two or more variables or sets of scores" (p. 338). And correlation is "a statistical test to determine the tendency or pattern for two (or more) variables or two sets of data to vary consistently" (Creswell, 2012, p. 338).

The statistic that expresses a correlation statistic as a linear relationship is the product-moment correlation coefficient (*r*). Creswell (2012) lists some common characteristics as to identify a study as an explanatory correlational study:

● *The investigators correlate two or more variables*. They report the correlation statistical test and mention the use of multiple variables.

● *The researchers collect data at one point in time*. In explanatory correlational research, the investigators are not interested in either past or future performance of participants.

● *The investigator analyzes all participants as a single group*. Compared to an experiment that involves multiple groups or treatment conditions, the researcher collects scores from only one group and does not divide the group into categories (or factors).

● *The researcher obtains at least two scores for each individual in the group—one for each variable*. In the method discussion, the correlational investigator will mention how many scores were collected from each participant.

● *The researcher reports the use of the correlation statistical test (or an extension of it) in the data analysis*. This is the basic feature of this type of research.

● *The researcher makes interpretations or draws conclusions from the statistical test results*. The conclusions do not establish a probable cause-and-effect (or causal inference) relationship because the researcher can use only statistical control rather than the more rigorous control of physically altering the conditions. (Creswell, 2012, p. 340)

The present study mainly aimed to investigate the relationships between Chinese EFL college students' working memory, learning styles, and reading strategy use, and further to find out the extent to which the dependent variable—reading performance could be predicted by the independent variables—working memory, learning styles and reading strategy use. The data collection involved gathering the whole information during three months, while data for each variable were collected at the same time. For all participants, the quantitative instruments were conducted on each variable and correlated all variables. These elements illustrated that from the quantitative part, the

present study was a correlational research design as it met the characteristics of what Creswell (2012) identifies as a correlational study.

Apart from the quantitative research design, the present study also included a qualitative design in which a semi-structured interview was created to collect in-depth data. The interview protocol was conducted aiming at answering the qualitative research question about identifying the differences between the participants with high working memory capacity and those with low working memory capacity.

3.2 Conceptual Framework of the Study

To examine the relations between participants' reading performance and their working memory capacity, learning styles and reading strategies, working memory capacity, learning styles and reading strategies were identified as independent variables while reading performance was the dependent variable. To investigate whether the participants' working memory capacity, learning styles and reading strategies were influenced by gender and level of English reading proficiency, gender and reading proficiency were set as independent variables, while working memory capacity, learning styles and reading strategies were dependent variables.

For such consideration, the study followed this conceptual framework as illustrated in Figure 3.1.

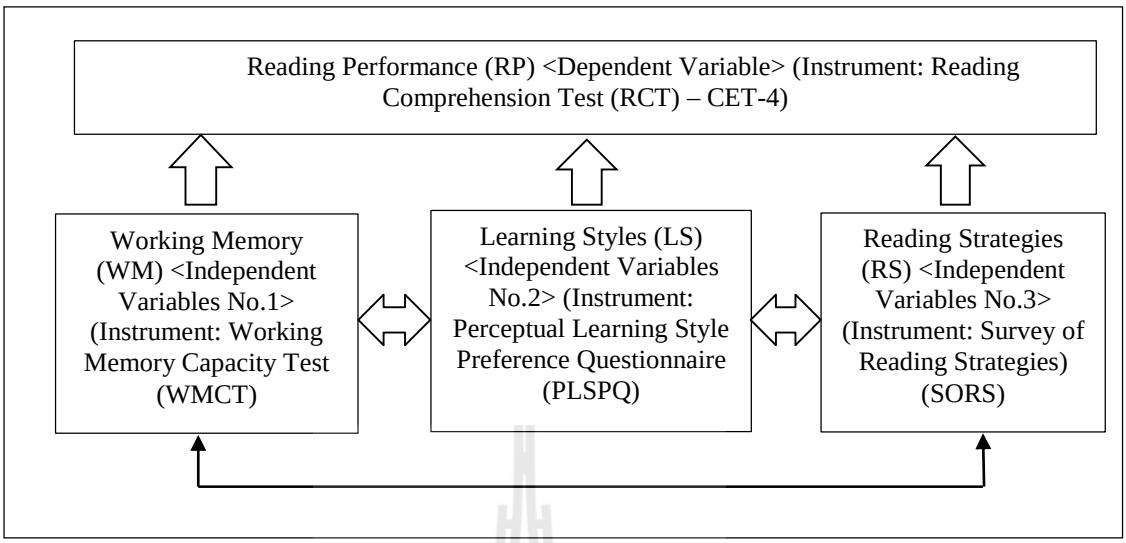

Figure 3.1 Conceptual Framework for the Study

3.3 Participants

Four hundred and fifty-two non-English major undergraduate students at Anhui University of Finance and Economics (AUFE), Anhui Province, China participated in the study. Non-English undergraduate students in AUFE are required to take English as a compulsory course in their first year. They must take midterm and final English examinations in each term, in which a listening test, an oral test, and a comprehensive test including reading and writing parts are held separately. Apart from the school-level achievement tests, they can take CET-4 in the first term, and are permitted to re-take it several times within their four university years if they are not satisfied with their scores. Some students can achieve a score of 426 or above in CET-4. In this case, they are permitted to apply to take CET-6 during their university period. In addition to the compulsory courses, other forms of reading courses, e.g., advanced reading, extensive reading, etc., are integrated into optional courses.

All the 452 students (among them, data from 245 students were found valid and kept for the main study, see "Description of Participants" in Section **4.2**) who took part in the study were first-year non-English major EFL undergraduate students who were in their second semester of four-year college education. They were divided according to two criteria—gender and level of English reading proficiency. Their English reading proficiency levels were divided into low, moderate and high according to the results of the Reading Comprehension Test (RCT). The participants were divided according to their performance in the RCT by the standard distribution classification criteria for item analysis and norm-referenced test scores. With norm-referenced test scores, an individual student's score is entirely dependent upon the performance of other students. According to the standard distribution classification criteria for item analysis, those scored below (or above) 27-33% of the whole number were set as low (or high) proficiency groups, those scored in between were set as a moderate proficiency group.

The participants ranged from 17 to 22 years of age, and they had learned English for 7 to14 years. Most of the students began to learn English from grade three in primary schools where English was taught as a compulsory course (but with less time than the subjects as Chinese and mathematics) in most places of China. For those who had learned English for 14 years started learning English from kindergartens in which English was taught as a featured and interest-aroused project.

3.4 Research Instruments

The instruments employed to collect data in the current study were designed to gather data in five major areas: the Working Memory Capacity Test (WMCT), two questionnaires—Perceptual Learning Style Preference Questionnaire (PLSPQ) and the

Survey of Reading Strategies (SORS), the Reading Comprehension Test (RCT) which was adopted from CET-4 as employed to test college non-English major EFL students' English proficiency by the Chinese education system, and a semi-structured interview, which intended to find out the differences between those participants with high and low working memory capacities.

3.4.1 The Working Memory Capacity Test (WMCT)

The researcher designed an online-administered Working Memory Capacity Test (WMCT) with the assistance of a computer specialist. There were two purposes for the design of the WMCT. First, the WMCT was intended to measure the reading span that was most commonly used to measure working memory capacity. Second, the participants were divided into three groups as high-capacity group, moderate-capacity group and low-capacity group according to their scores in the WMCT.

Reading span is the working memory task most frequently used in the individual differences tradition (Oberauer et al., 2000). Daneman and Carpenter (1980) devised a "reading span test" to measure both the processing and storage functions of working memory in L1. The Daneman-Carpenter span task was constructed with 60 unrelated sentences which were divided into three sets each of 2, 3, 4, 5, and 6 sentences, 13 to 16 words in length. Each sentence ended in a different word. In their study, twenty college students were required to read a series of sentences aloud at their own pace and, upon finishing the last sentence, to recall the last word of each sentence in the series. Testing begins with sequences of two sentences (span size 2), and the subjects were presented with increasingly longer sequences until they failed all three sets. Testing was terminated at that point. The subjects' reading span was the maximum number of sentences which they could read while correctly recalling the final words. The premise

was that there might be a trade-off between processing and storage functions of the working memory capacity, which seems like a potential source of individual differences in reading comprehension. The better reader might have more efficient processes so that he/she would have more capacity for storing and maintaining information. In other words, a good reader might use less processing capacity in comprehending the sentences, thus he/she might be able to produce more sentence-final words than a poor reader. The result of Daneman and Carpenter's study (1980) showed that there was a significant correlation between the subjects' working memory spans and reading comprehension scores ($r = .72$, $p < .01$). This indicates that the subjects who responded with the correct answer for the span tasks tended to score high in the reading comprehension tests, and vice versa.

The reading spans in Waters and Caplan's (1996) main study were calculated for 94 subjects (who had at least a high-school education, and most were undergraduates in McGill University, U.S.A.) using the methods and materials from Daneman and Carpenter (1980) and from Waters, Caplan, and Hildebrandt (1987). The stimulus sentences consisted of 100 unrelated sentences, ranging in length from 13 to 16 words. They were arranged in 5 sets each of 2, 3, 4, 5, and 6 sentences. Each sentence in the series ended in a different word. Reading span was defined as the largest set size at which all of the words had been recalled on at least 3 out of the 5 trials. As in Waters et al.'s task, the subjects were presented with a series of sentences on the video screen of a computer and were required to make a judgment about the acceptability of each sentence in the series, rather than read the sentences aloud, as in the Daneman-Carpenter task. On each trial, an asterisk appeared on the video screen, followed 200 msec later by the first sentence in the series. When the subject had made a decision

about the last sentence in the series, an asterisk appeared to indicate recall of the final word of each of the sentences in the correct serial order.

Ma and Wang (2011) carried out a study to investigate the effects of language aptitude and working memory on Chinese EFL learners' reading comprehension. The subjects in their study were 64 English-major sophomores in a Shanghai university. The study adapted Waters and Caplan's (1996) revised version of Daneman and Carpenter's (1980) reading span task to test the subjects' processing and storing functions of working memory simultaneously. There were 70 unrelated English declarative sentences, which ranged in length from 5 to 9 words. Half of the sentences were unreasonable sentences. Each sentence in the series ended in a different word. The sentences were arranged randomly in 5 sets, and each set contained 2, 3, 4, or 5 sentences. The time span between each two sentences were 3 sec. Subjects were required to judge whether the sentence was reasonable or not when each sentence appeared (processing function) and chose to tick "Yes" or "No" on the answer sheet (which means reasonable or unreasonable separately). Then the next sentence or set would appear. And they needed to recall the final word (storing function) and to write on the answer sheet the final word of each sentence after each set of sentences disappeared. The final words of the sentences were all commonly used non-compound nouns of which the length was between 1-3 syllables. There was no semantic connection between all the final words in each set. Two types of score were obtained in the study. A subject was given a score of 1 point if he/she judged a sentence correctly or if he/she correctly recalled a final word, regardless of the sequence of the final words, their singular/plural forms, nor being case sensitive. The reading span was calculated as the mean of the two scores.

The design of the WMCT of the present study was based on Waters and Caplan's (1996) modification of the classic Daneman-Carpenter (1980) reading span measure and Ma and Wang's (2011) study. The stimulus sentences of the WMCT consisted of 100 unrelated English sentences (see Appendix A-1), They were arranged in 5 sets each consisted of 2, 3, 4, 5, and 6 sentences that are 5-9 words in length, and they were presented in ascending order (i.e., from smallest to largest). These sentences were selected and revised from college-level reading material and Ma and Wang's (2011) study. No sentence-final words were repeated, nor were any contained in the other sentences. Half were reasonable and half were modified by the researcher to be unreasonable.

In combining sentences into the test, care should be taken to minimize semantic associations between the sentences, and especially between the final words. In the present study, the participants were required to judge whether the sentence is reasonable or not when each sentence appeared, and chose to click the "Correct" answer or the "Wrong" answer presented on the web page. And they were asked to type in the frame (which had been set on the answer page of the website) the final word of each sentence after each set of sentences were presented. The final words of the sentences were all commonly used non-compound nouns with a length between 1-3 syllables. There was no semantic connection between all the final words in each set. The duration of the sentences appeared on the screen for a maximum of 6000 ms before participants clicked the mouse to make a judgment.

This task yielded two scores: processing and recall. The processing score was calculated by summing the total number of correctly judged responses and the recall score were calculated by summing the total number of correctly recalled final words.

One point was given when a single sentence was correctly judged or a final word was written correctly, regardless of the order, capitalization or single/plural forms of the words. The final score of a participant' working memory capacity was the mean of the two kinds of scores.

3.4.2 Questionnaires

Questionnaires are "any written instruments that present respondents with a series of questions or statements to which they are to react either by writing out their answers or selecting them among existing answers" (Brown, 2001, p. 6). Mackey and Gass (2005) discuss the advantages of using questionnaires as "more economical and practical than individual interviews", they can "elicit longitudinal information from learners in a short period of time", and "can also elicit comparable information from a number of respondents" (p. 94). There are two types of questionnaire: closed and open ended. A closed-ended questionnaire is one for which the researcher determines the possible answers, which typically involve a greater uniformity of measurement and therefore greater reliability. An open-ended question, however, allows respondents to answer to express their own thoughts and ideas in their own manner, thus may result in more unexpected and insightful data (Mackey & Gass, 2005).

Two questionnaires were employed in the present study. One was a learning style inventory which was adopted from Reid's (1995) Perceptual Learning Style Preference Questionnaire (PLSPQ), and the other was a reading strategy questionnaire which was adopted from Mokhtari and Sheorey's (2002) Survey of Reading Strategies (SORS). The present study adopted the two closed-ended questionnaires because one of the research purposes was to explore the correlations between the variables rather than to elicit the opinions, beliefs or attitudes, etc. of the participants. In addition, for

more data collection, a background information section was added to the questionnaires to collect the participants' basic demographic information (i.e., student code, gender, age, major, and the number of years that they had studied English). It was attached to the two questionnaires and arranged in the first part of the questionnaire booklet.

The questionnaires for the current study were administered in Mandarin Chinese, the native language of the participants, to minimize the interference of their English abilities and to enable them to understand each statement more easily. The questionnaires had been translated from English into Chinese by the researcher, and checked and reviewed by two associate professors who were also doctoral degree holders in applied linguistics, and who had taught English for more than ten years for correctness, clarity, readability, and appropriacy.

3.4.2.1 Perceptual Learning Style Preference Questionnaire (PLSPQ)

A learning style inventory—Reid's (1995) Perceptual Learning Style Preference Questionnaire (PLSPQ, originally developed in 1984) was administered to explore the ways in which participants specify their preferred modality for their learning of English (Appendix B-1). The translated Chinese version of the questionnaire was administered.

The PLSPQ, constructed by Reid (1984), is a self-reporting questionnaire. It is designed to identify ESL students' perceptual-style preferences. The PLSPQ consists of five groups of total 30 statements randomly arranged to cover four learning style preferences—Visual, Auditory, Kinesthetic, Tactile, and two social interaction factors—Individual and Group learning. Participants were asked to read all statements and responded to each statement on a five-point Likert type scale in terms of their degree of agreement or disagreement (Strongly Disagree = 1, Disagree = 2, Undecided

= 3, Agree = 4, Strongly Agree = 5), focusing on behavioral preferences (e.g., "When the teacher tells me the instructions I understand better", "I prefer to learn by doing something in class").

Reid (1995) classifies learning styles as Major, Minor or Negligible. Major means it is a preferred learning style, Minor is one in which learners can still function well, and Negligible means they may have difficulty learning that way. When a numerical value is assigned to the corresponding learning style, the numbers will be added to obtain a total score and further, for convenience, multiplied by 2 to determine a person's Major, Minor or Negligible learning styles. Reid set the cut-off scores that distinguish between the three categories: 38-50 are considered as Major learning style preference; 25-37, Minor learning style preference; and 0-24 are considered as Negligible learning style preference. It should be noted that a person may possess more than one Major, Minor or Negligible learning styles.

As mentioned in **2.3.2.3.4**, The PLSPQ was chosen for the present study to investigate the participants' learning styles for the following reasons: 1) It was specifically developed for and normed on an adult ESL student population which included Chinese ESL learners (Reid, 1987; 1990). So, it was appropriate for the participants of this study who are all native Chinese speakers. 2) The inventory was validated using the split-half technique, and the validation used NNSs (Non-native Speakers) (Isemonger & Sheppard, 2003). 3) It had pre-established cut-off scores for major, minor, and negligible learning style categories, which were clear for categorization. 4) It had already been successfully piloted twice by Reid (1990). 5) A number of previous studies conducted in the Chinese context had employed this framework (e.g. Melton, 1990; Chang, 2003; M-L. Chen, 2009; Hou, 2009; Wu, 2010;

Weng, 2012). Adopting this framework thus allowed comparisons of the findings of the present study with that of previous research. 6) It was neither long nor time-consuming to complete, which was very convenient.

3.4.2.2 Survey of Reading Strategies (SORS)

The reading strategies questionnaire was adopted from Mokhtari and Sheorey's (2002) Survey of Reading Strategies (SORS) which is a self-report instrument on measuring the metacognitive awareness and perceived use of reading strategies ESL learners use "while reading school related materials in English" (p. 2). It consists of 30 items measuring three broad categories of reading strategies: Global reading strategies (GLOB), which can be thought of as generalized or global strategies aimed at setting the stage for the reading act; Problem solving strategies (PROB), which are localized, focused problem solving or repair strategies used when problems develop in understanding textual information; and Support strategies (SUP), which provide the support mechanisms or tools aimed at sustaining responsiveness to reading (Mokhtari & Sheorey, 2002).

The SORS instrument for the present study (see Appendix B-2) was administered in Chinese. A 5-point Likert type scale following each item indicated the frequency of strategy use ranging from 1 = "never or almost never do this" to 5 = "always or almost always do this". The higher the number, the more frequent the respondent employed the strategy.

The SORS instrument was chosen to measure reading strategies because: 1) It had been field-tested extensively with diverse student populations including native and non-native speakers of English and was found to have well-established psychometric properties including validity and reliability data (α = .93) which were

described in Mokhtari and Reichard (2002). 2) It was chosen for it was easy of administration (Malcolm, 2009). 3) It had been widely adopted or adapted in many studies on measuring reading strategies of EFL and ESL learners in American language centers (Anderson, 2003), Hungarian college students (Sheorey & Baboczky, 2008), Chinese senior high school EFL students (Zhang & Wu, 2009), adult ESL students in U.S.A. (Iwai, 2009), Arabic-speaking university students (Malcolm, 2009), ESL learners in Malaysia's university (Aziz et al., 2011), Collegiate Iranian ESP Learners (Tabatabaei & Assari, 2011), and Indian university ESL students (Madhumathi & Ghosh, 2012), etc. 4) It had been used in comparing both ESL and L1 English students in academic settings. 5) It had been previously used with Chinese-speaking students in an EFL setting.

3.4.3 The Reading Comprehension Test (RCT)

A reading comprehension test was conducted to categorize the participants into three proficiency groups: high, moderate and low. The RCT was derived from the reading parts of the two retired national College English Test Band 4 (CET-4) held in June and December of 2008 for non-English majors to collect reading scores of the participants.

As mentioned in **1.6.12**, CET-4 and CET-6 are considered to be standard tests designed to check college students' English levels. A large number of statistical analyses indicate that the tests are high in both reliability and validity.

The framework for the CET-4 test in June and December of 2008 is shown in Table 3.1. The test type of the RCT comprised the "Reading in Depth" part of CET-4 of June and Dec., 2008. Specifically, in the RCT, there were two passages for a "Fill-in the Blanks" task each of which asked students to choose 10 out of 15 words to fill in

the blanks, and four passages for “Multiple Choice” tasks each followed by five questions that asked students to choose the best choice for each question. The score for “Fill-in the Blanks” task was 1 point for each blank, and the score for “Multiple Choice” was 1.5 point for each question. This scoring was the same as the scoring of the real tests. The total score of the RCT is 50 points. The time was confined to 60 minutes as suggested by the pilot study, 10 minutes longer than the suggested time for the “Reading in Depth” parts in the real tests.

Table 3.1 Framework Structure of College English Test-Band 4 (June & Dec., 2008)

No.	Structure	Content		Type	Percentage of scoring (%)	Score	Time (min.)
I	Writing	Writing a Short Essay			15	106.5	30
II	Reading Comprehension (1)	Skimming and Scanning		Multiple Choice; Completing Sentences	10	71	15
III	Listening Comprehension	Conversations	Short Conversations	Multiple Choice	8	248.5	35
			Long Conversations	Multiple Choice	7		
		Listening Passages	Short passages	Multiple Choice	10		
			Passage Dictation	Words and Sentences Dictation	10		
IV	**Reading Comprehension (2)**	**Reading in Depth**		**Fill-in the Blanks**	**10**	**177.5**	**25**
				Multiple Choice	**15**		
V	Cloze			Selecting Words for Blanks	10	71	15
VI	Translation	Chinese-English Translation		Sentence Translation	5	35.5	5
Total					100	710	125

Participants in the present study were divided into three reading proficiency groups (high, moderate, and low) according to their scores in the RCT. According to the requirements of norm-referenced test, those scored below (or above) 27-33% of the whole number were set as low (or high) proficiency groups, those scored in between were set as moderate proficiency group.

3.4.4 Semi-structured Interview

The Interview is one of the primary data collection tools in doing research in language learning field. Punch (2005, p. 168) notes that interview is a very good way of accessing people's perceptions, meaning, definitions of situations, and constructions of reality, and one of the most powerful ways to understand the informants. Among the three types of interviews, namely, unstructured, structured, and semi-structured, semi-structured interview seems to be "popularly used in qualitative design since they are flexible" (Nunan, 1992, p. 149). Nunan (1992) also points out that the interviewer usually have a general idea of where the interview is supposed to go, and what should come out of it before doing a semi-structured interview (p. 149).

Based on the research purposes and research questions of the present study, a face-to-face semi-structured interview was designed to answer Research Question 5 "What are the differences, if any, between Chinese non-English major EFL learners with high working memory capacity and the learners with low working memory capacity?" It was conducted in data collection after the WMCT was administered with the purpose of gaining further in-depth understanding of the participants' working memory capacity differences and to triangulate the data gathered from the questionnaires and the WMCT. The interview questions was generate from the results of the WMCT in the previous step.

3.5 Data Collection Procedures

Data were collected from five steps: the first step was the pilot study; the second step was the Reading Comprehension Test; the third step involved administering the two questionnaires—the Perceptual Learning Style Preference Questionnaire and the Survey of Reading Strategies; the fourth step was administering the Working Memory Capacity Test; and the last step was the semi-structured interview. Table 3.2 illustrates these procedures.

Table 3.2 Data Collection Procedures

Step	Data Collection Instrument	Place	Time
1	Pilot study	Classroom Computer room	Week Seven, Week Eight
2	Reading Comprehension Test (RCT)	Classroom	Week Ten, Week Eleven
3	The Perceptual Learning Style Preference Questionnaire (PLSPQ); Survey of Reading Strategies (SORS)	Classroom	Week Ten, Week Eleven
4	Working Memory Capacity Test (WMCT)	Computer room	Week Thirteen
5	Semi-structured Interview	Classroom	Week Fifteen

3.5.1 The Reading Comprehension Test (RCT)

All the 452 students participated in a single 60-minute session for the RCT. Participants were informed that the test was only for them to practice the reading part of CET-4, and the scores were collected only for research use, without influencing any of their academic performances.

3.5.2 The Two Questionnaire Surveys

The PLSPQ and SORS questionnaires were administered after the completion of the RCT for each class. All participants were informed of the purpose and requirements of the survey and of the fact that there was neither right nor wrong answers, and were asked to express their honest opinions of each item. After careful examination, the valid questionnaires were used for statistical analysis.

3.5.3 The Working Memory Capacity Test (WMCT)

Prior to the test, all the participants were enrolled in the WMCT website. Their student codes were assigned as user name to log on to the website. The original password for all participants was the same.

A pre-test of WMC was arranged before the main test, with the purpose of helping the participants become familiar with the objectives and procedures of the main test. In the pre-test, 20 stimulus sentences were arranged in 5 groups, with 2 sentences, 3 sentences, 4 sentences, 5 sentences, and 6 sentences in each group, but unlike the 100-sentence main test, in which there were 5 sets each consisting of 2, 3, 4, 5, and 6 sentences, there was only one set in the pre-test. The 20 sentences in the pre-test ranged in length from 5 to 9 words each, and were presented in ascending order (i.e., from smallest to largest). None of the final words of the sentences were repeated, nor were they contained in other sentences. Half of the sentences were reasonable and half were unreasonable.

The participants did all tasks alone in a computer room. At the beginning of the test, the Internet-presented WMCT was administered to the participants seated at a comfortable distance from a desktop computer. To ensure that the participants understood the task requirements clearly, after they logged on to the online test page,

the researcher asked them to read silently the instructions first and explained the instructions to the participants, and then asked them whether they understood the procedures or not. After all participants nodded or said that they were clear about the requirements, they could begin to do the test. The stimulus sentences for the WMCT task were presented on the webpage after they clicked the "start" button for the pre-test to do the pre-test first.

For both the pre-test and main test, the time span between each two sentences of the same set was 6 seconds during which time span the participants judged the reasonableness of each sentence and at the same time memorized the last words of each sentence. After the last sentence of each set disappeared, there appeared on the webpage a series of frames (the number of the frames was the same as that of the sentences in the just disappeared set) with a caption in Chinese, meaning "Please type the final word of each sentence". At this time, the participants typed the last words that they could recall in each of the frames. No time limit was fixed for the recall task. After they clicked the "submission" button for a set, the first sentence of the next set appeared on the page and they repeated similar tasks again until submitting the recall task of the last set.

After they had finished doing the pre-test, there appeared on the screen another "start" button for the main test, and they then clicked the button to do the main test. As observed by the researcher, all participants understood the requirements and procedure after they finished doing the pre-test.

After they did all the required tasks for the main test, a frame appeared for them to type whether they had any suggestion or advice for improving the test, they could either type their suggestions or ignore it before click "submission" their answers. The click of the "submission" button meant that they had finished doing the main test. The

responses to the main test were recorded by the system, while responses to the pre-test were not recorded because the data were of no use for it. The system automatically marked the processing accuracy of each participant's responses to the sentences and recorded the scores of the processing task. The researcher checked the sentence-final recalling part and rated each student' recall of the final words. The score of each participant's working memory capacity test was the mean of the two kinds of scores.

3.5.4 The Semi-structured Interview

More than a week after the WMCT, 16 students out of the participants were interviewed. They were chosen according to the purposive sampling, specifically, 8 students who got high and another 8 who got low scores in the WMCT were singled out to be interviewed. The interviewees were asked a series of questions, such as: What do you usually do in your English reading class? What ways do you usually use to help understand English texts? How did you do in the WMCT? What do you usually do to improve your English in general? All the interview data were recorded with the interviewees' permission. The interview records were kept for further content analysis.

3.6 Ethical Issues in Data Collection

At the beginning of conducting each instrument, a question was attached by asking "Do you agree to respond to the questionnaires?" Participants were informed and guaranteed that the information for the questionnaires and the results of tests would be kept for research purpose only, and kept in a safe place and confidential without influencing their course examination results. All participants were confirmed to agree to participate in the study; therefore, consent was obtained from the participants.

3.7 Data Analysis Methods

All the data collected from the instruments were computer-processed and analyzed by SPSS 20.0 (Statistical Package for the Social Sciences). SPSS is "used by a majority of researchers working in the field of second language research" (Larson-Hall, 2010, p.7). In this study, the probability level of .05 was adopted as the cut off for significant results in the entire statistical analyses, i.e., the significance level was set at $p < .05$.

3.7.1 Descriptive Statistics

Descriptive statistics were employed to analyze the overall profiles of the participants' performance on the reading comprehension test, working memory, learning styles, and reading strategy use in order to compare means, standard deviations, etc.

3.7.2 Independent-samples *t*-tests

The *t*-test can be used when determining "if the means of two groups are significantly different from one another" (Mackey & Gass, 2005, p. 272). There are two types of *t*-tests: one is independent-samples *t*-test, which is used when the groups are independent; the other is paired-samples *t*-test, which is used when the groups are not independent, as in a pretest/posttest situation when the focus is within a group (Mackey & Gass, 2005).

In the present study, independent-samples *t*-test was chosen to test whether the participants' working memory, learning styles and reading strategy use were significantly different in terms of their gender, since there were two independent groups with gender—male group and female group.

3.7.3 One-Way ANOVA

The One-way Analysis of Variance (One-way ANOVA) is used when testing "whether the scores of three or more groups differ statistically" (Larson-Hall, 2010, p. 139). A one-way ANOVA has the following attributes (Larson-Hall, 2010):

- It has exactly two variables.
- One variable is categorical with three or more levels and it is the independent variable.
- The other variable is continuous and it is the dependent variable.
- If you took averages of the variables, you would have three or more averages.

(Larson-Hall, 2010, p. 140)

In the present study, One-way ANOVA were utilized to test whether the participants' working memory, learning styles or reading strategy use were significantly different as regard to their reading proficiency levels, i.e., high, moderate and low.

3.7.4 Post-hoc Multiple Comparisons

An ANOVA provides information on whether or not the three (or more) groups differ, without providing information as to the location or the source of the difference. In this situation, a follow-up post-hoc analysis needs to be performed to determine the location of the difference when there is significant difference in the analysis of variance. Common post-hoc analyses include the Tukey test, the Scheffé test, and the Duncan's multiple range test (Mackey & Gass, 2005).

In the present study, as the variable of reading proficiency was classified into three levels as high, moderate and low, the post-hoc Scheffé tests were run to determine where the differences were (between high-level and moderate-level groups, or between moderate-level and low-level groups, or between high-level and low-level groups) if significant differences were found in the variable by ANOVA of the participants' working memory, learning styles or reading strategy use.

3.7.5 Pearson's Correlation Coefficient

A correlation is "a statistical test to determine the tendency or pattern for two (or more) variables or two sets of data to vary consistently" (Creswell, 2012, p. 338). Correlational research attempts to determine degree of association (or relationship) between two or more variables or sets of scores (Mackey & Gass, 2005; Creswell, 2012). Pearson correlation coefficient (*r*) is "a common means for determining the strength of relations" (Mackey & Gass, 2005, p. 286). Therefore, *r* is used to measure the strength of a linear relationship between paired data.

In the current study, Pearson product-moment correlation coefficient (*r*) was used to assess: 1) the interrelationship between every two of the independent variables—participants' working memory, learning styles and reading strategies; and 2) the relationship between each of the three independent variables and the dependent variable—working memory, learning styles, reading strategies or reading performance.

3.7.6 Multiple Regression Analysis

Multiple regression analysis looks at the relationship among multiple variables to try to make a prediction about how some independent variables may predict scores on the dependent variable (Larson-Hall, 2010, p. 133).

In this study, multiple regression analysis method was performed to measure whether and the degree to which the participants' reading performance could be predicted by their working memory, learning styles or reading strategy use.

3.7.7 Analysis Procedures for Qualitative Data

Each of the sixteen interviews was recorded by a handheld digital recorder. The analysis began with the transcription of the recorded data. After that, the transcribed data were read through and analyzed by content analysis through open coding, axial

coding and selective coding to create categories and subcategories and further to generate themes.

3.8 Reliability and Validity Check

When designing a study, the reliability and validity should be taken into consideration, because they are two important factors of the data collection instruments for the overall measurement quality. Fraenkel, Wallen and Hyun (2012) suggest that the quality of the instruments used in research is very important, for the conclusions researchers draw are based on the information they obtain using these instruments. Accordingly, researchers use a number of procedures to ensure that the findings, based on the data collected, are valid and reliable.

3.8.1 Reliability Check for the Questionnaires

Reliability refers to "consistency in measurement" (Treiman, 2009, p. 243). The reliability of instruments is concerned with the degree to which the results of a questionnaire, a test or other measuring instruments are consistent (Phakiti, 2014). There are several ways to assess the reliability of a scale: internal (Cronbach's alpha and split-half) and external (test-retest). Internal-consistency reliability is a function of the correlation among the items in a scale. Cronbach's alpha is an internal consistency measure (Treiman, 2009). A test can be said to be internally consistent if the measure of Cronbach's alpha is over 0.7 (Muijs, 2004).

In this study, to check the reliability of the two questionnaires, Cronbach's alpha coefficient (a) was used to determine the internal consistency of the 60 items in the two questionnaires by analyzing the data collected from the pilot study. As analyzed in the pilot study, the results of alpha were 0.805 (for PLSPQ) and 0.813 (for SORS). These

figures were higher than 0.7, which is generally accepted as a reliable indication. The results showed that the two questionnaires were acceptable for the main study.

3.8.2 Content Validity Check for the Questionnaires

Validity and its measurement play an important part in determining the appropriate methodology to employ. Validity refers to the "truthfulness", "correctness" or "accuracy" of research data (Burton & Bartlett, 2005, p. 27). Validity is related to the accuracy, correctness and legitimacy of the measurements and observations made during data collection, and the soundness of the inferences made on the basis of the data collected (Phakiti, 2014).

Validity has three distinct aspects: content, criterion and construct validity. Content validity refers to whether or not the content of the manifest variables is right to measure the latent concept that the researchers are trying to measure (Muijs, 2004). A common way to obtain content validity is "member check" (Burton & Bartlett, 2005, p. 27), in other words, to obtain content validity, it is useful to have a panel of experts in the field to judge the content and format of the instrument and judge whether or not the instrument is appropriate (Muijs, 2004; Fraenkel & Wallen, 2009).

For the present study, the two questionnaires were translated from English into Chinese to ensure the participants' entirely clear understanding. Dörnyei and Csizér (2012) have discussed the translating of questionnaires, in their opinion, translating questionnaires is common, due to the frequency of multinational research team. They point out that "the main challenge in translating a questionnaire is to reconcile two somewhat contradictory criteria: (a) the need to produce a close translation of the original text so that we can claim that the two versions are equivalent, and (b) the need to produce natural-sounding texts in the target language" (p. 79). They further suggest a useful

practice—"term-based brainstorming and negotiation". After the initial translation is completed, two options can be done to ensure the equivalence of the two versions—"to consult bilingual external reviews or to recruit an independent translator to back-translate the target language version into the source language" (Dörnyei & Csizér, 2012, p. 79).

To obtain content validity, the two questionnaires were translated from English into Chinese by the researcher, and checked by two Ph.D. associate professors who were both native Chinese speakers, but fluent in English and, who had taught English for more than ten years. They rated the translation of each item of the questionnaire, and checked the evaluation form by using Index of Item-Objective Congruence (IOC) calculations as a validation method for the appropriateness of the translation. Developed by Rovinelli and Hambleton in 1977, the IOC is a process used in test development for evaluating content validity at the item development stage. Content experts use this method to evaluate each item by giving the item a rating of 1 (for clearly measuring), -1 (clearly not measuring), or 0 (degree to which it measures the content area is unclear) for each objective (Turner & Carlson, 2003). Thus, for the present study, the two experts rated in the evaluation form, using a 3-point scale (1 = relevant, 0 = uncertain, -1 = irrelevant). The result of the IOC check for the questionnaire was 95% (see Appendix D), which indicated that the translation of the questionnaires was valid and appropriate. Then the items of the questionnaires were modified according to the suggestions of the experts to establish the accuracy of the translation.

3.8.3 Internal Validity Check for the RCT

Internal validity is related to the extent to which other confounding variables influence the research outcomes (Phakiti, 2014). The testing effect may ruin internal validity; participants may do better in the test because they remember the answers to

some of the questions, or are familiar with the test questions, tasks or content of the test. This may mean that their performance in a test may not be their real proficiency level (Phakiti, 2014).

To avoid testing effect as that the RCT was not new to some participants, at the end of the test, a question was attached to the reading passages, “Have you ever read one or more of the above passages? If yes, circle the corresponding number of the passage(s) you have read.” Those participants who circled one or more passages were excluded from statistical analysis. Only those who circled “No” were included in data analysis because they had never read the reading passages in the RCT.

3.8.4 Content Validity Check for the WMCT

The content validity of the WMCT was checked by using IOC. The same two experts who had checked the questionnaires were also invited to rate each stimulus sentence of the WMCT. The experts rated the relevance of each sentence for the purpose of the test and the appropriateness of the content areas, and checked the evaluation form by using IOC. And they were required to judge whether each sentence was reasonable or not. The evaluation form used a 3-point scale (1 = relevant, 0 = uncertain, -1 = irrelevant). The result of the IOC check was 93.5% (see Appendix E), indicating that the WMCT was valid to be adopted as a test. Then the researcher revised the test according to the suggestions of two experts and further discussed with them to ensure the validation of the version.

3.8.5 Validity Check for the Semi-structured Interview

To ensure the validity of the interview questions, cross-check was performed under the guidance of two experts in language teaching field who helped check the questionnaires. The interview questions were delivered in Chinese in order to avoid any

ambiguity and to ensure that the interviewees could understand and respond without language obstacles.

The recorded interviews were transcribed by the researcher. In addition, since the transcriptions were in Chinese, the Chinese versions of the interview transcriptions needed to be translated into English for the research use. Therefore, the researcher translated the Chinese versions of the interview transcriptions into English, and the two experts checked the translation including words and meaning to guarantee the validity.

3.9 Pilot Study

A pilot study is a small-scale trial of the proposed procedures, materials, and methods, etc. Pilot testing is carried out to uncover any problems, and to assess the feasibility and usefulness of the data collection methods so as to make necessary revisions before the main study is conducted (Mackey & Gass, 2005). As stated by Seliger and Shohamy (1989), a pilot study "will significantly improve the quality of the data obtained" (p. 173).

The WMCT, the Chinese versions of the PLSPQ and the SORS, and the RCT were pilot-tested with an intact class of 49 students outside of but similar to the main study in order to check the feasibility of the WMCT and the RCT, the clarity and comprehensibility of the items of the PLSPQ and the SORS, and the amount of time needed to answer the questions. This class was chosen by a convenience sampling.

First, the RCT and the two questionnaires were piloted. RCT was administered to the students in the first step, and the time was set at 50 minutes as that allocated in CET-4. But after 50 minutes, some students said that they had not finished the test, so the test was extended by 10 minutes. As the researcher observed, the students completed

the test within 60 minutes, none of whom questioned anything unclear about the test. After collecting the paper sheets of RCT, a booklet consisting of the two questionnaires was distributed to the students. The researcher explained to the students the purpose, the requirements and the instructions of the questionnaires, and informed that if they had any question they could seek information from the researcher. It was estimated that the time for them to finish the questionnaires was around 30 minutes.

The WMCT was implemented to the piloted students four days after the questionnaire survey. They were organized to a computer room to do the online-administered WMCT. Before taking the test, the researcher instructed them how to do the task. It was observed that the students finished the test for about 25 to 40 minutes. Before the end of the WMCT, there appeared a frame on the webpage to collect their suggestions or advice to the test. From the piloted students' feedback on the WMCT, the researcher found that some of them wrote that the duration of the sentences in the same set which appeared on the screen for 5000 ms was not long enough. In the study conducted by Keijzer (2013), the sentences were projected for a maximum duration of 6000 ms or upon pressing the spacebar. Therefore, in order to avoid errors due to time constraints instead of smaller working memory capacity (WMC), the duration of the sentences in each set in the main study was kept for a maximum of 6000 ms before participants clicked the mouse to make a judgment.

Finally, the semi-structured interview was piloted as well. To pilot an interview enables the researcher to find out any wrong parts of the interview questions. It also helps to set the appropriate sequence to put forward the questions, to find out best ways of interviewing, and to determine time needed, etc. to prevent the main study from any problems that may occur in data collection procedure.

Four days after the piloting of the WMCT, the interview piloting was carried out with four students out of the 49 who were in the piloting group. Among them, two students were with high working memory capacity, another two with low working memory capacity. They were informed of the purpose of the interview. To estimate how long an interview would last, no specific time limit was set for each interview. The interviews were recorded. After examining the interview questions, some less clear questions were revised and improved. The final version of the interview questions for the main study is listed in Appendix F.

Cronbach's Alpha (α) was used to examine the internal consistency of the items of the questionnaires. The results indicated that Cronbach's Alpha reliability coefficient was 0.805 (α = .805) for the PLSPQ, and 0.813 (α =. 813) for the SORS. The results showed that these instruments could be considered as reliable tools for data-collection part of the main study.

3.10 Summary

To sum up, this chapter describes the research methodology issues of the present study. The research design, the conceptual framework, the participants are discussed at first, followed by the research instruments, which include a Working Memory Capacity Test (WMCT), two questionnaire surveys—the Perceptual Learning Style Preference Questionnaire (PLSPQ) and the Survey of Reading Strategies (SORS), the Reading Comprehension Test (RCT), and the semi-structured interview. After that, the procedures for data collection, and the data analysis methods are presented. Towards the end of the chapter, validity and reliability check, and pilot study are presented. The next chapter will report the detailed data analyses and the results of the present study.

CHAPTER 4

DATA ANALYSIS AND RESULTS

This chapter reports the results generated from the quantitative and qualitative data collected for the main study. The research findings are presented in response to the five research questions identified in Chapter One. This chapter is organized into two major sections. The first section reports the results of the data gathered through the Working Memory Capacity Test (WMCT), the Perceptual Learning Style Preference Questionnaire (PLSPQ), the Survey of Reading Strategies (SORS), and participants' performance on the Reading Comprehension Test (RCT). The second section deals with the qualitative data generated from the semi-structured interview.

4.1 Results of Cronbach's Alphas Coefficients for Questionnaires

As shown in Table 4.1, Cronbach's alphas coefficients (α) for the two questionnaires, i.e., the Perceptual Learning Style Preference Questionnaire (PLSPQ) (30 items), and the Survey of Reading Strategies (SORS) (30 items) were 0.711 (α = .711) and 0.836 (α = .836) respectively.

De Vellis (2003) suggests a range for coefficient alpha: below .60, unacceptable; .60 - .65, undesirable; .65 - .70, minimally acceptable; .70 - .80, respectable; .80 - .90, very good (pp. 95-96). According to this criterion, the two questionnaires were found to be highly reliable for the main study.

Table 4.1 Reliability for the Two Questionnaires

	N of Valid Cases	N of Items	Cronbach's Alpha
PLSPQ	245	30	.711
SORS	245	30	.836

4.2 Description of Participants

As mentioned in **3.3** in Chapter Three, 452 students from ten intact classes in Anhui University of Finance and Economics (AUFE), Anhui Province, China, participated in the study. Their majors cover economics, finance, accounting, auditing, international trade, business administration, law, statistics, logistics management, and engineering cost management.

Just like the steps in the pilot study, all the 452 students took part in the Reading Comprehension Test (RCT) first. The time for doing the test was allocated in 60 minutes. Because all the students were not available to do the test at the same time, the RCT was administered to the classes at different time within a week. To ensure that the students were double-blinded to the test, the classes were chosen from different schools on two campuses, and the orders of the answers to the questions were different for different classes. Apart from that, the students were informed that the test was only for them to practice the reading part of CET-4, and the scores were collected only for research use, without influencing any of their academic performance. The students all agreed to take the test, and finished the test on time.

After the answer sheets of RCT were collected, they all seated to do the two questionnaires—PLSPQ and SORS which were bound together into a booklet. After distributing the set of inventory, the researcher announced the purposes, instructions

and requirements for responding to the questionnaires. And the students were guaranteed that the purpose was to provide suggestions to learning and teaching. The time for responding the questionnaires was settled for 30 minutes. All students completed the questionnaires on time.

Around two weeks after the previous task, all the 452 students were informed to take part in the Work Memory Capacity Test (WMCT). But 38 of them did not attend because of different reasons, such as attending club or association activities, illness. Therefore, 414 students participated in the WMCT.

After the RCT, the two questionnaire surveys, and the WMCT, the data were sorted and saved for further analysis. It was found that 47 students had done one or more reading passages of the RCT, so their scores of RCT were dropped. Another 61 students missed some information or made two choices for one item of the questionnaires, so their responses to the questionnaires were excluded. In addition, due to the unreliable Internet access, 73 students' responses to the WMCT were incomplete or invalid. There was an overlap for some students who missed information in two instruments. After discarding the invalid ones, at last, data collected from 245 students for all the instruments were valid and kept for the main study.

Among these 245 participants (N = 245), 170 were female students (69.4%) and 75 were male students (30.6%). It is not surprising to find that the majority of the participants were females, because in AUFE, a university of finance and economics, female students greatly outnumber males. As mentioned in **3.3**, the participants were divided according to the standard distribution classification criteria for item analysis and norm-referenced test scores. With norm-referenced test scores, the level of an individual student's score is entirely dependent upon the performance of other students.

According to the standard distribution classification criteria for item analysis, those scored below (or above) 27-33% of the whole number were set as low (or high) proficiency groups, those scored in between were set as a moderate proficiency group. In this way, the participants were divided into three levels of English reading proficiency groups according to their performance in the RCT: 77 of them (31.4%) who scored between 6 to 24 out of the total score of 50 were considered as low reading proficiency group, 94 (38.4%) who scored between 24.5 to 32.5 fell in moderate reading proficiency group, and 74 (30.2%) who achieved 33- 44 were grouped as high reading proficiency (see Table 4.2).

Table 4.2 Participants' Reading Performance and Gender for the Two Questionnaires and WMCT

		Levels of English Reading proficiency			
		Low proficiency	**Moderate proficiency**	**High proficiency**	**Total**
Gender	Male	37	27	11	75
	Female	40	67	63	170
Total		77	94	74	245

Table 4.2 shows a description of the participants whose data were valid in the Reading Comprehension Test (RCT), the two questionnaires and the Working Memory Capacity Test (WMCT).

4.3 Results of the Reading Comprehension Test (RCT)

Table 4.3 presents the overall results of the participants' RCT scores. The participants' minimum and maximum scores were 6 and 44. The mean score was 27.47

(M = 27.47) out of the 50 total score, and the standard deviation was 8.13 (S.D. = 8.13). Figure 4.1 illustrates the histogram graph of the participant's performance in the RCT, and it is found that the scores were in a pseudo-normal distribution curve. This means that the majority of the participants scored in the middle of the range for the RCT.

Table 4.3 Descriptive Statistics for Reading Comprehension Test (RCT)

	N	Min.	Max.	Mean	S.D.
RCT	245	6	44	27.47	8.13
Valid N (listwise)	245				

Note. N = Number of participants; Min. = minimum; Max. = Maximum;
S.D. = Standard Deviation

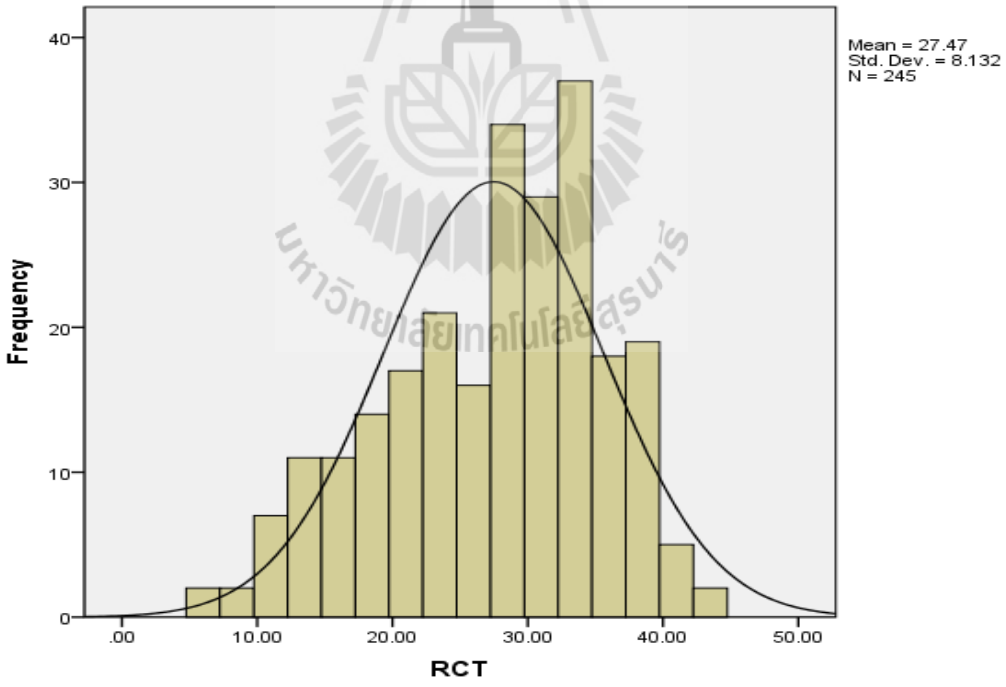

Figure 4.1 Participants' Scores in the Reading Comprehension Test (RCT)

4.4 Results in Relation to Research Questions

The results to the five research questions identified in Chapter One are reported one by one in the following sections.

4.4.1 Results in Relation to Research Question 1

This section is concerned with the findings of the first research question, "What are the overall profiles of the Chinese non-English major EFL learners' working memory, learning styles and reading strategy use?" In response to this question, descriptive results of the participant' scores in the Working Memory Capacity Test (WMCT), the Perceptual Learning Style Preference Questionnaire (PLSPQ), and the Survey of Reading Strategies (SORS) were reported. The mean and Standard deviation scores of the participants' performance on the WMCT and responses to the questionnaires are presented to describe the overall profiles of the three variables.

4.4.1.1 Results of Descriptive Statistics for WMCT

As mentioned in **3.4.1**, the stimulus sentences of the WMCT consisted of 100 English sentences. The score of the WMCT was calculated by summing the total number of the correctly reasonable responses, and the recall score was calculated by summing the total number of correctly recalled final words. One point was given when a sentence was correctly judged or a final word was written correctly. The total score of the WMCT was the mean of the two scores. Therefore, the total score of the WMCT was 100, i.e., (100 correctly reasonable responses + 100 correctly written final words) / 2 = 100. The final score of each participant's WMC was the mean of the two kinds of scores.

Table 4.4 Descriptive Statistics for WMCT

	N	Min.	Max.	Mean	S.D.
WMCT	245	33	91	59.92	10.47
Valid N (listwise)	245				

Note. N = Number of participants; Min. = minimum; Max. = Maximum; S.D. = Standard Deviation

Table 4.4 shows that, the participants' minimum and maximum scores of WMCT were 33 and 91. The mean score of the participants' WMCT was 59.92 (M = 59.92, S.D. = 10.47) out of the total score of 100. **Figure 4.2** displays the histogram graph of the participant's performance in the WMCT, and it is found that the scores were in a pseudo-normal distribution curve, which means that most participants achieved scores in the middle of the range for the WMCT.

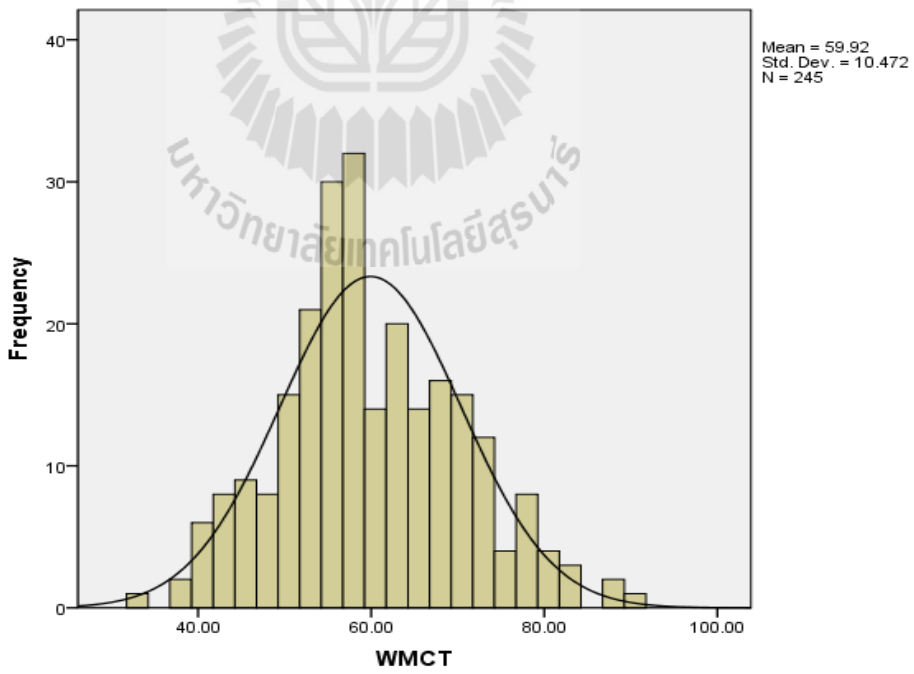

Figure 4.2 Participants' Scores in the Working Memory Capacity Test (WMCT)

In order to find respondents for the interview who had high WMC and those had low WMC, the participants were divided according to the standard distribution classification criteria for item analysis and norm-referenced test scores (the methods were discussed in **4.2**). In this way, the participants were divided into three WMC groups according to their scores in the RCT: 77 of them (31.4%) who scored between 33-54.5 out of the total score of 100 were considered as low WMC group, 89 (36.3%) who achieved 55- 64 fell in moderate WMC group, and 79 (32.2%) who scored between 64.5-91 were grouped as high WMC. Among them, the respondents for the interviews were selected from only the high and low WMC groups, while the moderate WMC group was excluded from the interview because it was unnecessary to interview students in the moderate group.

4.4.1.2 Results of Descriptive Statistics for Learning Styles

Reid (1995) classifies learning styles as Major, Minor or Negligible. For the five-point Likert scale PLSPQ, each learning style consists of 5 items which has a numerical value of one to five. The numbers of the same style construct are added together to obtain a total score for that type, and then that, for convenience, it is multiplied by 2 to determine the major, minor or negligible learning styles of each person. She sets cut-off scores to distinguish between the three categories: cut-off scores falling in 38-50 are considered as Major learning style preference; 25-37, Minor learning style preference; and 0-24 are considered as Negligible. Major means the ways in which a learner learns best, Minor indicates areas that a learner can still function well, while Negligible means that s/he may have difficulty learning in that way.

Table 4.5 shows the descriptive statistics for the participants' profiles/scores and ranking of the six individual types of learning style preferences. The

average scores are presented in descending order. They are: Kinesthetic styles (M = 3.61, S.D. = .53), Tactile styles (M = 3.49, S.D. = .60), Visual styles (M = 3.44, S.D. = .39), Auditory styles (M = 3.42, S.D. = .45), Individual styles (M = 3.30, S.D. = .59), and Group styles (M = 3.16, S.D. = .66).

As the table illustrates, the participants scored higher in the following four perceptual preferences: Kinesthetic, Tactile, Visual, and Auditory, whereas they scored lowest in the two social preferences as Individual and Group. Among the perceptual preferences, Kinesthetic and Tactile styles were preferred over either Visual or Auditory, with Auditory style ranking the lowest of the four. In addition, all six constructs of learning styles fell into a Minor-use range, because the scores of each construct (group score is equal to the total of each item of a certain style group multiplied by 2 to compare with the cut-off scores of Major/Minor/Negligible styles) reach the cut-off score of 25-37 set for Minor style preference. Neither Major nor Negligible style existed among the participants. The results indicate that, in general, students did not have difficulty in their ways of learning, instead, they could still function well whatever their preferred learning styles were, although no style preference could indicate which style enabled them to learn best, nor did they have difficulty in their ways of learning with any of them. Overall, among their Minor preferences, the two styles that they favored more were Kinesthetic and Tactile, while their least favored two were Individual and Group styles.

Table 4.5 Descriptive Statistics for Learning Styles

	N	Min.	Max.	Mean	S.D.	Group Score	Group Level	Rank
Kinesthetic	245	2.20	5.00	3.61	.53	36.07	Minor	1
Tactile	245	1.60	5.00	3.49	.60	34.92	Minor	2
Visual	245	2.60	4.60	3.44	.39	34.35	Minor	3
Auditory	245	2.00	5.00	3.42	.45	34.20	Minor	4
Individual	245	1.60	5.00	3.30	.59	33.01	Minor	5
Group	245	1.00	5.00	3.16	.66	31.55	Minor	6

Note. N = Number of participants; Min. = minimum; Max. = Maximum; S.D. = Standard Deviation; Group Score = Σ (Item of a certain style group) × 2 = Mean × 5 × 2

4.4.1.3 Results of Descriptive Statistics for Reading Strategies

In examining participants' reading strategy use in terms of the 5-point Likert type scale, ranging from 1 to 5: 1 = "never or almost never", 2 = "occasionally", 3 = "sometimes", 4 = "usually", 5 = "always or almost always". Each item is scored from 1 to 5 with "5" being the most frequent use and "1" being the lowest frequency use. The frequency of their responses to the inventory was categorized as "high", "moderate" or "low". This study adopted the criteria of three levels of usages as suggested by Sheorey and Mokhtari (2001) and Mokhtari and Reichard (2004) for using their reading strategy inventory, that is, the mean score of 3.5 or above = high usage; the mean score between 2.50 and 3.49, indicating moderate degree; and the mean score below 2.50 = low usage.

Table 4.6 presents the descriptive statistics for the participants' profiles/scores of the overall and the three categories of reading strategies. The results showed that students on the whole reported using the available reading strategies at a

moderate-frequency level (M = 3.24, SD = 0.47). And the mean scores of the three subscales of reading strategies are (in descending order): Problem solving reading strategies (M = 3.59, S.D. = .54), which fell in the high usage group; Global reading strategies (M = 3.18, S.D. = .58) and Support reading strategies (M = 3.01, S.D. = .52), which showed moderate usage. These results indicate that for the three subscales, students showed a moderate to high usage, with PROB used most frequently, followed by moderately used two others—GLOB and SUP.

Table 4.6 Descriptive Statistics for Reading Strategies

	N	Min.	Max.	Mean	S.D.	Level
PROB	245	1.75	5.00	3.59	.54	High
GLOB	245	1.85	4.69	3.18	.58	Moderate
SUP	245	1.22	4.44	3.01	.52	Moderate
Overall	245	1.90	4.53	3.24	.47	Moderate

Note. N = Number of participants; Min. = minimum; Max. = Maximum;
S.D. = Standard Deviation; GLOB = Global Reading Strategies;
PROB = Problem Solving Strategies; SUP = Support Reading Strategies

4.4.2 Results in Relation to Research Question 2

This section is concerned with the findings of the second research question, "Are there any significant differences in the Chinese non-English major EFL learners' working memory, learning styles and reading strategy use with regard to their gender and level of English reading proficiency?" In order to answer this question, the results of Independent-samples *t*-test for the male and female groups with working memory, learning styles and reading strategies were reported, followed by the reporting of the results of One-Way ANOVA analyses for the three reading proficiency groups with high, moderate and low in working memory, learning styles and reading strategies.

4.4.2.1 Results of Independent Samples T-Tests for Gender Differences in Working Memory, Learning Styles, and Reading Strategies

Independent-samples *t*-tests were employed to test whether there were any significant differences between gender in the participants' working memory, learning styles and reading strategies. The results are reported in the following.

4.4.2.1.1 T-Test for Gender Difference in Working Memory

The output is shown in Table 4.7 with the mean, standard deviation, *t* value, the p-value of the difference (Sig. (2-tailed)), and the number of both males and females.

Table 4.7 demonstrates that female participants (M = 61.50, S.D. = 10.39) scored more highly than males (M = 56.34, S.D. = 9.81) in the WMCT. There was a significant difference between males and females (t = -3.645, p = .000 < .001). This result suggests that female participants achieved significantly higher WM scores than did their male counterparts.

Table 4.7 T-Test for Gender Difference in Working Memory

	Gender	N	Mean	S.D.	t	Sig. (2-tailed)
WMCT	Male	75	56.34	9.81	-3.645	.000***
	Female	170	61.50	10.39		

Note. N = Number of participants; S.D. = Standard Deviation; t = *t*-test value;
***. Correlation is significant at the 0.001 level (2-tailed).

4.4.2.1.2 T-Test for Gender Difference in Learning Styles

The data from Independent-samples *t*-test in Table 4.8 show that female participants reported higher scores in Tactile, Auditory and Kinesthetic style

preferences than males, while male participants reported higher scores in Visual, Group and Individual style preferences than females. Among the six constructs of learning styles, only Group style was found to have significant difference in the distribution of learning style preferences between male (M = 3.3200, S.D. =.70) and female (M = 3.0824, S.D. = .63) participants (t = 2.619, p = .009 < .01). This reveals that compared with female participants, male participants tended to have Group style preference and the difference was significant. In other words, male students stated that they would learn better by studying with at least one other student or working together with others than did females.

Table 4.8 T-Test for Gender Difference in Learning Styles

	Gender	N	Mean	S.D.	t	Sig. (2-tailed)
Visual	Male	75	3.5040	.38	1.844	.066
	Female	170	3.4047	.39		
Tactile	Male	75	3.4853	.59	-.119	.905
	Female	170	3.4953	.61		
Auditory	Male	75	3.3787	.40	-.944	.346
	Female	170	3.4376	.47		
Group	Male	75	3.3200	.70	2.619	.009**
	Female	170	3.0824	.63		
Kinesthetic	Male	75	3.5627	.55	-.881	.379
	Female	170	3.6271	.52		
Individual	Male	75	3.3013	.63	.002	.998
	Female	170	3.3012	.57		

Note. N = Number of participants; S.D. = Standard Deviation; t = *t*-test value;
**. Correlation is significant at the 0.01 level (2-tailed).

4.4.2.1.3 T-Test for Gender Difference in Reading Strategies

Table 4.9 indicates that there was no significant gender difference between males (M = 3.16, S.D. = .49) and females (M = 3.28, S.D. = .46) in the overall perceived use of reading strategies (t = -1.874, p = .062 > .05). As regards the three categories, female participants reported higher mean scores in using all the three categories of reading strategies than males. Only the subscale of Support reading strategies was identified to have significant gender difference in which males (M = 2.84, S.D. = .55) scored lower than females (M = 3.09, S.D. = .49) (t = -3.546, p = .000 < .001). This means that female participants used SUP significantly more frequently than did male participants.

Table 4.9 T-Test for Gender Difference in Reading Strategies

					t	Sig. (2-tailed)
	Gender	**N**	**Mean**	**S.D.**		
GLOB	Male	75	3.15	.56	-.512	.609
	Female	170	3.20	.59		
PROB	Male	75	3.52	.57	-1.394	.165
	Female	170	3.62	.52		
SUP	Male	75	2.84	.55	-3.546	.000***
	Female	170	3.09	.49		
Overall	Male	75	3.16	.49	-1.874	.062
	Female	170	3.28	.46		

Note. N = Number of participants; S.D. = Standard Deviation; t = *t*-test value;
***. Correlation is significant at the 0.001 level (2-tailed).

4.4.2.2 Results of One-Way ANOVA for Reading Proficiency Differences in Working Memory, Learning Styles, and Reading Strategies

One-Way ANOVA analyses were performed to test whether there existed any significant differences between the low, moderate and high English reading

proficiency groups in relation to the participants' working memory, learning styles and reading strategies. The results are presented below.

4.4.2.2.1 One-Way ANOVA for Reading Proficiency Differences in Working Memory

Table 4.10 illustrates the One-Way ANOVA analysis for English reading proficiency differences in working memory, a significant difference was found between the participants' reading proficiency ($F = 20.455$, $p = .000 < .001$).

Table 4.10 One-Way ANOVA for Reading Proficiency Differences in Working Memory

Reading Proficiency	N	Mean	S.D.	F	Sig.
Low	77	54.91	9.91	20.455	.000***
Moderate	94	60.01	8.51		
High	74	65.03	10.91		
Total	245	59.92	10.47		

Note. N = Number of participants; S.D. = Standard Deviation; F = F-value;
***. Correlation is significant at the 0.001 level (2-tailed).

To further determine which reading proficiency groups were different from others, a follow-up Multiple Comparisons Test using the Scheffé Post Hoc criterion for significance was run. As found in Table 4.11, there were significant differences between all groups, i.e., the low reading proficiency group was significantly different from the moderate and the high reading proficiency groups on the means of reading proficiency, the *p* vales were .003 ($p = .003 < .01$) and .000 ($p = .000 < .001$) separately. The mean scores of the low reading proficiency group (M = 54.91, S.D. = 9.91) was significantly lower than the moderate group (M = 60.01, S.D. = 8.51) and the

high group (M = 65.03, S.D. = 10.91). Moreover, the moderate reading proficiency group was found to be significantly different from the high group (p = .004 < .01), in which the mean scores of the moderate group was significantly lower than that of the high proficiency group. These suggest that different reading proficiency groups differed from each other significantly in their working memory capacity, and each group's working memory scores varied in the same direction with their reading proficiency scores.

Table 4.11 Multiple Comparisons Test for Reading Proficiency Differences in Working Memory

Dependent Variable	(I) Reading proficiency	(J) Reading proficiency	M.D. (I-J)	Std. Error	Sig.
WMCT	Low	Moderate	-5.09623*	1.49482	.003**
		High	-10.12469*	1.58316	.000***
	Moderate	Low	5.09623*	1.49482	.003**
		High	-5.02846*	1.51138	.004**
	High	Low	10.12469*	1.58316	.000***
		Moderate	5.02846*	1.51138	.004**

Note. M.D. = Mean Difference; **. Correlation is significant at the 0.01 level (2-tailed).
***. Correlation is significant at the 0.001 level (2-tailed).

4.4.2.2.2 One-Way ANOVA for Reading Proficiency Differences in Learning Styles

Table 4.12 displays the One-Way ANOVA analysis for reading proficiency differences in learning styles, among the six learning style preferences, only the distribution of the Group style preference was found to have a significant difference between the participants' levels of English reading proficiency (F = 4.440, p = .013 < .05).

Table 4.12 One-Way ANOVA for Reading Proficiency Differences in Learning Styles

	Reading Proficiency	N	Mean	S.D.	F	Sig.
Visual	low	77	3.43	.40	.025	.975
	moderate	94	3.43	.40		
	high	74	3.44	.37		
	Total	245	3.44	.39		
Tactile	low	77	3.52	.63	.524	.593
	moderate	94	3.52	.56		
	high	74	3.43	.63		
	Total	245	3.49	.60		
Auditory	low	77	3.47	.46	.797	.452
	moderate	94	3.39	.43		
	high	74	3.40	.47		
	Total	245	3.42	.45		
Group	low	77	3.33	.71	4.440	.013*
	moderate	94	3.11	.59		
	high	74	3.03	.67		
	Total	245	3.16	.66		
Kinesthetic	low	77	3.55	.53	.805	.448
	moderate	94	3.61	.50		
	high	74	3.66	.56		
	Total	245	3.61	.53		
Individual	low	77	3.25	.60	.409	.665
	moderate	94	3.32	.58		
	high	74	3.33	.59		
	Total	245	3.30	.59		

Note. N = Number of participants; S.D. = Standard Deviation; F = F-value;
*. Correlation is significant at the 0.05 level (2-tailed).

To further examine the differences between high, moderate and low English reading proficiency levels, a subsequent Multiple Comparisons Test using the Scheffé Post Hoc criterion for significance was performed. What displayed in Table 4.13 is only the Group style preference, while the other types of learning styles are removed. It can be seen that there were significant differences between the low English reading proficiency and high English reading proficiency participants on the means of Group style preference at the 0.05 level of significance. The *p* vales was .019 ($p = .019 < .05$). The mean scores of the low reading proficiency participants (M = 3.33, S.D. =.71) was significantly higher than that of the high reading proficiency participants (M = 3.03, S.D. = .67). This reveals that low reading proficiency participants and high ones differed significantly in Group style preference, with the former tending to prefer Group style.

Table 4.13 Multiple Comparisons Test for Reading Proficiency Differences in Learning Styles (Group Style Preference)

Dependent Variable	**(I) Reading Proficiency**	**(J) Reading Proficiency**	**M.D.(I-J)**	**Std. Error**	**Sig.**
Group	low	moderate	.22396	.10041	.085
		high	.30274*	.10635	.019*
	moderate	low	-.22396	.10041	.085
		high	.07878	.10152	.740
	high	low	-.30274*	.10635	.019*
		moderate	-.07878	.10152	.740

Note. M.D. = Mean Difference; *. Correlation is significant at the 0.05 level (2-tailed).

4.4.2.2.3 One-Way ANOVA for Reading Proficiency Differences in Reading Strategies

Table 4.14 displays the results of One-Way ANOVA analysis for the participants' perceived use of reading strategies across the high, moderate, and low English reading proficiency groups. No significant difference was observed in the responses among the three reading proficiency groups in using GLOB, PROB and SUP. Therefore, it was not necessary to conduct a Multiple Comparisons Test to test which groups were different from others in reading strategy use.

Table 4.14 One-Way ANOVA for Reading Proficiency Differences in Reading Strategies

	Reading Proficiency	N	Mean	S.D.	F	Sig.
GLOB	low	77	3.09	.56	1.526	.219
	moderate	94	3.24	.59		
	high	74	3.21	.58		
	Total	245	3.18	.58		
PROB	low	77	3.50	.59	1.644	.195
	moderate	94	3.61	.49		
	high	74	3.66	.53		
	Total	245	3.59	.54		
SUP	low	77	2.92	.60	1.838	.161
	moderate	94	3.04	.48		
	high	74	3.08	.49		
	Total	245	3.01	.52		

Note. N = Number of participants; S.D. = Standard Deviation; F = F-value

4.4.3 Results in Relation to Research Question 3

This section reports the findings of the third research question, "What are the relationships between the Chinese non-English major EFL learners' working memory capacity, learning styles, and reading strategy use?" In an attempt to answer this question, Pearson's correlations coefficients were calculated to determine the relationships between working memory, learning styles and reading strategies.

4.4.3.1 Criterion for Pearson's Correlation Coefficient (*r*)

This study uses the criterion that Cohen (1988, pp. 79-80) suggests for the effect size of Pearson product-moment correlation coefficient (*r*) to interpret the strength of correlations, that is, a correlation of 0.5 is large, 0.3 is medium, and 0.1 is small. It is usually interpreted as: $r > 0.5$, large/high; 0.3-0.5, medium/moderate; 0.1 - 0.3, small/low; < 0.1, very small/trivial.

4.4.3.2 Results of Correlation between Working Memory and Learning Styles

Table 4.15 presents the results of Pearson correlation calculation between WMC and the six learning style preferences.

As is found in Table 4.15, there were significant positive correlations between the participants' WMC and two learning style preferences: Kinesthetic style and Individual style. And there was a significant negative correlation between the participants' WMC and Group style preference. However, the correlations were low. The Pearson's *r* value between WMC and Kinesthetic style preference was .142 ($r = .142$, $p < .05$). The correlation coefficient between WMC and Individual style preference was .132 ($r = .132$, $p < .05$), and the correlation coefficient between WMC and Group style preference was -.139 ($r = -.139$, $p < .05$). These mean that an increase

in the value of Kinesthetic style or Individual style would be accompanied by a simultaneous increase in the value of WMC. In addition, an increase in the value of Group style would be correspondingly accompanied by a decrease in the value of WMC. Nevertheless, WMC was found to be unrelated to Visual, Tactile or Auditory preferences.

Table 4.15 Results of Pearson's Correlation between Working Memory and Learning Styles

		Visual	Tactile	Auditory	Group	Kinesthetic	Individual
WMCT	Pearson Correlation	.026	.005	-.025	-.139*	.142*	.132*
	Sig. (2-tailed)	.686	.936	.695	.029	.026	.039
	N	245	245	245	245	245	245

Note. N = Number of participants; *. Correlation is significant at the 0.05 level (2-tailed).

4.4.3.3 Results of Correlation between Working Memory and Reading Strategies

Table 4.16 displays the results of Pearson product-moment correlation analyses between WMC and the three reading strategies.

As seen from Table 4.16, there appeared to be positive significant correlations between WMC and all the three reading strategies. However, the correlations were low. Among them, the highest correlation was between WMC and PROB (r = .238, p < .001). While the lowest correlation was between WMC and SUP (r = .178, p < .01). The strength of correlation between WMC and GLOB was in between (r = .181, p < .01). These suggest that the more use of the three types of reading

strategies, with PROB slightly more than GLOB and GLOB slightly more than SUP, would correspondingly increase in their WMC scores.

Table 4.16 Results of Pearson's Correlation between Working Memory and Reading Strategies

		GLOB	PROB	SUP
WMCT	Pearson Correlation	.181**	.238***	.178**
	Sig. (2-tailed)	.004	.000	.005
	N	245	245	245

Note. N = Number of participants; **. Correlation is significant at the 0.01 level (2-tailed).
***. Correlation is significant at the 0.001 level (2-tailed).

4.4.3.4 Results of Correlation between Learning Styles and Reading Strategies

Table 4.17 shows the results of Pearson product-moment correlation analyses between the six learning style preferences and the three reading strategies. Form Table 4.17, it can be observed that all the three categories of reading strategies correlated significantly with three types of learning style preferences—Visual, Tactile and Kinesthetic. The *r* correction values are: GLOB-Visual ($r = .211$, $p = .001$), GLOB-Tactile ($r = .170$, $p < .01$), GLOB- Kinesthetic ($r = .206$, $p = .001$); PROB-Visual ($r = .222$, $p = .000$), PROB-Tactile ($r = .156$, $p < .05$), PROB-Kinesthetic ($r = .166$, $p < .01$); SUP-Visual ($r = .200$, $p < .01$), SUP-Tactile ($r = .179$, $p < .01$), SUP-Kinesthetic ($r = .212$, $p = .001$). In addition, Auditory learning style correlated significantly with Global reading strategy ($r = .129$, $p < .05$) and Problem solving strategy ($r = .229$, $p = .000$), which appeared to be the lowest and the highest significant correlations separately. However, all the significant correlations were low. No significant correlation was found between Auditory learning style and Support reading strategy

(r = .121, p > .05). There were no significant correlations between each of the three categories of reading strategies and the two social learning style preferences—Group and Individual. These results indicate that participants with Visual, Tactile or Kinesthetic style preferences would use more of the three categories of reading strategies, and participants who preferred Auditory learning style would use more of Global reading strategies and Problem solving strategies.

Table 4.17 Results of Pearson's Correlation between Learning Styles and Reading Strategies

		Visual	Tactile	Auditory	Group	Kinesthetic	Individual
GLOB	Pearson Correla-tion	.211**	.170**	.129*	.116	.206**	.051
	Sig. (2-tailed)	.001	.008	.044	.070	.001	.430
	N	245	245	245	245	245	245
PROB	Pearson Correla-tion	.222***	.156*	.229***	.021	.166**	.122
	Sig. (2-tailed)	.000	.015	.000	.741	.009	.057
	N	245	245	245	245	245	245
SUP	Pearson Corre-lation	.200**	.179**	.121	.113	.212**	.042
	Sig. (2-tailed)	.002	.005	.059	.077	.001	.517
	N	245	245	245	245	245	245

Note. N = Number of participants; *. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
***. Correlation is significant at the 0.001 level (2-tailed).

4.4.4 Results in Relation to Research Question 4

This section deals with the findings of the fourth research question, "To what extent can the Chinese non-English major EFL learners' reading performance be predicted by their working memory, learning styles, and reading strategies?" in order to answer this question, multiple linear regression analyses, with the enter method selected, were

performed to determine how well the participants' reading performance could be predicted by the scores achieved from their working memory capacity test, and their reported scores in learning styles and in reading strategies. The reading comprehension test scores (RCT) served as the dependent variable, while the scores of WMCT, learning styles, and reading strategies served as the independent variables respectively.

4.4.4.1 Criterion for Multiple Regression Correlation Value (R^2)

This present study uses Cohen's (1988, pp. 413-414) criteria for assessing the contribution of the independent variables in behavioral sciences. R^2 measures the extent to which the independent variables involved in the model predict the dependent variable. The criteria are, for multiple regression models, squared (R^2, or partial R^2) correlation value of .26 is considered to have large effect sizes, .13 is medium, and .02 is small. In other words, R^2 (or partial R^2) between 2% - 12.99% suggests small effect sizes, values between 13% - 25.99% indicate medium effect sizes, and values > 26% suggest large effect sizes.

4.4.4.2 Results of Regression for Working Memory and Reading Performance

Linear regression analysis is used when a researcher is interested in the linear relationship between two variables (Kerr, Hall & Kozub, 2002). As mentioned above, a multiple linear regression analysis with "enter" method was performed to examine to what extent WM predicted reading performance. Table 4.18, 4.19, and 4.20 show the results of the linear regression analysis for WM and reading performance.

Table 4.18 shows that the multiple correlation coefficient between WM and reading performance was 0.413 (R = .413). The coefficient of determination for the sample is 17% (R^2 = .170), that is to say, 17% of the variance in reading performance

was accounted for by the variance in the WMC, therefore, WMC had a medium predictive power of reading performance.

Table 4.18 Results of Model Summary for Working Memory and Reading Performance

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.413[a]	.170	.167	7.42248

a. Predictors: (Constant), WMCT

Table 4.19 displays the ANOVA for WM and reading performance. The F-value (F = 49.899, df = 1, p = .000 < .001) shows that there was a linear relationship between the independent and dependent variables, so the model of WM successfully explained the variance of reading performance, i.e., WM had significant predictive power with regard to reading performance. As shown in Table 4.18, 17% of the variance in reading performance was accounted for by WM, and this percentage was statistically significant.

Table 4.19 Results of ANOVA for Working Memory and Reading Performance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2749.080	1	2749.080	49.899	.000[b]
	Residual	13387.659	243	55.093		
	Total	16136.739	244			

a. Dependent Variable: Reading Performance
b. Predictors: (Constant), WMCT

Table 4.20 presents the coefficients of multiple regressions for WM and reading performance. It is found that WM had a significant positive influence on reading performance (t = 7.064, p = .000 < .001).

Table 4.20 Summary of Coefficients of Linear Regression for Working Memory and Reading Performance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.260	2.760		2.993	.003
	WMCT	.321	.045	.413	7.064	.000

a. Dependent Variable: Reading Performance

Based on the above findings, for the regression equation, the intercept which is termed the constant had the value 8.260. The slope of the line had the value .321 (B = .321). Substituting these values for the intercept and the slope into the equation "Y = A + BX", the regression equation for predicting the reading performance is:

Predicted Reading Performance = 8.260 + (0.321 × WMCT score)

The values of the regression coefficients show that a 1% increase in WMCT score is associated with 0.321% increase in reading performance.

4.4.4.3 Results of Regression for Learning Styles and Reading Performance

An enter multiple regression analysis was run to examine the contribution of each of the six learning styles, i.e., Visual, Auditory, Kinesthetic, Tactile, Group, and Individual, towards reading performance. Table 4.21, 4.22, and 4.23 show the results of multiple regression analyses for the six types of learning styles and reading performance.

Table 4.21 shows that the multiple correlation coefficient between the six learning styles and reading performance was 0.290 (R = .290). The coefficient of determination for the sample is 8.4% (R^2 = .084), i.e., 8.4% of the variance in reading

performance is accounted for by the variance in the six learning styles, and the predictive power of the six learning styles as a whole was in a small effect size.

Table 4.21 Results of Model Summary for Learning Styles and Reading Performance

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.290[a]	.084	.061	7.87942

a. Predictors: (Constant), Individual Style, Auditory Style, Tactile Style, Visual Style, Group Style, Kinesthetic Style

Table 4.22 shows the ANOVA results for learning styles and reading performance. The F-value (F = 3.652, df = 6, p = .002 < .01) shows that the overall model with the six predictors of learning styles had successfully explained the variance in reading performance. From Table 4.21, 8.4% of the variance in reading performance was explained by learning styles, and this percentage was statistically significant. In other words, the model showed that the six learning styles combined to explain a significant portion of variance in reading performance.

Table 4.22 Results of ANOVA for Learning Styles and Reading Performance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1360.437	6	226.740	3.652	.002[b]
	Residual	14776.302	238	62.085		
	Total	16136.739	244			

a. Dependent Variable: Reading Performance
b. Predictors: (Constant), Individual Style, Auditory Style, Tactile Style, Visual Style, Group Style, Kinesthetic Style

Table 4.23 indicates the coefficients of multiple regressions for the six learning styles and reading performance. It is found that Kinesthetic style had significant positive influence on reading performance (t = 3.310, p = .001). While both Tactile style (t = -2.596, p = .01) and Group style (t = -3.020, p = .003 < .01) had significant negative influence on reading performance respectively. The regression equation for predicting the reading performance is as follows:

Predicted Reading Performance = 36.347 + (0.869 × Visual Style) − (2.748 × Tactile Style) − (1.414 × Auditory Style) − (2.828 × Group Style) + (4.075 × Kinesthetic Style) − (0.973 × Individual Style)

For the above equation, the values of the regression coefficients show that Kinesthetic style (B = 4.075) was the strongest contributor of English reading performance. That is, a 1% increase in Kinesthetic style is associated with 4.075% increase in reading performance score.

Table 4.23 Summary of Coefficients of Multiple Regressions for Learning Styles and Reading Performance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	36.347	6.668		5.451	.000
	Visual Style	.869	1.460	.042	.595	.552
	Tactile Style	-2.748	1.058	-.203	-2.596	.010
	Auditory Style	-1.414	1.160	-.078	-1.219	.224
	Group Style	-2.828	.936	-.230	-3.020	.003
	Kinesthetic Style	4.075	1.231	.264	3.310	.001
	Individual Style	-.973	1.059	-.070	-.918	.359

a. Dependent Variable: Reading Performance

4.4.4.4 Results of Regression for Reading Strategies and Reading Performance

An enter multiple regression analysis was carried out to examine to what extent the three subscales of reading strategies, namely Global, Problem solving and Support strategies predicted reading performance. Table 4.24, 4.25, and 4.26 show the results of multiple regression analyses for the three reading strategies and reading performance.

Table 4.24 shows that the multiple correlation coefficient (*R*) between the three reading strategies and reading performance was 0.204 (*R* = .204). The coefficient of determination for the sample is 4.1% (R^2 = .041), i.e., 4.1% of the variance in reading performance is accounted for by the variance in the three categories of reading strategies, and the predictive power of the overall three reading strategies was in a small effect size.

Table 4.24 Results of Model Summary for Reading Strategies and Reading Performance

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.204[a]	.041	.030	8.01144

a. Predictors: (Constant), SUP, GLOB, PROB

Table 4.25 shows the ANOVA results for reading strategies and reading performance. The overall model with the three predictors of reading strategies had successfully explained the variance in reading performance (F = 3.472, df = 3, p = .017 < .05). As shown in Table 4.24, although only 4.1% of the variance in reading performance was explained by reading strategies, this percentage was statistically significant.

Table 4.25 Results of ANOVA for Reading Strategies and Reading Performance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	668.610	3	222.870	3.472	.017[b]
	Residual	15468.129	241	64.183		
	Total	16136.739	244			

a. Dependent Variable: Reading Performance
b. Predictors: (Constant), SUP, GLOB, PROB

Table 4.26 indicates the coefficients of multiple regressions for reading strategies and reading performance. Problem solving strategy was found to have a significant positive influence on reading performance (t = 2.261, p = .025 < .05). The regression equation for predicting the reading performance is as follows:

Predicted Reading Performance = 16.255 − (0.449 × Global Strategy) + (2.857 × Problem solving Strategy) + (0.792 × Support Strategy)

For the above equation, the values of the regression coefficients show that Problem solving strategies (B = 2.857) was a stronger contributor to English reading performance than Support strategies (B = 0.792). That is, a 1% increase in PROB is associated with 2.857% increase in reading performance score, whereas, a 1% increase in SUP is associated with 0.792% increase in reading score. Moreover, 1% increase in GLOB (B = - 0.449) is associated with 0.449 % decrease in reading score.

Table 4.26 Summary of Coefficients of Multiple Regressions for Reading Strategies and Reading Performance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.255	3.727		4.362	.000
	GLOB	-.449	1.150	-.032	-.391	.696
	PROB	2.857	1.264	.189	2.261	.025
	SUP	.792	1.254	.051	.631	.529

a. Dependent Variable: Reading Performance

From the linear regression analysis, it can be concluded that working memory contributed the most 17.0%, followed by learning styles 8.4%, and reading strategies only contributed 4.1 % towards reading performance.

4.5 Semi-structured Interview

This section reports the findings of the fifth research question, "What are the differences, if any, between Chinese non-English major EFL learners with high working memory capacity and the learners with low working memory capacity?" The purpose was to elicit more insightful information about students' perceptions on English learning and in particular, their reading habits, and the differences between the high WMC and low WMC learners. In order to answer this question, a semi-structured interview was carried out to 16 participants two weeks after the WMCT. The 16 respondents were singled out according to their scores on the WMCT. Among them, 8 who scored above 75 and the other 8 who scored below 45 were categorized as high WMC group and low WMC group separately (Cut-off scores were: 33 - 54.5 for low

WMC group; 64.5 - 91 for high WMC group. See **4.4.1.1** about the criteria of the classification of the participants).

The interview data were analyzed qualitatively with "open, axial, and selective coding" techniques. At first, for convenience, the interviewees were encoded by using the acronyms of their "surname + given name" to represent their real full names. The presentation of the findings is organized based on two sub-subsections: opinions of the interviewees with high WMC, and opinions of the interviewees with low WMC. The findings elicited form the interview data are presented as following.

4.5.1 Interviewees with High Working Memory Capacity

The opinions of the interviewees with high WMC were organized and categorized into five main themes as: 1) Having higher motivation, 2) Management of reading process and avoiding translating into mother tongue in reading, 3) Actively participating in classroom activities, 4) Having flexible testing skills and high level of vocabulary, and 5) Multiple input. These themes are presented in the following:

Theme 1: Having higher motivation. The first interview question was whether they like (to learn) English or not, this question was relevant to the students' motivation in English learning. Crump (1995) defines motivation as exciting the mind of the student to receive the instruction. It was found that the majority of the high WMC interviewees (7 out of 8) said that they liked (to learn) English or that English was very important/useful/ interesting. For example:

CWL: I liked to learn English when I was in primary school, it was very useful. I attended additional English classes, and got progress in English, so I found I have some talent in English.

RPK: I quite like English. Learning a foreign language is very interesting. Reading original books is fun. For example, the translated things will lose its original flavor.

Although only one interviewee in this group did not like English too much, she still thought it important:

DYX: I'm not interested in English very much, but I still think it is very important, so I need to learn it well. I attended additional English classes for three years in middle school, so my English was good at that time.

The second interview question was about their self-evaluated English level. This question was to probe students' self-confidence. Self-confidence is one of the cognitive components of motivation, and accordingly, one of the cognitive components of self-confidence is self-evaluation of L2 proficiency (Dörnyei, 1994). Accord to Dörnyei, self-confidence refers to the belief that an individual has the ability to create results, achieve goals or do tasks competently. The results of this interview question showed that most of the interviewees with high WMC evaluated their own English grades at middle to upper level compared with their classmates or other subjects they learned. Examples are:

CWL: Compared with other subjects, my English grades were higher and English learning was easier.

LYL: My English is okay among my classmates, and it is better than other subjects I study.

ZJH: I began to learn English from kindergarten. My English level is middle to upper, and it is okay.

Theme 2: Management of reading process and avoiding translating into mother tongue in reading. The interviewees were asked about their reading habits, including how they read a text, whether they marked something or not in the text, which they focused on: general ideas or details, and whether or not they would translate English into Chinese. It seemed that the interviewees with high WMC could manage

their reading, they knew to which parts they would pay more attention, and they would highlight those they believed important. For instance:

CWL: For me, reading is to read through the text. I could feel which parts are important, that is, some paragraphs that explained something. I would think about it after reading, and knew what the text was about. But if it was very difficult or had nothing to do with us, I wouldn't think. I would underline some words that I couldn't understand and some important sentences which related closely to the text. I mainly focused on the main ideas, but not good at grasping details.

DYX: I usually read from the beginning of the text, and I would skip it if I couldn't understand. If the later part explained the prior, it was good. If I couldn't understand after I finished reading the text, I would think again. I would mark the new words and the parts I didn't understand. I would pay attention to the general meaning. I would think of what the text was about after reading.

HBR: At first, I would look at the first sentence of the first paragraph, and guessed what the text was about. In general, the first sentence is the topic. Then I looked at the first sentences of each paragraph. I used different ways to deal with different types, for example, I looked for those proper nouns with capital letters, and then I looked for these nouns in the text. I marked those special things, for example, the first topic sentence of the first paragraph, and the sentences that summarized meanings.

LYL: I drew lines under those important sentences or I couldn't understand well. I guessed the meanings of the new words, if they didn't influence understanding, I skipped.

ZYM: I could understand the meaning after I read the whole sentences. I read on and then I would have an overall impression.

ZZH: If I could understand the text, that's okay. I would read from the beginning to the end. If I couldn't understand the meaning, I would read several times. I marked the important parts, for example, the summaries of the previous texts, and those parts that seemed familiar but I couldn't think out the meaning. Then I would check.

When they were asked during the reading process whether or not they would translate English into their mother tongue, it appeared that the high WMC interviewees did not translate too much when reading, that is, they tended not to depend on their mother tongue. Here are the examples:

HBR: To improve English, I normally won't translate. The foreign languages have their own styles of thinking, if every sentence is translated into Chinese, it will be very strange. Why to translate? You know what it means, that's enough.

RPK: I won't translate the sentences into mother tongue. I think of them in English as much as possible.

ZYM: I won't translate on purpose. I know the meaning after reading, so I don't need to translate.

ZZH: I wouldn't translate into Chinese. I only translated those that I couldn't understand.

Theme 3: Actively participating in classroom activities. The interviewees were asked whether they would listen to the lectures attentively or not, whether they would answer the teachers' questions actively, and whether they participated the classroom activates. Most interviewees with high WMC said that they were attentive in reading class and actively participated in classroom activities. They believed that participating in the activities could improve their learning and the effects were better than just listening to the lecturers. For example:

LYL: I actively thought about the questions asked by the teacher. I like classroom activities, and we were active in doing them. We formed a group, made Power Points and presented in class. The parts that I was assigned was more effective than just listening to lectures.

ZJH: I am attentive in reading class. I like classroom activities, it's interesting. I actively participated in the activities assigned by the teacher. This semester we did a few times, it's helpful to me. In the past I was afraid of speaking in public. The first time I was nervous and forgot words, but I feel much better now.

Theme 4: Having flexible testing skills and high level of vocabulary. The interviewees were asked how they did in the WMCT, and how they dealt with the two tasks of it: judging the reasonableness of the sentences and recalling the final word of each sentence. It was found that the interviewees with high WMC could deal with the two tasks of the WMCT although some of them thought the test was difficult. Most of them would memorize the final words by their Chinese meanings which showed that they could adjust their testing skills to the test. Meanwhile, they could write the final words if they could remember the words. The correct spelling of words indicates their high level of vocabulary. Examples are:

HBR: At first I looked at the sentence at a glance and quickly judged whether it was right or wrong. Then I memorized the Chinese meanings of the final words and silently read the Chinese meanings. When I typed the final words I thought about whether the words were long or short. The test was difficult.

RPK: The task was difficult. I judged the sentences at first. For the final words I memorized as many as I could. I translated the sentences and memorized the Chinese meanings, so they had some impression on me. If I could remember [the Chinese meanings], I could write the final words.

WL: When I saw the sentences I translated them into Chinese in my mind quickly, and memorized their Chinese meanings. Then I typed the final words. I could probably judge the sentences after I saw them.

ZYM: Sometimes I memorized the pronunciations and meanings of the words, and I judged the sentences by feeling [intuition].

Theme 5: Multiple input. When asked what they usually did to improve their English after class, it was found that the high WMC group would find various approaches to practicing English, i.e., they had large sources of English input, such as watching English movies, listening to English songs, reading English novels and

newspapers, playing games, or joining in competitions. Some examples are presented below:

CWL: I listen to BEC and VOA English programs. They are helpful. I read short English articles that published in the school coaching newspaper. If I am busy, I won't do, but in the summer vacation, I will. Now I deliberately practice English by listening to English songs. I not only pay attention to the rhythms, but also to the lyrics. I watch English movies, not only look at the Chinese and English subtitles, but also pay attention to the pronunciation.

DYX: [One thing to improve English is that] I sometimes listen to the original listening material. The other is to watch American TV series. At the beginning I looked at the Chinese subtitles, but later on, I found it was not too difficult to understand the English version [of the subtitles]; maybe they talked in daily English.

HBR: I took part in many English competitions, including speaking, writing, and English contest. I plan to attend an additional English class this summer vacation. I like English games, for example, I play "River Jump" to memorize words, sometimes when I feel bored, I would play with it.

RPK: I've downloaded BEC and VOA English news, and listen to special English from them. I memorized new words whenever I encountered them.

ZJH: I mainly watch American TV series, they are interesting. I would watch several times, and looked at the English and Chinese subtitles. I feel I improved much in oral English. I read the English version of "Harry Potter", I am very interested in it, and I like it very much. I read the Chinese version before, so I can understand it. Sometimes I chat in English with a former classmate who is in American now.

ZYM: I like to watch foreign movies and listen to the original language. I read English books for leisure before sleeping.

4.5.2 Interviewees with Low Working Memory Capacity

Each of the eight respondents with low WMC was interviewed to gain insights about their opinions on reading. The findings are organized into another five major themes: 1) Lack of motivation, 2) Concentrating on individual words or sentences and using more translating in reading, 3) Being passive in classroom interactions, 4) Having difficulty in test and low level of vocabulary, and 5) Limited input.

Theme 1: Lack of motivation. The first theme was emerged from the first interview question as to whether they liked (to learn) English or not, and it was found that all the low WMC interviewees did not like (to learn) English. The reasons they mentioned were: (learning) English was difficult, not interesting, or what they gained was less than they devoted to it. Some examples are:

CQQ: If there were no English exams, I wouldn't learn it.

GJJ: I can't say I like it [English]. It's just that I have to learn it, because there are exams for it. The difficulty is I can't remember the words, and the sentences are not easy to understand. I did not pass the CET-4 last semester, and I will take part in the test this semester. Last semester I spent less time on it, but this semester, I spend more.

HYQ: I liked learning English in middle school when I began to study English. Later it became more difficult so I no longer liked it.

LYF: It's hard to tell whether I like English or not, it's only an instrumental subject. I spent more but gained less. I have no talent in learning English. I forgot [English] quickly. I spent more time in middle school, less in high school, and the least in college.

RY: I don't like learning English, it's boring. Of course I have to learn English, but it has nothing to do with liking or disliking.

Besides, their responses to the second interview question as to how they would self-evaluate their English levels showed that most of the interviewees with low WMC

evaluated their own English grades at a lower level compared with their classmates or other subjects they learned. For examples:

CQQ: My English is poorer than my classmates and my other subjects. I'm afraid of it. I only spend some time in learning English on Saturdays.

GJJ: Compared with my other subjects and my classmates, my English is weaker.

LYF: My English is poorer than my classmates and my other subjects. I found my English was poor from middle school.

RY: My English is worse than my classmates. My English was always weak form middle school to high school. In college, except for in English class, I spent little time on learning English.

WYB: I evaluate my English level as poor. Because of region difference, I came from the less developed area, and my English was the lowest here. My English was the lowest among the subjects I took in the college entrance examination. So is it normally.

Theme 2: Concentrating on individual words or sentences and using more translating in reading. It was found that in reading, the interviewees with low WMC paid more attention to individual words or sentences, seldom did they think about the text from a macroscopic perspective. Examples are:

RY: I read though the text, and read each word and sentence without skipping. If I skipped, I couldn't understand.

WYB: I concentrated on the individual words and sentences, less on something macroscopically.

Apart from concentrating on individual words or sentences, their answers also revealed that they used more translating in reading. It was found that most of the low WMC interviewees were dependent on their native language when reading. They preferred to translate the sentences into Chinese during reading process. Below are the examples:

GJJ: I would read and translate at the same time.

HYQ: During reading, if I knew every word I would translate the sentences automatically in mind.

LYF: During the process of reading, I would translate the sentences into Chinese.

RY: I translated every sentence intuitively. I mainly thought in native language.

WYB: To me, reading is translation. I read very slowly because of translating.

Theme 3: Being passive in classroom interactions. This theme includes two aspects which provide a more comprehensive description of the opinions and experiences of the respondents regarding their habits in reading classes: being reluctant to answer questions, being passive in classroom interactions. On the one hand, most interviewees with low WMC said that in reading class they could listen to the lectures, and could think about the questions raised by the teachers, but would not answer the questions for fear of making mistakes. For instance:

CQQ: If the teacher asks a question in Chinese, it is ok. If in English, I can't understand all, so [I hope the questions] do not always in English, and [the teacher] does not ask too difficult questions. If I cannot find the answer, I will feel frustrated, and be more unwilling to learn.

GJJ: I would think the questions, but I wouldn't answer.

LYF: What I did in reading class was to listen and follow the teacher. When the teacher asked a question I would think, but I couldn't come up with the answer.

RY: I just listened to lectures in class without doing other things. When the teacher asked a question I would think but did not answer.

WYB: I would think of the questions the teacher asked, but I wouldn't answer, because I was afraid of giving wrong answers.

However, one interviewee in the low WMC group said that he paid less attention to the lecture in reading class:

CLF: I sometimes didn't listen to the lectures attentively in reading class.

On the other hand, although some low WMC interviewees said they liked classroom activities, they needed enough time to prepare. Nevertheless, still others said that they would not take part in the activities because the activities needed group work, but the reality was that not all students would cooperate with others. The following examples illustrate these points:

CQQ: I like classroom interactions and activities, but we need to be given enough time to think. I expect to do tasks. I would spend a lot time to prepare, [I found] it was helpful after I did, and it helped for self-confidence a little. I hope the teacher to leave one or two questions and ask us the next class.

HYQ: I like interaction. But not all of my classmates were willing to be involved in it, they did their own, so it did not work effectively. I would prefer to listen to the lectures. I think the group discussion activity is better, and I'm willing to participate.

RY: I don't like classroom activities. I don't like to speak in public.

Theme 4: Having difficulty in test and low level of vocabulary. It was found that the low WMC interviewees could only handle one of the two tasks—judging and recalling—when there were more than three sentences in a group. Sometimes they could not spell the final words correctly even though they could recall that words and this indicates that their vocabulary level was low. They said the WMCT was difficult. Examples are:

YCQ: The [WMCT] task was too difficult. I memorized the final words and most sentences I did not have judgments. I couldn't spell some final words. The time was very limited.

CLF: I judged the sentences at first, when there were more sentences in a group, I gave up [judging], only memorized the final words. But when the final words become more, I couldn't remember. When I typed the next group's final words, the words in the previous group would suddenly appear in my mind. It's too hard to remember. The time was not enough.

CQQ: Before I could give a judgment of the sentences, they disappeared. When there were a lot of final words to remember, I memorized the short and simple ones and gave up the long words.

Theme 5: Limited input. It was found that the low WMC group did not seek many resources to improve their English except for learning with testing material after class. For instance:

GJJ: I mainly do English exercises. Sometimes I watched English movies, but not too many. When I couldn't understand, I looked at the English subtitles of the movies.

LYF: I think besides memorizing words and doing a lot of exercises, there aren't other effective ways to learn English well. The entertainment is only to relax, it will be forgotten soon.

RY: I don't have much feeling on English movies. When I watched English movies, I had to look at the subtitles; otherwise I couldn't know what they were talking about.

To sum up, this section reports the findings elicited from the interview data of the high- and the low WMC interviewees respectively concerning their perspectives on reading. Themes form both groups provided useful information about Chinese students' preferred approaches to reading tasks and ways to deal with the WMCT.

4.6 Summary

In summary, this chapter reports the findings in the main study. In response to the research purposes and the research questions, data were analyzed from both quantitative and qualitative methods. First, the reliability results of the questionnaires are reported, and then the participants' background information is presented, followed by the analysis of the results obtained from the Reading Comprehension Test. And the five research questions are answered by using different data analyses methods,

including descriptive statistics (means, standard deviations), Independent-samples *t*-test, One-Way ANOVA, Pearson's correlation, Multiple regression analysis, and content analysis methods. In the next chapter, all the findings and results will be discussed and explained in detail.

CHAPTER 5

DISCUSSION

This chapter presents discussions based on the main research findings in Chapter Four. The discussion falls into six sections: The first section is about the overall profiles for working memory, learning styles and reading strategy use with regard to the first research question. The second section discusses gender differences and differences between levels of English reading proficiency in relation to working memory, learning styles and reading strategy use stemming from the second research question. Section three concerns the relationships between working memory, learning styles, and reading strategies concerning the third research question. Section four involves the extent to which reading performance could be predicted by working memory, learning styles, and reading strategies stemming from the fourth research question. The fifth section discusses the differences between high- and low-working memory capacity learners. The last section is the summary of this chapter.

5.1 The Overall Profiles for Working Memory, Learning Styles and Reading Strategy Use

The following discussion will center on the findings based on the first research question, i.e., the overall profiles of the Chinese non-English major EFL learners' WM, learning styles, and reading strategy use. Findings emerged from descriptive statistics including means and standard deviations are discussed as follows.

5.1.1 Working Memory

In the present study, the participants' WMC was tested by a reading span task, specifically, to judge whether each of the 100 stimulus sentences was reasonable or not and at the same time to recall the final word of each sentence. The total score of the WMCT was set at 100. The findings showed that the participants' scores of the WMCT ranged from 33 to 91, with the mean score of 59.92 (M = 59.92, S.D. = 10.47). Furthermore, the scores were in a pseudo-normal distribution curve, indicating that most participants achieved scores in the middle of the range for the WMCT.

As mentioned in **2.3.1.2.1**, in Baddeley and Hitch's (1974) model of WM, the central executive system, a limited capacity system, is the overall supervisor and coordinator of information. The other two subsystems are responsible for system maintenance: the phonological loop contains acoustic and verbal information, while the visuospatial sketchpad stores visual and spatial information. The episodic buffer, the later added (Baddeley, 2000) fourth component to the system, is the holder of information that includes and integrates other information (e.g., visual, semantic, phonological) (Gass & Lee, 2011). The episodic buffer, by feeding information into and retrieving information from episodic long-term memory (Baddeley, 2000) , accounts for the fact that sentences are recalled better than a set of unrelated words when the number of words is the same (Gass & Lee).

As discussed in **2.3.1.7** and **3.4.1**, the reading span task, which is used to assess the WMC, measures the ability to process and store information simultaneously. For the present study, the processing task for the reading span dual-tasks was to judge the reasonableness/plausibility of the sentences, while the storage task was to recall the final word of each sentence. The dual-tasks compete constantly with each other for the

limited WM resources, leading to a trade-off between the two functions. It is found that in the present study a majority of the participants performed both the two tasks of recalling and processing; nevertheless, a few participants only did one task while abandoning the other. To tap both the two functions of WM, i.e., processing and storage, the mean of the two tasks was set as the score of the WMCT. On the whole, the participants could achieve a score that reflected their WMC.

5.1.2 Learning Styles

Learners prefer to learn in many different ways. The perceptual learning style preference questionnaire (PLSPQ) employed in this study was designed by Reid (1984) to test ESL students' preferred ways of learning English. In many cases, students' learning style preferences indicate how well they learn in different situations.

In the current study, descriptive analysis showed that the rankings of style preferences were (in descending order): Kinesthetic (M = 3.61, S.D. = .53), Tactile (M = 3.49, S.D. = .60), Visual (M = 3.44, S.D. = .39), Auditory (M = 3.42, S.D. = .45), Individual (M = 3.30, S.D. = .59), Group (M = 3.16, S.D. = .66). The participants' scores in perceptual/sensory preferences (Kinesthetic, Tactile, Visual, and Auditory) were found to be higher than their scores in social preferences (Group and Individual). Among the perceptual preferences, Kinesthetic and Tactile styles were preferred over either Visual or Auditory, with Auditory style ranking the lowest of the four. In addition, all six constructs of learning styles fell into a Minor-use range. Neither Major nor Negligible style existed among the participants. The results indicate that, in general, students could still function well whatever their preferred learning styles were, although no style preference could indicate which style enabled them to learn best, nor did they have difficulty in their ways of learning with any of them. Overall, among their Minor

preferences, the dominant two learning style preferences for the Chinese EFL students were Kinesthetic and Tactile, while their least favored two were Individual and Group styles.

These findings were consistent with a number of studies which used the same measuring instrument, i.e., Reid's (1984) PLSPQ. A comparison with previous studies and the reasons for the results are discussed as follows:

The present study lends support to the findings of Reid's (1987) survey on non-native speakers in the United States, including Arabic, Spanish, Japanese, Malay, Chinese, Korean, Thai, and Indonesian students that, overall, non-native speakers had a strong preference for Kinesthetic and Tactile learning. In addition, the present study confirms another claim by Reid (1987), that the majority of her subjects showed a negative preference for Group learning. Therefore, it appears that non-native speakers prefer Kinesthetic and Tactile learning, while disfavoring Group learning.

This study supports, to some extent, Rossi-Le's (1995) study conducted on 147 adult immigrants in ESL programs in two U.S. community colleges. Rossi-Le found that the majority of the adult immigrant students expressed a major learning style preference for the Tactile and Kinesthetic modes. In the present study, although students did not display a major learning style preference, their first two favored styles were also Kinesthetic and Tactile. Rossi-Le (1995) also found that all language groups in her study indicated a preference for Group style, which result was inconsistent with the present study that the participants showed a minor preference for Group style. Rossi-Le stated that her results suggested that the immigrant ESL students preferred a style of learning that would involve them in the totality of the language learning experience (Tactile and Kinesthetic) and in collaborative work, therefore, they might

benefit from realistic contexts and interactive behavior as a basis for their language development. While in the present study, although their least favored learning style preference was Group learning, the students would still learn well by collaborating with others.

This study also partially confirms Peacock's (2001) study carried out with 206 Chinese students taking EFL classes as part of their degree courses at the City University of Hong Kong. Peacock found that the most popular styles of his subjects were Kinesthetic and Auditory, while the least popular were Individual and Group, though neither was negligible. The commonalities between the present study and Peacock's (2001) are that Kinesthetic was the most favored preference, and social preferences i.e., Individual and Group styles, were the least favored.

In addition, the non-existence of any Major learning style preference of the participants of this study parallels the finding of Lin & Shen's (1996) study that investigated Taiwanese junior college ESL students which found that no specific learning style was preferred by the Chinese ESL learners in Taiwan. They held that college students employed multiple learning styles in class and learners who were able to use multiple learning styles achieved greater success in class. Moreover, students' learning styles were malleable and they were able to adjust to their teachers' teaching styles intuitively (1996). The tendency of no major learning styles preferences in this study is also consistent with Hyland's (1993) investigation that Japanese students appeared to exhibit no specific major learning style but had multiple minor learning styles.

Price, Dunn and Sanders (1980) found that the younger children were the most tactile/kinesthetic, that there was a gradual development of visual strengths through the elementary grades, and that only in fifth or sixth grades could most youngsters learn

and retain information through the auditory sense (cited in Reid, 1987). Carbo (1984) maintained that good readers preferred to learn through their visual and auditory senses. Price, Dunn and Sanders (1980) found that poor readers preferred to learn tactually and kinesthetically (cited in Carbo, 1984). As compared with Price, Dunn and Sanders' (1980) and Carbo' (1984) findings, for the present study, due to their less English (reading) proficiency than a native English speaker's, it is reasonable to assume that the Chinese EFL students' preferences were just like native English-speaking children who favored tactile and kinesthetic learning in which they preferred to learn by experiences such as participating in activities or learning through making something for a class project. Based on these previous studies, one could predict that when students achieve higher language proficiency, they might depend more on their visual and auditory senses to learn. In the early stages of reading, they would prefer kinesthetic and tactile styles but move to visual and auditory as their proficiency develops.

Another possible reason for why the Chinese students showed only Minor style preferences was probably related to cultural influence. Wintergerst & DeCapua (2001) pointed out that the Japanese students in Reid's (1987) study responded more moderately on the PLSPQ than did all the other non-native English speaker groups. They noted a similar tendency in their Russian-speaking participants studying in the U.S. who rarely checked "strongly agree" or "strongly disagree" on the PLSPQ. Wintergerst & DeCapua (2001) attributed the tendency to strong cultural influence. Similar results were found in Stebbins' (1995) conclusion that neither Chinese nor Japanese students showed a strong preference for any style modality. Stebbins (1995) offered the explanation that perhaps Japanese as well as Chinese students are unwilling to express their opinions due to traditional cultural ideas. Chinese students are educated on the basis of traditional

Confucian culture which emphasizes control and order instead of "acting out" (pp. 111-112). Similarly, in the current study, Chinese students were also found to prefer to check "agree" or "disagree", or mostly "undecided" rather than "strongly agree" or "strongly disagree". Due to the long-term influence of Chinese culture, which favors apparent modesty and mildness, in general, the Chinese students were conservative in responding to the inventory, avoiding the extremes. So, just as Wintergerst & DeCapua (2001) concluded that in cultures where extremes are not favored, students may not display clearly defined Major learning style preferences. This does not mean that they do not have clearly defined preferences, only that they do not say so.

5.1.3 Reading Strategy Use

In the present study, it revealed from the descriptive statistical analysis that the students' overall use of the reading strategies was at a moderate-frequency level (M = 3.24, SD = 0.47). In terms of the three categories of reading strategies, participants showed a moderate to high use, with Problem solving reading strategies (M = 3.59, S.D. = .54) in high usage, Global reading strategies (M = 3.18, S.D. = .58) and Support reading strategies (M = 3.01, S.D. = .52) in moderate usage. These results indicate that among the three categories, PROB was the most frequently used, while SUP was the least frequently used, and the frequency of using GLOB was in between.

One possible reason for the students' displaying moderate use of the overall reading strategies, and moderate to high use of the three categories is, in general, the students had strategic awareness when comprehending academic texts in which they could employ a range of reading strategies at a frequent level. In other words, they were active during reading process and were conscious of their cognitive process when dealing with academic materials.

The results echoed the findings of Zhang and Wu's (2009) study which showed a similar moderate to high usage of the three categories of reading strategies reported by a group of Chinese senior high school students, with PROB as their prime choice, followed by GLOB and SUP. The subjects in Zhang and Wu's study were senior high school students in China, as compared with the participants of the present study who were first-year college students. The commonality between the results of the two studies results in such a speculation that the students in their early tertiary levels might still use the strategies that they had used in high schools.

5.2 Gender Differences and Differences between Levels of Reading Proficiency in Relation to Working Memory, Learning Styles and Reading Strategy Use

The following section discusses the differences of gender and levels of reading proficiency in the Chinese non-English major EFL learners' working memory, learning styles and reading strategy use.

5.2.1 Gender Differences

As an individual difference in the biological sense, gender is among the most explored variables in language learning surveys. Independent-samples *t*-tests are usually employed to test whether there are any significant differences between males and females. The participants' gender differences in working memory, learning styles and reading strategy use are discussed in this section.

5.2.1.1 Gender Differences in Working Memory

Results from the Independent-samples *t*-test revealed that female participants (M = 61.50, S.D. = 10.39) scored more highly than male participants (M =

56.34, S.D. = 9.81) in the WMCT, and there was a significant difference between males and females (t = -3.645, p < .001). This finding indicates that female participants significantly outperformed their male counterparts on the WM reading span task.

Gender differences in WM have been examined in a variety of fields such as cognitive psychology, neuroscience, and education. Advanced brain imaging, e.g., fMRI (functional magnetic resonance imaging) (e.g., Shaywitz et al.) and Brain-map (e.g., Hill, Laird & Robinson, 2014) are employed to test whether there exists brain differences between males and females. Although findings contradict each other about sex differences of brain function, there is evidence from numerous studies that a brain structure—the hippocampus—plays a crucial role in many types of memory tasks, and females have the larger size and show more rapid growth during adolescence (Halpern, 2012).

The finding of the present study that females outperformed males in the WM reading span task was in parallel with a popular view that females excel over males in verbal working memory. A large amount of research has shown female advantage in performing verbal working memory tests and in verbal activities, while male advantage has been found in most measures of visuospatial abilities (Halpern, et al., 2007; Hausmann et al., 2000). The female advantage in several specific verbal abilities, like reading, is international (Halpern, et al. 2007). For example, fourth-grade girls outscored fourth-grade boys in every participating country in an international reading literacy study program, and similar results appeared among 15-year-olds in each of the 25 countries that participated in a program for international student assessment (Halpern, et al., 2007). Verbal abilities, for example, as Halpern (2012) interpreted, apply to all the components of language usage, including skills like word fluency,

grammar, spelling, reading, vocabulary, verbal analogies, and language comprehension. The reading span task in the present research was a verbal test to tap the participants' WMC. The finding of this study also supports Huang's (1993) research into Chinese high school students that the girls outperformed boys significantly on a series of working memory span tasks.

5.2.1.2 Gender Differences in Learning Styles

Independent-samples *t*-test analysis showed that female participants reported higher scores in Tactile, Auditory and Kinesthetic styles preferences than males, while male participants reported higher scores in Visual, Group and Individual styles preferences than females. Among the six constructs of learning styles, only Group style was found to have significant difference in the distribution of learning style preferences between male (M = 3.3200, S.D. =.70) and female (M = 3.0824, S.D. = .63) participants ($t = 2.619$, $p < .01$). This revealed that compared with female participants, male participants tended to have Group style preference and the difference was significant. In other words, male students stated that they would learn better by studying with at least one other student or working together with others than did females.

A possible reason that accounts for this result might be that male students were more willing to work with others than their female counterparts. This may be because the participants in the present study were in their first year at college, and their learning behavior in secondary school might influence their learning habits in college. In secondary schools, most of them would focus on study in order to pursue higher education instead of participating in group activities which might cost a lot of time. There are less group activities in secondary school than in college. In this situation, male students appeared to convert to collaboration more quickly than their female peers.

In addition, all the participants in the current study were students in a university of finance and economics where students are encouraged to participate in multiple associations and collaborative activities to develop their communicative skills in order to meet the needs of their future work after graduation. According to the observation of the researcher, male students are more open or "bold" to these activities and are more willing to work in a group than female students who tend to show more consciousness in some activities.

However, the finding was opposite to Khatib & Ghosheh's (2013) results that there was a significant difference between Arabic male and female students regarding Auditory learning style, Tactile learning style, and Group learning style in which male students favored Auditory and Tactile learning styles more than females. On the other hand, in that study, female students favored Group learning style more than male students.

5.2.1.3 Gender Differences in Reading Strategy Use

Independent-samples *t*-test found no significant gender difference between males (M = 3.16, S.D. = .49) and females (M = 3.28, S.D. = .46) in the overall perceived use of reading strategies (t = -1.874, p > .05). As far as the three categories are concerned, female participants reported higher scores in using all the three strategy categories than males. Only the subscale of Support reading strategies was identified to have significant gender difference, with males (M = 2.84, S.D. = .55) lower than females (M = 3.09, S.D. = .49) (t = -3.546, p < .001). This means that female participants reported using SUP significantly more frequently than did male participants.

This would seem to confirm the trend observed by Sheorey and Mokhtari (2001) that no statistically significant differences were found between the male and female ESL students, nor were any significant differences found in the overall means for ESL male and female students. Besides, the female ESL students' means were higher than those for male ESL students. Sheorey and Mokhtari (2001) attribute, without certainty, the lack of gender effect for ESL readers to the uneven distribution between their subjects: male (n = 92) and female (n = 60). The unbalanced distribution of male and female participants was also the case of the current study, with males being 75, while females, 170. Therefore, further research is needed to examine the gender effect on reading strategy use.

The tendency that females scored significantly higher on SUP than males was also found in Poole's (2009) investigation on Columbia university students. Poole also reported a significantly higher score of females on PROB than males, but this result was not located in this study.

In the current study, although no significant difference existed at the overall level, the female students' means were higher than those for male students. The finding provides supportive evidence for previous studies (e.g., Poole, 2009; Sheorey & Mokhtari, 2001) that females reported using more reading strategies than males. This probably indicates that compared with their males counterparts, females tended to use more reading strategies.

5.2.2 Differences between Levels of English Reading Proficiency

Apart from gender difference, another frequently examined variable is language proficiency. In the following part, working memory, learning styles, and reading strategies are discussed in terms of reading proficiency differences.

5.2.2.1 Differences between Levels of Reading Proficiency in Relation to Working Memory

A One-Way ANOVA analysis, employed to test whether different English reading proficiency groups would perform differently based on WM, found a significant overall difference between the participants' English reading proficiency ($F = 20.455$, $p < .001$). Follow-up Post Hoc Scheffé tests revealed significant differences between all groups, i.e., the low reading proficiency group was significantly different from the moderate and the high reading proficiency groups on the means of reading proficiency, the p vales were .003 ($p < .01$) and .000 ($p < .001$) separately. The mean scores of the low reading proficiency group (M = 54.91, S.D. = 9.91) was significantly lower than the moderate group (M = 60.01, S.D. = 8.51) and the high group (M = 65.03, S.D. = 10.91). Moreover, the mean scores of the moderate group were significantly lower than the high proficiency group ($p < .01$).

These findings suggested that different reading proficiency groups differed from each other significantly in their WMC, and each group's WM scores varied in the same direction with their reading comprehension scores. According to Daneman and Carpenter (1980), the trade-off between processing and storage functions of WM appears like a potential source of individual differences in reading comprehension. The better reader might have more efficient processes so that he/she effectively would have more capacity for storing and maintaining information. However, Daneman and Carpenter (1980) argue that "a major difference between good and poor readers is the efficiency of their processing, rather than static memory capacity" (p. 465). As elaborated by Turner and Engle (1989), good and poor readers are assumed to have equivalent overall WMC. Good readers are supposed to have efficient reading

skills which demand relatively less WM resources, leaving more rooms of the WMC for the storage task. Due to this trade-off, good readers outperform poor readers that the former have more WMC available for the storage of products, while the latter have less residual WMC for storing the products of reading (Turner and Engle, 1989).

Gass and Lee (2011) interpret that an individual's WMC is stable, but that one's ability to fully utilize this capacity changes with proficiency. As Keijzer (2013) states, if processing is more efficient and faster, more storage space is available, for a beginning L2 learner, almost all resources need to be allocated to processing and as his/her L2 proficiency increases, processing will become more automatic, resulting in more available storage for L2 information.

5.2.2.2 Differences between Levels of Reading Proficiency in Relation to Learning Styles

One-Way ANOVA indicated that of the six learning style preferences, only the distribution of the Group style preference was found to have a significant difference between the participants' levels of English reading proficiency ($F = 4.440$, $p < .05$). Subsequent Post Hoc Scheffé procedures showed that there were significant differences between the low English reading proficiency and high English reading proficiency participants on the means of Group style preference ($p < .05$). The mean scores for the low English reading proficiency participants ($M = 3.33$, S.D. =.71) was significantly higher than that of the high English reading proficiency participants ($M = 3.03$, S.D. = .67). This revealed that low English reading proficiency participants and high ones differed significantly in Group style preference, with the former tending to prefer Group styles.

The present study demonstrated that those who were low in reading proficiency preferred working with others, possibly because they were weak in reading ability and would seek help from others or be more confident when working in a group. This finding supports Peacock's (2001) work that learners who favored working in groups had significantly lower EFL proficiency.

5.2.2.3 Differences between Levels of Reading Proficiency in Relation to Reading Strategies

The results of One-Way ANOVA analysis found that all the three English reading proficiency groups (high, moderate, and low) reported no significant differences in their use of the three categories of reading strategies—GLOB, PROB and SUP. This suggests that the students' reading proficiency did not affect their use of the three reading strategies.

A similar finding was found in Anderson's (1991) research. Based on his research on Spanish speaking ESL learners, Anderson (1991) found that good and poor L2 readers seemed to use the same kinds of strategies while reading and answering comprehension questions. Anderson explained that the nonexistence of difference revealed strategic reading is not only having the knowledge of what strategy to use, but also knowing how to use a strategy successfully and coordinate with other strategies. Anderson furthered that strategy use may also be involved in vocabulary control and general background knowledge. Low level language learners may be aware what strategies to use but short of vocabulary or other schema related information, thus, they may not have a strong enough language foundation to build on. Sheorey and Mokhtari (2001) asserted similarly that skilled readers are more able to reflect on and monitor their cognitive processes while reading. They are aware not only of which strategies to

use, but they are also better at regulating the use of such strategies. These explanations can be applied to the discussion of this study that compared with high proficiency readers, low proficiency readers may also know which strategies to be using, but lack the knowledge whether he/she applied them successfully. In other words, they know which strategies to use and how to use them, and they know the conditions under which strategies ought to be used.

5.3 Relationships between Working Memory, Learning Styles, and Reading Strategy Use

This section provides a discussion on the relationships between working memory, learning styles and reading strategy use. Pearson product-moment correlation coefficient (*r*) was computed to assess the degree of correlations between every two of the variables.

5.3.1 Relationship between Working Memory and Learning Styles

The Pearson correlational analyses revealed that three out of the six learning constructs were significantly correlated to WMC, namely, Kinesthetic ($r = .142$, $p < .05$), Individual ($r = .132$, $p < .05$), and Group ($r = -.139$, $p < .05$) preferences. Among them, significant positive correlations were found between the participants' WMC and Kinesthetic style/Individual style; and a significant negative correlation existed between WMC and Group style preference. On the other hand, WMC was found to be unrelated to Visual, Tactile or Auditory style preferences. These suggest that an increase in the value of Kinesthetic style or Individual style would be accompanied by a simultaneous increase in the value of WMC. In addition, an increase in the value of Group style would be correspondingly accompanied by a decrease in the value of WMC.

Kinesthetic learners tend to participate in learning with their whole or parts of the body. The finding that there existed a significant correlation between WM and Kinesthetic style indicated that the more an individual used his/her kinesthetic sensory, the more active he/she was to process and/or store information in completing WM tasks. It is known that the four sensory modalities: visual, auditory, kinesthetic, and tactile indicate different ways that individuals receive information (Itzen, 1995). As previously found in **4.4.1.2** in this study, Kinesthetic style was the style most preferred by the participants. According to Ryan (2014), cognitive processing involves changing information from the modality used when the information was received to a preferred modality during processing, and it may be easier to process information using a more preferred learning modality during information processing to improve their performance in WM score.

There existed in the current study a significant positive correlation between the students' WMC and Individual style, and a significant negative correlation between WMC and Group style preference. A possible reason for these findings is that the WMCT is a task for an individual to perform on his/her own, without being accompanied by others. Therefore, it probably caters for those with an Individual learning preference who would prefer to learn alone. Conversely, the same holds true for those Group style learners who would prefer to learn with others.

5.3.2 Relationship between Working Memory and Reading Strategies

The results of the Pearson correlation tests revealed that there were positive significant correlations between WMC and all the three reading strategies, i.e., Global, Problem solving, and Support strategies. The highest correlation was found between WM and PROB (r = .238, p < .001). While the lowest correlation was between WMC

and SUP (r = .178, p < .01), and in between was the strength of correlation between WM and GLOB (r = .181, p < .01). These suggest that WMC scores would increase along with the frequent use of the three reading strategies.

There is little research into the relationship between WM and reading strategies. However, it seems reasonable to suggest that readers use more effective strategies in reading. It is assumed that if readers are able to manipulate reading strategies, more space would be saved for the storage function of WM, because less processing is needed in this case, considering the trade-offs between the WM processing and storage functions.

5.3.3 Relationship between Learning Styles and Reading Strategies

The results of Pearson product-moment correlation analyses between the six learning style constructs and the three reading strategies showed that all three categories of reading strategies—Global, Problem solving, and Support reading strategies—correlated significantly with three out of the six types of learning style preferences—Visual, Tactile and Kinesthetic. Moreover, Auditory learning style correlated significantly with Global reading strategy (r = .129, p < .05) and Problem solving strategy (r = .229, p < .001), which appeared to be the lowest and the highest significant correlations respectively, although all the significant correlations were low. No statistical significant correlation was found between Auditory learning style and Support reading strategy (r = .121, p > .05), nor between each of the three categories of reading strategies and the two social learning style preferences—Group and Individual. These results indicate that students who are more visual-, tactile- or kinesthetic-oriented may prefer all the three reading strategies as GLOB, PROB and SUP. In addition, students with auditory style preference are likely to use PROB and GLOB. However,

those who are individual or group-oriented do not show any preferences to the three reading strategy types.

Most studies were conducted on the relations between learning styles and language learning strategies (e.g., Ehrman & Oxford, 1990) rather than between learning styles and reading strategies. However, language learning strategies tend to include strategies on its specific domains, e.g., reading or listening, and may also lend themselves to these specific fields. Therefore, language learning strategies may sometimes be domain-free.

Taking this into consideration, the findings can be claimed to partly support some previous studies conducted in Chinese context. For example, Hou's investigation (2009) showed that the Taiwanese EFL students' perceptual learning style preferences had a positive correlation with their use of learning strategies. That is, the more learning styles students preferred the more learning strategies they used. Tsai (2012) found Taiwanese undergraduate students' learning styles, motivation and reading strategies were inter-correlated with each other, besides, reading strategies were highly correlated with learning styles and motivation.

If reading comprehension skills are considered as reading strategies in a broad sense, the results can be said to half support as well as half contradict Erginer's (2014) study on 71 fourth grade Turkish students which found a slight correlation between reading comprehension skills and learning styles but that no learning style was a significant predictor of reading comprehension skills.

5.4 The Extent to Which Reading Performance Could be Predicted by Working Memory, Learning Styles, and Reading Strategies

In this section, findings emerging from multiple regression analyses are discussed in detail to examine the extent to which reading performance could be predicted by working memory, learning styles, and reading strategy use.

5.4.1 Working Memory and Reading Performance

A multiple linear regression analysis was run to determine the contribution of WM, one of the independent variables, towards reading performance. The regression revealed that the correlation coefficient between WM and reading performance was 0.413 (R = .413), and the value of R^2 (R^2 = .170) contributes 17.0 % which is a medium predictive power towards reading performance among the Chinese EFL students. It is found that WM had a significant positive influence on reading performance (B = .321, t = 7.064, p < .001). Therefore, there was significant contribution from one independent variable—WM dimension towards reading performance.

A number of studies reported a relationship between WM and L2 learning (e.g., Alptekin & Erçetin, 2009; Alptekin & Erçetin, 2011; Friedmana & Miyake, 2004; Leeser, 2007; Ma & Wang, 2011; Osaka & Osaka, 1992; Walter, 2004). This finding supports Harrington and Sawyer's (1992) study which compared ESL learners' L2 WMC and their L2 reading proficiency as measured by the reading/grammar subsections of TOEFL, and a significant correlation was found between the learners' performance in the L2 reading span task and their scores on the TOEFL subsections. The finding of the present study also confirms Shibasaki et al.'s (2015) study conducted on Japanese high school students that L2 WM significantly supported L2 general reading. Shibasaki et al. thus asserted that the ability to efficiently use limited

processing resources of WM differentiated proficient readers from non-proficient readers.

Although the proportion of variance in reading proficiency explained by WM is small, it still represents a significant effect. The significant predictor of reading proficiency by WM provides support to Linck et al.'s (2014) research. Based on a meta-analysis of data from journal studies including 79 samples involving 3,707 participants providing 748 effect sizes, Linck et al. (2014) found that WM is positively associated with both L2 processing and proficiency outcomes, therefore, a directional relationship is inferred in which greater WM resources cause better performance on the L2 criterion measures.

Engle and Kane (2004) believed that WMC span tasks strongly predict a broad range of higher-order cognitive capabilities (e.g., language comprehension). According to Engle and Kane (2004), the predictive power of WM complex span tasks lies in the fact that they tap executive attention processes, i.e., the ability to maintain goal-relevant information in a highly active, accessible state in case of interference or competition. But, so far very little is known about the unity and diversity of WM and executive function (e.g., the number and nature of executive functions), how these functions—updating, shifting, and inhibition—correlate, and how these abilities operate in the L1 and L2 domains (Linck et al., 2014).

5.4.2 Learning Styles and Reading Performance

A multiple linear regression analysis was computed to determine the contribution of the six learning styles towards reading performance. The regression revealed that the correlation coefficient between learning styles and reading performance was 0.290 (R = .290). The coefficient of determination for the sample is

8.4% (R^2 = .084), that is, learning styles combined to explain 8.4 % of the total variance but with small predictive power. Apart from that, Kinesthetic style was found to significantly positively predict reading performance (B = 4.075, t = 3.310, p = .001). While both Tactile style (B = -2.748, t = -2.596, p = .01) and Group style (B = -2.828, t = -3.020, p < .01) significantly negatively predict reading performance respectively. Therefore, Kinesthetic style was found to be the best predictor of reading performance.

The small proportion of variance in reading performance explained by the combined learning styles indicates that learning styles may not be a strong predictor of English reading performance. The finding provides supportive evidence for the view that students' academic achievement positively increases if they are aware of their learning styles and how they learn best (Nolting, 2002, cited in Moayyeri, 2015). However, this finding was in conflict with Tsai's (2012) investigation on Taiwanese EFL undergraduate students that no correlation was found between learning styles and reading performance.

Another finding that the significant power to predict reading performance was found on the Kinesthetic learners suggests that students who prefer to get involved in information through kinesthetic sense may perform better in reading. A possible interpretation might be that, as suggested by Reid (1995), Kinesthetic learners prefer physical experience by actively participating in activities. They may understand new material well through a combination of stimuli that allow them to participate actively. When examining the five items which indicate the Kinesthetic style preferences in the PLSPQ, it can be found that in classroom learning, the Kinesthetic learners can learn better by doing things in class (Item 2, 8 and 15), and by participating in role-playing and activities (Item19 and 26). In the reading class, participating in role-play tasks will

enable them to capitalize on their strength in physical movements, thus may help them achieve a better understanding of the reading material. Nonetheless, this finding is in direct contradiction to the study conducted by Bailey, Onwuegbuzie, and Daley (2000), who concluded that higher achievers in foreign language courses tend to prefer not to receive information via the kinesthetic mode.

5.4.3 Reading Strategies and Reading Performance

Multiple regression analysis revealed that the correlation coefficient between the three categories of reading strategies and reading performance was 0.204 (R = .204). The coefficient of determination for the sample is 4.1% (R^2 = .041), i.e., 4.1% of the variance in reading performance was explained by the variance in the combined reading strategies, but the predictive power was weak. Moreover, Problem solving strategy was the only found significant predictor of reading performance among the three subscales (B = 2.857, t = 2.261, p < .05). Therefore, PROB significantly contributed to reading performance.

The finding that there was a significant but weak correlation between reading strategies and reading performance was in line with those reported by several previous studies (Al-Nujaidi, 2003; Kamran, 2013; Tobing, 2013) in multiple cultural contexts. Using a modified version of Mokhtari and Sheorey's (2002) SORS, Al-Nujaidi (2003) investigated EFL first-year university students in Saudi Arabia, and found a significant correlation between reading strategies and reading comprehension which also indicated a small contribution to prediction model. Based on an investigation of high school students in Indonesia, Tobing (2013) found that there was a significant correlation between the Indonesian students' overall use of reading strategies and their reading comprehension, but the use of overall reading strategies was a weak predictor of reading

comprehension ability. This finding also basically supports one of the conclusions drawn by Kamran (2013) that the overall reading strategy used by Iranian EFL learners was a predictor of RCT scores but with low predictive power.

Another finding showed that among the three reading strategy subscales, only PROB use could be a predictor of reading performance. As defined by Mokhtari and Sheorey (2002), PROB are actions and procedures that readers use while working directly with the text. These are localized and focused techniques used when problems develop in understanding text. Examples are: paraphrasing, reading slowly, paying closer attention, rereading, adjusting the reading speed, etc. (Kamran, 2013). PROB is directly relevant to readers' reactions to problems in comprehending text, which is expected to be performed by many Chinese EFL learners in solving specific problems when reading texts, and could be a predictor of reading comprehension test scores. A possible reason is that the participants in the current study were college freshmen, who had experienced numerous exams before entering university. In their previous learning stage, they were trained with many test-taking skills, including skills to handle reading problems in English exams. Among the many possible skills, those targeted at solving specific types of problems might be highlighted by their teachers and themselves. As a result, those highly proficient students with reinforced PROB strategies might perform better in all kinds of exams not merely EFL reading, in this regard, PROB could be a predictor of the RCT scores.

5.5 The Differences between High- and Low Working Memory Capacity Learners

The above discussions are concerned with the quantitative results of the present study. In this section, results obtained from the qualitative data are discussed. The qualitative data, collected form face-to-face oral semi-structured interviews, were analyzed by content analysis. These qualitative data triangulated the data collected from the participants' self-report Questionnaires and the Working Memory Capacity Test. Among the 16 interviewees, 8 who achieved high scores in the WMCT formed the high WMC group, and the other 8 who scored low formed the low WMC group. They were interviewed to gain insightful information about their experiences and opinions of English learning, reading habits and the ways they took in the WMCT.

As shown in **4.5**, five main themes were elicited from the opinions of the eight interviewees with high WMC, namely: 1) Having higher motivation, 2) Management of reading process and avoiding translating into mother tongue in reading, 3) Actively participating in classroom activities, 4) Having flexible testing skills and high level of vocabulary, and 5) Multiple input. Meanwhile, another five major themes were generated from the other eight respondents with low WMC, i.e., 1) Lack of motivation, 2) Concentrating on individual words or sentences and using more translating in reading, 3) Being passive in classroom interactions, 4) Having difficulty in test and low level of vocabulary, and 5) Limited input. It is evident that the themes in both WMC groups were in one-to-one correspondence, which formed five contradictory pairs. These themes are discussed in the following.

1) The first pair of themes elicited from the high and the low WMC groups is concerned with motivation. As seen in Table 2.1 discussed in 2.2.3, motivation, one of

the individual learner factors, belongs to the category of propensities (Ellis, 2008). Crump (1995) holds that excitement, interest, and enthusiasm toward learning are the main goals in motivation, and students are willing to learn what they are interested in; otherwise they may have difficulty in learning. Comparing the two WMC groups, it is clear to find that the high WMC group liked (to learn) English because they believed it was important, useful and interesting. On the contrary, the low WMC group did not like (to learn) English as they thought it was difficult, dull, or they spent more time studying while not seeming to learn.

Different types of motivation might affect learning achievement. It is assumed that language learners have two motivations: integrative and instrumental (Dörnyei, 2001; Gardner, 1985). The former reflects a favorable attitude toward the target language community, and learners with integrative motivation want to interact with and even become similar to the members of that community; the latter refers that learning the target language is for practical gains, such as getting a better job, or a language requirement (Dörnyei, 2001; Root, 1999). Another well-known distinction in motivation theory is between intrinsic and extrinsic motivations. According to Dörnyei (1994), learners with extrinsic motivation learn to receive some extrinsic rewards (e.g., good grades) or to avoid punishment. Intrinsic learners learn to receive internal rewards (e.g., the joy of doing a particular activity or satisfying one's curiosity). Based on the above motivation theories, it is obvious that being interested in learning English belongs to integrative and intrinsic motivation. High WMC students who had high motivation and intrinsically motivated were more likely to maintain long-lasting power in learning. Low WMC students, however, either lacked interest in learning English or learned it only for the purpose of passing the exams, had instrumental and extrinsic motivation,

were hard to make progress in it or lost the power of learning English after they passed the exams.

In addition, the high and the low WMC groups assessed their own English levels at high and low correspondingly. The sharp contradiction between the two groups might result from their different self-confidence of learning English. Self-confidence is one of the cognitive components of motivation, while self-evaluation of L2 proficiency is one of the cognitive components of self-confidence (Dörnyei, 1994). According to Crump (1995), student's learning and memory are closely linked to motivation. As is known that foreign language learning is a long process, during which learners with sufficient motivation can achieve success, whereas learners without sufficient motivation are likely to fail to attain any language (Dörnyei, 2001). High WMC students, who believed English was interesting and useful, had enough motivation to learn it well. By contrast, low WMC students, who thought it boring, lacked motivation, which is probably the reason why their self-assessment of their English levels was lower.

2) The second opposing pair of themes is involved in reading process. It was found that the high WMC group was able to manage their reading process, they knew which parts of the text deserved more concentration, and they would highlight those they believed important. The low WMC group, however, focused more on the individual words or sentences, and they seldom thought about the text from a macroscopic perspective. These differences indicate that for the low WMC group, the lack of sufficient reading proficiency might result in their shortage of the ability to manage their reading, in other words, they could hardly know the new words or comprehend the sentences at the micro layer, let alone thought the whole text from a macro view. Therefore, a basic requirement for the low WMC group was to try to

understand what the text was saying, to meet this, they had to translate almost every sentence to help comprehend, which is also the reason why they used the translation approach frequently. On the contrary, the high WMC group usually deliberately avoided translating but thinking in English so as to develop their reading ability because they were not confined to just concentrating on the individual words or sentences.

3) The third contradictory pair of themes is concerned with activities in reading class. The high WMC group was found to participate actively in classroom activities contrary to their low WMC peers, who were found passive in classroom interactions. The high WMC group believed that participating in activities could improve their learning and the learning effect was better than just listen to lectures. However, although some interviewees of the low WMC group welcomed classroom activities, not everyone would cooperate with others to complete the tasks. Furthermore, some low WMC students were reluctant to answer questions asked by the teachers for fear of losing face if making mistakes. To solve this problem, teachers should encourage the students to actively take part in activities, tell them it is natural to make mistakes in the learning process, and design tasks that are suitable to their proficiency level, so that they may have enough confidence in learning. As discussed previously, self-confidence is essential to L2/FL achievements.

4) The fourth theme pair that directly distinguishes the two groups is whether they were able to handle the WMCT or not. It was evident that the high WMC group was more capable in doing the test, whilst their low WMC peers were less. Although both groups complained that the WMCT was difficult and the time was not sufficient, the high WMC group could deal with the test using their preferred ways, e.g., memorizing the final words by Chinese meanings. By contrast, the low WMC group

had some difficulties in doing the two tasks of the WMCT—judging and recalling, e.g., catching one while losing another/attending to one thing and losing another, being unable to spell the final words correctly. It should be noted that the dual-tasks of the working memory reading span that tap the WMC compete with each other for a limited capacity, therefore, it is easy to understand why the low WMC readers would fall into the dilemma of trade-off. Besides, the result of the low WMC students' misspelling the words showed that their level of vocabulary was low in which they might know the meaning the words but could recall their corrected forms when they were asked to spell them.

Moreover, it is interesting to find that in doing the WMCT, the high score group used translation strategies, while they avoided using it during reading. It is probably due to the different tasks. The WMCT needed to be completed in limited time, so they employed every useful skill to do it well including translating into mother tongue. However, in ordinary reading, they deliberately avoided translating but tried thinking in English so as to develop their reading ability.

5) The last opposing pair of themes was found between the amounts of English input after class. It was found that the high WMC group would seek various approaches to practicing English, such as watching English movies, listening to English songs, reading English novels, reading English newspapers, playing games, or joining in English competitions. Nevertheless, the low WMC group was struggling to cope with the testing material, e.g., they memorized the vocabulary and did exercises for the exams, and rarely found the time to learn English from other sources.

5.6 Summary

In summary, this chapter provides discussions and explanations of the research findings concerning the five research questions, and the results are compared with previous studies to see the similarities and differences. In the next chapter, conclusions of the findings, pedagogic implications, limitations, and recommendations for future research will be presented.

CHAPTER 6

CONCLUSION

This chapter summarizes the study. It is organized into four main sections. The first section summarizes the main findings in relation to the research questions that initiated the study; the second section describes a model for working memory/learning styles/reading strategies and reading proficiency; the third section is concerned with implications of the study; the fourth section involves limitations of the study; and finally, the fifth section provides recommendations for future research.

6.1 Summary of the Study

This study aimed at exploring the possible relationships between Chinese non-English major EFL undergraduates' working memory capacity, learning styles, reading strategy use and reading performance. It was conducted to answer the following five research questions: 1) What are the overall profiles of the Chinese non-English major EFL learners' working memory, learning styles and reading strategy use? 2) Are there any significant differences in the Chinese non-English major EFL learners' working memory, learning styles and reading strategy use with regard to their gender and level of English reading proficiency? 3) What are the relationships between the Chinese non-English major EFL learners' working memory capacity, learning styles, and reading strategy use? 4) To what extent can the Chinese non-English major EFL learners' reading performance be predicted by their working memory, learning styles, and

reading strategies? 5) What are the differences, if any, between the Chinese non-English major EFL learners with high working memory capacity and the learners with low working memory capacity?

In order to fulfill the research objectives and also seek answers to these questions, a mixed method research design combining quantitative and qualitative methods was employed. Two hundred and forty-five non-English major freshmen participated in the study. The quantitative data were collected through a battery of instruments: a Working Memory Capacity Test (WMCT) and two questionnaires—Perceptual Learning Style Preference Questionnaire (PLSPQ) and Survey of Reading Strategies (SORS). The qualitative data were collected from semi-structured interviews carried out on sixteen students in the pool of the samples. After the data analysis process, all five questions were answered. What follows is a brief summary of the major findings of the study.

1. The first research question was to investigate the overall profiles of the Chinese non-English major EFL learners' working memory capacity, learning styles and reading strategy use. Descriptive statistics including the mean and standard deviation scores were employed to analyze the quantitative data collected form the WMCT and the questionnaires. There were three main findings: 1) It was found that the participants' scores of the WMCT ranged from 33 to 91 out of a total score of 100, with a mean score of 59.92, indicating that most participants achieved scores in the middle of the range for the WMCT. 2) With regard to the distribution of their learning styles, the participants' scores in perceptual preferences (Kinesthetic, Tactile, Visual, and Auditory) were found to be higher than their scores in social preferences (Group and Individual). Among the six learning styles, Kinesthetic and Tactile styles were

preferred over either Visual or Auditory, with Auditory style ranking the lowest of the four. Meanwhile, all six constructs of learning styles fell into a Minor-use range, neither Major nor Negligible styles existed among the participants. 3) Concerning reading strategies, the participants reported using overall reading strategies moderately frequently. Among the three categories, they showed a moderate to high use, with Problem solving reading strategies (PROB) the most frequently used, followed by moderate use of the two others—Global reading strategies (GLOB) and Support reading strategies (SUP).

2. The second research question intended to identify whether there were significant differences with regard to the learners' gender and level of English reading proficiency. To answer this question, Independent-samples t-test, One-Way ANOVA analyses and multiple comparisons test using the Scheffé Post Hoc criterion for significance were utilized. 1) With respect to gender, results indicate that female participants achieved significantly higher working memory scores than did their male counterparts. Furthermore, among the six learning styles, male and female participants only had significant difference in the distribution of Group styles, with the former scoring significantly higher than the latter. In addition, female participants used Support reading strategies (SUP) significantly more frequently than did male participants. 2) As regards level of English reading proficiency, it was found that the high, moderate and low reading proficiency groups differed from each other significantly in their working memory capacity, and each group's working memory scores varied in the same direction with their reading comprehension scores. Besides, there was a significant difference between the low reading proficiency and high reading proficiency participants in Group style preference, with the former scoring significantly higher than

the latter. Moreover, the entire three English reading proficiency groups—high, moderate, and low—reported no significant differences in their use of the three categories of reading strategies—Global reading strategies (GLOB), Problem solving strategies (PROB) and Support reading strategies (SUP).

3. The third research question sought to explore the relationships between the learners' working memory capacity, learning styles, and reading strategy use. Correlation analyses were performed to gain insights into the relationships between the three individual variables. In general, it was revealed that all the significant correlations between the three variables were low. 1) Concerning the relation between working memory and learning styles, results indicate that there were significant positive correlations between the participants' working memory capacity and Kinesthetic/Individual style, and there was a significant negative correlation between working memory capacity and Group style preference. 2) With regard to the relation between working memory and reading strategies, significant positive correlations were established between working memory capacity and all the three reading strategies, i.e., Global, Problem solving, and Support reading strategies. The highest correlation was between WM and PROB, while the lowest correlation was between WM and SUP, and in between was the strength of correlation between WM and GLOB. 3) As to the relation between learning styles and reading strategies, it was found that all the three categories of reading strategies—Global, Problem solving, and Support—correlated significantly positively with three types of learning style preferences—Visual, Tactile and Kinesthetic. Moreover, Auditory learning style correlated significantly positively with Global reading strategies and Problem solving strategies, which appeared to be the lowest and the highest significant correlations respectively.

4. The fourth research question aimed to examine whether the learners' reading performance could be predicted by their working memory, learning styles and reading strategies. This question was answered by regression analyses. Findings reveal that learners' working memory, learning styles and reading strategies had medium to low predictive power of reading performance. 1) Working memory was found to be a significant predictor of English reading performance with a medium predictive power. 2) Learning styles had a weak predictive power of reading performance. Among the six types of learning styles, three significantly predicted reading performance. Specifically, Kinesthetic style had significant positive influence on reading performance. While Tactile style and Group style had significant negative influence on reading performance respectively. 3) Reading strategies had a low predictive power of reading performance. Among the three subscales of reading strategies, only the category of Problem solving strategies was found to be a significant predictor of reading performance.

5. The fifth research question was devoted to probing the differences between the Chinese non-English major EFL learners with high working memory capacity and those with low working memory capacity. The data gathered from semi-structured interviews provided in-depth insights into this question. Five main themes were elicited from the opinions of the eight interviewees with high WMC: having higher motivation, management of reading process and avoiding translating into mother tongue in reading, actively participating in classroom activities, having flexible testing skills and high level of vocabulary, and multiple input In the meantime, another five major themes were generated from the eight respondents with low WMC: lack of motivation, concentrating on individual words or sentences and using more translating in reading, being passive in classroom interactions, having difficulty in test and low level of

vocabulary, and limited input. These themes in both WMC groups were in one-to-one correspondence, and thus formed five counterparts.

To conclude, the results of the current study provide some practical evidence to research on language learners' individual differences in L2/FL learning. Specifically, in some areas of L2/FL learning, individual learner factors such as working memory, learning styles and reading strategies play an important part for tertiary level EFL learners to promote their reading/language learning proficiency. This echoes Koda's (2005) response to the question as to why readers' individual differences should be studied, that is, research into learners' individual differences can yield useful theoretical and practical findings to refine the existing reading models and to provide referential information to instruction (as mentioned in **2.2.3**). Therefore, a good knowledge of these areas may provide useful suggestions to researchers and educators.

6.2 A Model for Working Memory/Learning Styles/Reading Strategies and Reading Proficiency

Based on the findings of the present study, a model is proposed to account for the interrelatedness of working memory, learning styles and reading strategies, and for their predictions of reading proficiency, as well as for their differences regarding gender and level of English reading proficiency (see Figure 6.1). The main purpose of this model is to help instructors and learners have a good understanding of the role that the individual learner factors paly in FL reading, hence to improve learners' FL reading proficiency. The whole model is a combination of five parts which depict the five aspects as correlations, predictions, differences among levels of English reading proficiency, gender differences, and differences in WMC.

Firstly, from the results of the correlation analyses, it is clear to see the relationships between working memory, learning styles and reading strategies. As seen in Figure 6.1, the double-headed arrows at the top of the model represent the correlations between each two individual factors. PC means there is a positive correlation between them, while NC indicates a negative correlation. This model suggests that a learner who preferred Kinesthetic/Individual styles would score slightly higher in the WMCT, while a learner who preferred Group style would have a slightly lower WMCT score. Apart from that, learners who used Global, Problem solving or Support reading strategies in reading would achieve a higher score in the WMCT compared with those who did not. Learners with Visual/Tactile/Kinesthetic learning styles as their major style preference would probably use more of the three reading strategies, while an Auditory learner would use more of Problem solving strategies and Global reading strategies.

Secondly, building on the results of the multiple regression analyses, the prediction of reading proficiency by working memory, learning styles and reading strategies can be illustrated by this model. In Figure 6.1, single-headed arrows stand for the three individual factors' prediction of reading proficiency. PP means it is a positive predictor of reading proficiency, while NP means a negative predictor. As the model depicts, a learner's score in the WMCT could positively predict his/her reading proficiency. Furthermore, Kinesthetic style had positive influence on reading performance, whereas Tactile or Group styles had significant negative influence on reading performance respectively. In addition, Problem solving reading strategies had positive influence upon reading proficiency.

Thirdly, the differences among levels of English reading proficiency are illustrated in the model. As displayed by the solid lines in the middle of the model, the three groups of English reading proficiency—high, moderate and low—achieved high, moderate or low working memory scores correspondingly. Besides, the low reading proficiency students scored significantly higher than the high reading proficiency students in Group style preference.

Fourthly, this model shows gender differences in working memory, learning styles and reading strategies. As shown by the solid lines at the bottom of the model, female students achieved significantly higher working memory scores than did male students. Male students scored significantly higher than female students in the distribution of Group styles. In addition, female students used Support reading strategies significantly more frequently than male students.

Finally, this model also displays the differences between the interviewees with high working memory capacity and those with low working memory capacity. The participants were divided into three groups according to their scores in the working memory capacity test, only those got high or low WMCT scores were selected to be interviewed according to the research design. As indicated in Figure 6.1, the dotted line in the middle of the model means that the participants who achieved moderate scores in the WMCT were excluded from data collection of the interview. The five main theme counterparts elicited from the opinions of the interviewees with high- or low WMC described the differences of their opinions and habits in English learning, reading process, classroom activities and ways of doing the WMCT.

In sum, this model provides a clear panorama of the relationships between the variables of the present study, i.e., working memory, learning styles, reading strategies, and reading proficiency, and also gender and level of English reading strategy.

PC = Positive correlation; NC = Negative correlation
PP = Positive predictor; NP= Negative predictor

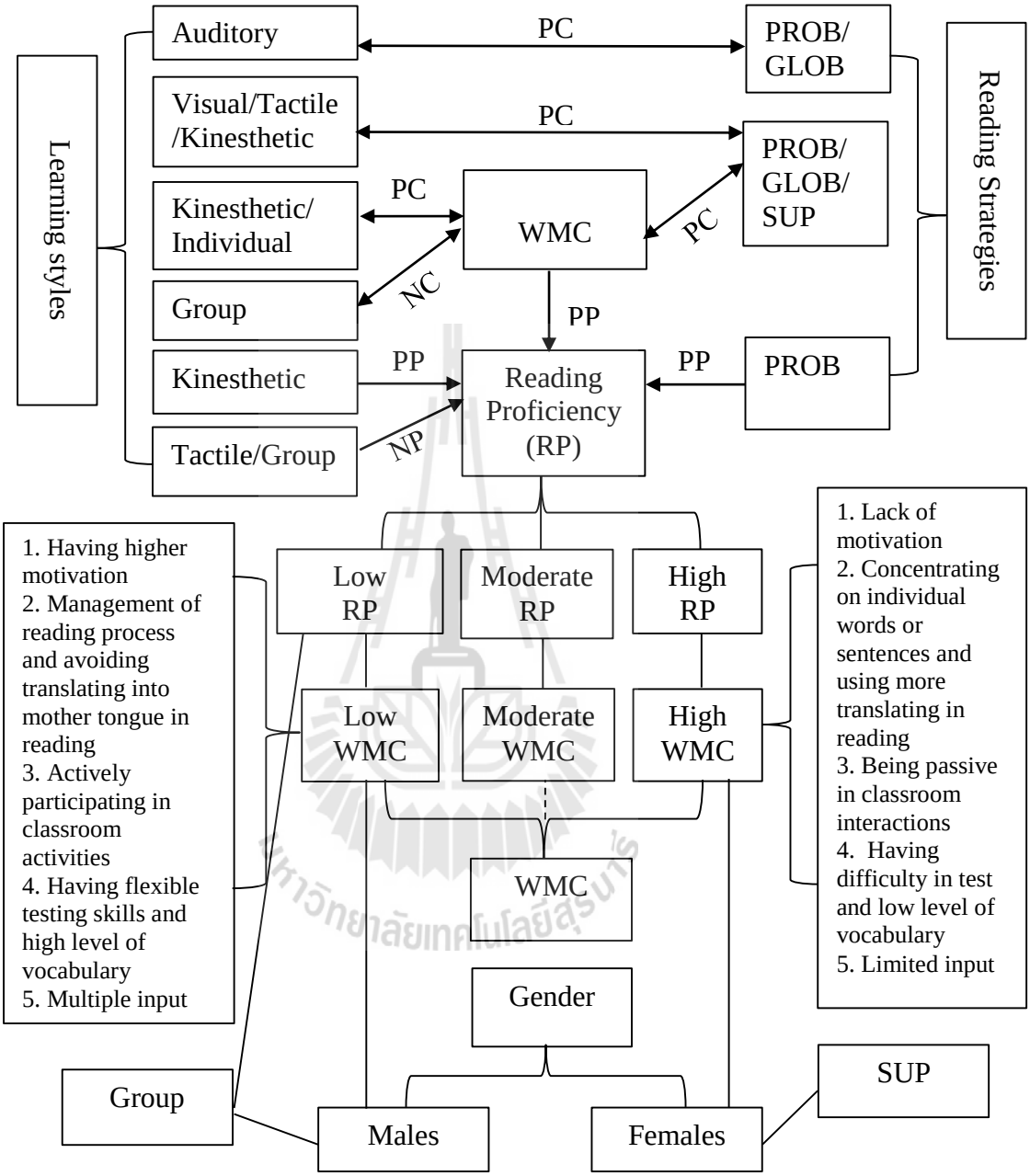

Figure 6.1 A Model for Working Memory/Learning Styles/Reading Strategies and Reading Proficiency

6.3 Pedagogic Implications

The present study attempted to explore the relations between working memory, learning styles, reading strategy use, and reading performance. Results from this study provide implications for both reading/language learning and instruction.

1. Developing working memory. The results of the present study indicate that the high English reading proficiency group had higher working memory capacity and working memory was a significant predictor of reading performance. This provides evidence that learners can promote their reading proficiency by developing their WMC.

As reviewed in **2.3.1.8**, some approaches have been introduced and testified to improve WMC, such as AIT (auditory integration training) (Ryan, 2014), teaching memory strategies including information chunks (Turley-Ames & Whitfield, 2003; Yohman et al., 1988, , cited in Yuan et al., 2006), training executive control processes (Linck et al., 2014), and using computer-based programs (Melby-Lervåg & Hulme, 2013).

Compared with using technologies, teaching memory strategies is convenient and practical in classroom. In teaching reading, teachers should emphasize memory strategies such as rehearsal and chunking techniques, and guide their students to develop the ability of doing them. Meanwhile, students should pay attention to chunks in the reading material and practice to develop these techniques. For example, the practicing of chunking can follow such a procedure of five steps below as shown in Figure 6.2 (cf. Facing History and Ourselves, https://www.facinghistory.org/resource-library/teaching-strategies/chunking):

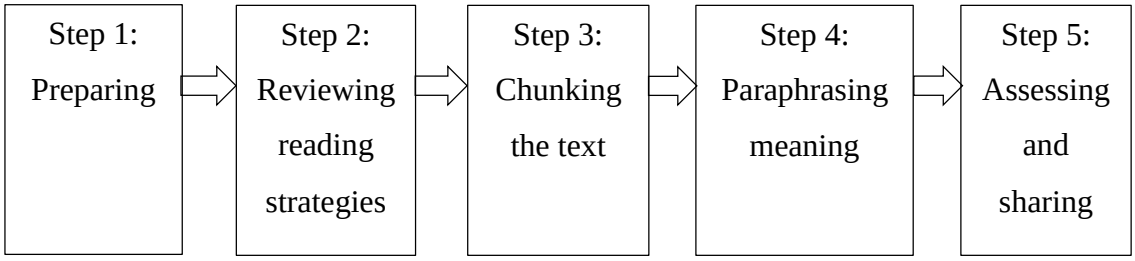

Figure 6.2 A Flowchart for Developing Chunking

Step 1: Preparing. A paragraph can be chunked into phrases and sentences, while a reading of several pages can be chunked into paragraphs or sections. Teachers can prepare chunks in graphics in advance to help students record information about each chunk in a graphic organizer.

Step 2: Reviewing reading strategies. Before asking students to paraphrase the text, teachers can review the specific decoding strategies to remind them by posting on the board, such as: to circle unfamiliar words, define by using context clues, look up the meaning of new words, write synonyms for these new words in the text, underline important proper name such as places and people and identify, read aloud and, read several times.

Step 3: Chunking the text. This step is to split the text into smaller sections. At first, teachers can demonstrate how to chunk the text to set an example for the students. If students acquire the strategies, they can work either in a group or alone to practice chunking the text.

Step 4: Paraphrasing meaning. Students are required to rewrite "chunks" in their own words. They should have a paraphrased version of the original text in the end.

Step 5: Assessing and sharing. Teachers can use the paraphrased text to evaluate students' understanding and reading ability. Students can compare their versions of the

text with each other, and they can share ideas through discussion.

The above discussed five steps of chunking are the basic approaches to developing chunking technique in order to improve working memory capacity in reading a text. Of course, teachers can make some variations according to the task, text or students' situations.

2. Raising awareness of learning styles. Research on learning styles provides teachers with an understanding of students and how they learn (Wintergerst & DeCapua, 2001). Some instructional implications can be generated from the results of the current study.

First, the knowledge of learning styles can help educators and trainers to develop curricula and address individual learning needs (Khatib & Ghosheh, 2013). Carbo (1984) asserted that one of the most promising solutions to raising reading achievement levels is the use of learning style diagnosis and prescription in designing reading programs. Kinsella (1995) held it not only essential for teachers to have a practical understanding of learning styles, but also important for students to be aware of their own strengths and weaknesses in learning. And the awareness of these is possible for students to develop a more versatile approach to learning in and out of classrooms. Rossi-Le (1995) suggested that language learners should be aware of their perceptual style dominance and their strategic approaches to learning, and that learners take the PLSPQ inventory to get to know their strengths and weaknesses in learning so as to be able to reflect on their learning processes. Peacock (2001) suggested that EFL teachers should teach in a balanced style in order to accommodate different learning styles. Furthermore, it is suggested that instructors understand their own teaching styles to develop flexible and varied approaches to instruction. Nel (2008) provided detailed

suggestions for teachers in instructional planning and preparation that a variety of language learning tasks should be included so as to allow learners with different styles to do well. Materials should be selected from a variety of sources, since different students with different interests may respond favorably to different stimuli.

Second, the findings of the current study shed light on the instructions of foreign language reading. According to Reid (1984), being involved physically in classroom experiences and actively participating in activities is suitable for kinesthetic learners. Therefore, in a reading class where most learners are kinesthetic, instructors can keep them actively involved in classroom activities by providing opportunities for them to practice, for example, assigning role-play tasks of what is (or is going to be) learned or asking them to put information on cards to assist understanding.

Third, from the findings of the present study, it is also suggested that instructors take into consideration gender differences and English reading proficiency levels when designing reading activities so as to better accommodate students' multiple learning styles. For example, tasks that are designed for female students might provide more opportunities for them to participate in group work. In the same vein, low English reading proficiency students might be encouraged to join in collaborative activities with their high proficiency peers. Peacock (2001) suggested that teachers can reduce learner resistance to studying in groups by arranging group activities that are appropriate for them, explaining the rationale and benefits behind them, monitoring students as they work, and paying attention to feedback from groups after the activity.

All in all, recognition of learning styles enables both learners and educators to understand how to learn and teach more effectively. By consciously exerting their strongly preferred learning styles and avoiding their disfavored styles, learners may

perform better. However, it seems appropriate to encourage learners to develop a range of style modalities so as to become more flexible and versatile and, thus, evolve the ability to adjust to a greater range of learning activities.

3. Training reading strategies. The results of this study show that Problem solving strategies was a significant predictor of reading performance. As mentioned previously, PROB are the actions and procedures that readers use while working directly with the text, e.g., adjusting the speed of reading when the material becomes difficult or easy, guessing the meaning of unknown words, and rereading the text to improve comprehension. This result provides implications for EFL instructors to train effective reading strategies. Reading strategy training can lead to better achievements in reading comprehension (Kamran, 2013). During training, teachers can integrate explicit instruction of reading strategies into lectures through a variety of activities. To achieve this, teachers can embed the following five features in the course curriculum: 1) explicitly discussing what reading strategies are, where, when, and how to use them; 2) teacher modeling strategic reading behavior; 3) students reading and thinking aloud to practice targeted strategies; 4) classroom discussion; and 5) adopting a sustained area of content for the course (Janzen, 2001, cited in Anderson, 2003).

Aside from the training of the specific Problem solving strategies, the awareness of the strategies should be emphasized as well. Sheorey and Mokhtari (2001) held that metacognitive reading strategies teaching should be included in the overall reading curriculum so as to increase students' metacognition about reading. In doing so, students can not only promote an increased awareness of the mental processes involved in reading but also develop "thoughtful and constructively responsive reading" (p. 446). Such training of useful strategies will attribute to their academic reading and academic achievement as well.

4. Paying attention to motivation, vocabulary and FL input. The findings from the interviews indicate that high- and low WMC students distinguished from each other in some aspects as motivation, vocabulary and English input.

Although the current study focused on individual differences of working memory, learning styles and reading strategies, and yielded interesting outcomes out of them, other individual learner factors (e.g., motivation, and one of its cognitive components—self-confidence) were also found contributing to the results. Specifically, students with low WMC were found to be short of motivation compared with those with high WMC. Motivation is considered as one of the major determining factors of L2/FL learning accomplishment (Dörnyei, 1994), it is thus important to motivate students in learning English. It is suggested that teachers guide students to find out the interest of learning English and stimulate their intrinsic motivation. Dörnyei (1994) provided some methods for teachers to develop students' motivation: teachers can help students value English learning as a meaningful experience that yields satisfaction and enriches life, teachers can share their personal interest in English (learning) with their students, and raise task interest by connecting the task with things that students already find interesting. Besides, to help students develop their self-confidence, as suggested by Dörnyei (1994), teachers can express trust and belief that students will accomplish their goals, teachers can deliver praise and encouragement regularly, teachers ensure that students experience regular success and a sense of achievement, and teachers can help students remove uncertainties of competence by giving positive examples, reduce frustration by providing students with more favorable, less tough activities, and assign confidence-building tasks, etc.

Vocabulary is a headache for many FL learners, and some students with low WMC failing to spell some words correctly proved this point. Unlike an output process of writing which requires accurate spelling of words, reading is a process of input that sometimes a vague memory of some words does not hurt the comprehension. In some cases, one can still understand reading materials without knowing the exact form of a word or only knowing its approximate form. However, a word consists of both the meaning and the form, which are of equal importance. Some students see English learning as vocabulary remembering on which they spend much time. They all agree that recalling the meaning of a word is more difficult than recalling its form, so they tend to ignore the forms of the words. To avoid misspelling words, students should pay more attention to word formation. Teachers can take some measures to urge students to remember the form of words by dictation. As far as the researcher knows, dictation is mostly used by primary and secondary school teachers to test the students' correct spelling of the words to help them lay a solid foundation of English learning. Although the focus of college English converts to developing the students' reading ability, teachers can still design tasks to check students' spelling by classroom dictation or ask them to do peer dictation.

It was found from the interviews of the present study that the students with high WMC would search for various approaches to practicing English, such as watching English movies, listening to English songs, reading English novels, reading English newspapers, playing games, or joining in English competitions. As is well acknowledged that foreign language acquisition cannot be achieved without large input, but that input should be comprehensible. According to Krashen's (1982) "Input Hypothesis", the acquisition is obtained by understanding language that contains

structure a little beyond the acquirer's current level of competence (*i + 1*; "*i*" stands for the acquirer's current stage of linguistic competence, while "*1*" means one step beyond current competence). Krashen (1982) suggests that the classroom may be a better place than the outside world for L2 acquisition, at least up to the "intermediate" level (p. 30), because it can provide more comprehensible input; therefore, he advise teachers to provide comprehensible input an hour a day in classroom for the beginners. However, due to the limited class time, apart from what is gained from the teachers, students should take responsibility for their own learning by approaching to multiple inputs. Although English is treated as a foreign language in China, where there is insufficient environment to use it, students can still find extra materials out of their course requirements that are suitable for their own levels and seek chances to get accesses to English.

6.4 Limitations of the Study

Although this study yielded some valuable insights into EFL language learners' individual differences, it does not go without some limitations.

Firstly, among the various measures of working memory, learning styles, and reading strategies, this study only selected a single instrument for each variable. In addition, as a mixed-method design, it only used semi-structured interviews to elicit qualitative data. However, no instrument is perfect. Therefore, inevitably, the results generated form these instruments may not always be identical to those elicited from other instruments.

Secondly, the sample was confined to first-year non-English majors in a university of finance and economics in China due to convenience sampling, excluding

learners at other tertiary levels which could provide valuable information. Apart from that, the participant scale of sample size was not big enough to reflect the nature of the entire population of Chinese undergraduate EFL students. Thus, generalization of the results to all Chinese EFL learners should be treated with caution.

Thirdly, this study used the reading comprehension part of a retired CET-4 to determine the participants' levels of English reading proficiency. Nevertheless, students' real proficiency is hardly likely to be reflected in a single test.

Finally, in response to the research questions, the investigation was conducted at a certain point in time as the study was synchronic by nature. However, learners' reading proficiency and working memory capacity may change with time, and their reading strategy use or even learning style preferences may vary accordingly. Therefore, the data obtained from the same participants in this instance might show a difference from those collected at another time.

6.5 Recommendations for Future Research

In spite of the aforementioned limitations, this study still achieved its aims successfully, based on which some recommendations for further research can be made.

Firstly, future studies may consider using multiple instruments with high validity and reliability to create more opportunities of cross-checking the results. Moreover, other qualitative data collecting instruments such as think-aloud protocol and journals can be included in the instrument package to provide more insights into the issue explored.

Secondly, although the results of the present study were effective on the basis of its sample pool, a large scale investigation representing diverse populations is

recommended for further research. Such work could add more supportive evidence to the results.

Thirdly, further research should take into consideration integrating several reading proficiency tests to divide students according to their English reading levels. Such testing methods could yield more reliable results.

Finally, future studies might as well consider carrying out a longitudinal design to allow tracing the same learners at different periods. Learners' outcomes and changes during this time may provide valuable evidence for them to develop their reading proficiency by training on the useful individual factors.

In summary, this study has shed some new light on the area of individual differences in L2/FL learning. It should be acknowledged that the study is a preliminary attempt on working memory, learning styles and reading strategies, the relationships between them could not be exhausted in a single study due to their complexity. Therefore, further research related to this research field may yield more effective and valuable findings to gradually unveil L2/FL learning so as to offer suggestions to language teachers and learners.

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APPENDICES

APPENDIX A

A-1 The Working Memory Capacity Test (WMCT)

The stimulus sentences for the working memory reading span task (for Pre-test):

1. The prize won the mirror.
2. Service is included in your bill.
3. She got the idea from an article.
4. The wood is made of floor.
5. The lake has huge economic problems.
6. Private automobiles are not allowed on campus.
7. The leaders worked out a peace plan.
8. The cap carefully takes care of the safety.
9. Eyeglasses help to better listen to the sound.
10. The children were collecting shells on the beach.
11. You should pay attention to the warning signs.
12. This team has a good meaning of chance.
13. The dinner sat down and dialed a number.
14. He will probably wait until the last minute.
15. It was a sunny day in early spring.
16. Despite all our games we lost the effort.
17. Employees must show their identity cards at the gate.
18. I keep a careful pressure on my blood check.
19. There was such a sad look in his mouth.
20. Business graduates have a good record in finding jobs.

The stimulus sentences for the working memory reading span task (for Main test):

1. This film brings back memories.
2. The eggs laid three horses.
3. Dogs always bark at strangers.
4. September is biting the kitty.
5. The ocean is throwing stones.
6. We benefit from daily exercises.
7. The bus landed the pilot.
8. They decorated the old bridge.
9. We accidentally broke the radio.
10. My mother kills the soup.
11. French has learnt my uncle.
12. The housewife is baking the spoon.
13. The plants benefited from the rain.
14. Jane blew out the birthday candle.
15. The ice-cream stood on a plane.
16. The police have blocked the road.
17. The scientists discovered a new star.
18. The newspaper writes the new editor.
19. The hospital could find my keys.
20. The soil has buried a bone.
21. My sister found a model ship.
22. The banana will cancel the party.

23. They sometimes go to the market.

24. The sofa jumped on his nose.

25. His shirt laughed at the visitor.

26. His shoes gave him an office.

27. She lost her dictionary last week.

28. Bus pushed them into the garden.

29. The nurse gave him some medicine.

30. My aunt bargained with the trader.

31. The children eat biscuits and cakes.

32. The mountains often climb our neighbor.

33. Tall trees blinded our downstairs windows.

34. A wild animal pursued a hunter.

35. David angrily scolded the naughty pupil.

36. The theater quarreled with many events.

37. She usually sings an English song.

38. The girl bit into the apple.

39. The fish may follow public opinion.

40. Several stamps brought me some salad.

41. The manager closed the international company.

42. The young mother is feeding the board.

43. The jacket doesn't believe in the bull.

44. I spoke with him on the phone.

45. The furniture boasted of his new pet.

46. The magazines burnt up his favorite story.

47. He wrote a letter from his country.

48. The football kicks the man with force.

49. He felt a hand on his shoulder.

50. The black bike is watching a picture.

51. The basket couldn't bear your hot temper.

52. The engineer is designing a computer program.

53. There are many pages flying the kite.

54. The young professor brightened up my life.

55. He heard footsteps coming up the stair.

56. We received a big and heavy parcel.

57. The pollution cleaned the city with noise.

58. Tomorrow we shall visit the car factory.

59. The lamp has already tasted its dinner.

60. The woman built a strong stone wall.

61. The colorful balloon pushed a little mouse.

62. I effectively and successfully finished the task.

63. The table developed several new housing projects.

64. The chairman declared the result of election.

65. The food is cooked over an open flame.

66. He is sitting at the door begging money.

67. The yellow flower is operating a machine.

68. Many buildings broke into the jewelry shop.

69. Both Tom and his bother resemble their father.

70. It might have been a very sad accident.

71. The meat cut off a piece of knife.

72. Most of the pillows like eating the candies.

73. It was difficult to calm down the fans.

74. I thought he was going to shake hands.

75. The medal happily gave him to the principal.

76. He took a notebook out of his pocket.

77. The river crossed the soldier to the army.

78. Library is one of my classmates in college.

79. Some people are unwilling to correct their mistakes.

80. The meal is laughing at all the world.

81. These pipes are used to carry waste water.

82. Several experts are doing research on the disease.

83. The restaurant will soon finish its college universitycourse. studies

84. I shall meet you at the railway stationplatform.

85. My brother burned the rug with a cigarette.

86. The teacher entered the classroom with a smile.

87. The painting will open up a new museum.

88. The sun is the center of our solar system.

89. The proud coat has eaten up all the chicken.

90. A lot of students failed to pass the exam.

91. A group of clothes are walking across the street.

92. They ran all the way to catch the train.

93. The chairman is at the center of the hall.

94. The truck stopped the driver at a gas station.

95. One of these beautiful classes wants to drink milk.

96. The map showed her the headmaster of the school.

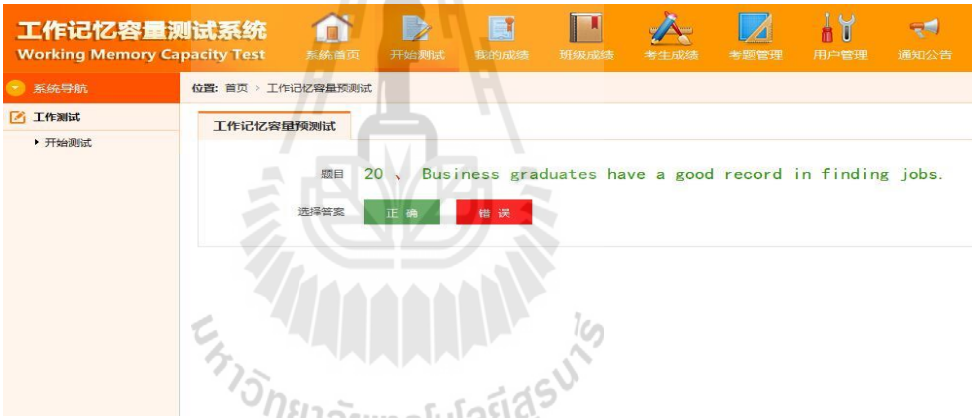
97. It’s brave of her to fight against the thief.

98. Last night the TV next door bothered my feet.

99. The ground is usually covered with leaves and grass.

100. Mrs. White gave birth to a fine healthy baby.

A-2 Samples of the Internet-presented Working Memory Capacity Test (WMCT)



APPENDIX B

Perceptual Learning Style Preference Questionnaire (PLSPQ)

and Survey of Reading Strategies (SORS)

Directions:

Please read each statement or item of the questionnaires carefully, then fill in the blanks or put a "√" in proper spaces. It is important to answer in terms of how well each statement describes you, NOT in terms of what you think you should do, or what other people do. THIS IS NOT A TEST. There is no right or wrong responses to these statements. The score you obtain will not affect any of your academic grades. The results will be used ONLY for research purpose, and your information will be kept confidential.

SECTION 1: Individual Background Inforamtion

Instruction: Please respond to the background information by filling in the blanks or marking the appropriate answer in □.

Major: _____ Name: _____

Student code: _____ Age: _____

Gender: □ Male □ Female

How many years have you studied English? _____years

What was your English score in the previous final-term exam? _____

SECTION 2: Perceptual Learning Style Preference Questionnaire (PLSPQ) and Survey of Reading Strategies (SORS)

B-1 Perceptual Learning Style Preference Questionnaire (PLSPQ)

This questionnaire has been designed to help you identify the way(s) you learn best – the way(s) you prefer to learn. Please respond to the statement AS THEY APPLY TO YOUR STUDY OF ENGLISH. Decide whether you agree or disagree with each statement. Please respond to each statement quickly, without too much thought. Try not to change your responses after you choose them. Please answer all the questions. Please put a "√" to mark your choices.

1 means "Strongly Disagree",

2 means "Disagree",

3 means "Undecided",

4 means "Agree", and

5 means "Strongly Agree".

Perceptual Learning Style Preference Questionnaire (PLSPQ)

Statements	SD	D	U	A	SA
	1	2	3	4	5
1. When the teacher tells me the instructions I understand better.					
2. I prefer to learn by doing something in class.					
3. I get more work done when I work with others.					
4. I learn more when I study with a group.					
5. In class, I learn best when I work with others.					
6. I learn better by reading what the teacher writes on the chalkboard.					
7. When someone tells me how to do something in class, I learn it better.					
8. When I do things in class, I learn better.					
9. I remember things I have heard in class better than things I have read.					
10. When I read instructions, I remember them better.					
11. I learn more when I can make a model of something.					
12. I understand better when I read instructions.					
13. When I study alone, I remember things better.					
14. I learn more when I make something for a class project.					
15. I enjoy learning in class by doing experiments.					
16. I learn better when I make drawings as I study.					
17. I learn better in class when the teacher gives a lecture.					
18. When I work alone, I learn better.					

19. I understand things better in class when I participate in role-playing.					
20. I learn better in class when I listen to someone.					
21. I enjoy working on an assignment with two or three classmates.					
22. When I build something, I remember what I have learned better.					
23. I prefer to study with others.					
24. I learn better by reading than by listening to someone.					
25. I enjoy making something for a class project.					
26. I learn best in class when I can participate in related activities.					
27. In class, I work better when I work alone.					
28. I prefer working on projects by myself.					
29. I learn more by reading textbooks than by listening to lectures.					
30. I prefer to work by myself.					

Self-Scoring Sheet

VISUAL

6 - _____

10 - _____

12 - _____

24 - _____

29 - _____

Total_____ x 2 = _____(Score)

TACTILE

11 - _____

14 - _____

16 - _____

22 - _____

25 - _____

Total_____ x 2 = _____(Score)

AUDITORY

1 - _____

7 - _____

9 - _____

17 - _____

20 - _____

Total_____ x 2 = _____(Score)

GROUP

3 - _____

4 - _____

5 - _____

21 - _____

23 - _____

Total_____ x 2 = _____(Score)

KINESTHETIC

2 - _____

8 - _____

15 - _____

19 - _____

26 - _____

Total_____ x 2 = _____(Score)

INDIVIDUAL

13 - _____

18 - _____

27 - _____

28 - _____

30 - _____

Total_____ x 2 = _____(Score)

Major Learning Style Preference	38-50
Minor Learning Style Preference	25-37
Negligible	0-24

B-2 Survey of Reading Strategies (SORS)

The purpose of this survey is to collect information about the various strategies you use when you read **school-related academic materials in ENGLISH** (e.g., reading textbooks for homework or examinations; reading journal articles, etc.). Each statement is followed by five numbers, 1, 2, 3, 4, and 5, and each number means the following:

‘1’ means that ‘I never or almost never do this’.

‘2’ means that ‘I do this only occasionally’.

‘3’ means that ‘I sometimes do this’. (About 50% of the time.)

‘4’ means that ‘I usually do this’.

‘5’ means that ‘I always or almost always do this’.

After reading each statement, circle the number (1, 2, 3, 4, or 5) which applies to you. Note that there are no right or wrong responses to any of the items on this survey.

Survey of Reading Strategies (SORS)

Statements	Never or almost never	Occasionally	Sometimes	Usually	Always or almost Always
	1	2	3	4	5
1. I have a purpose in mind when I read.					
2. I take notes while reading to help me understand what I read.					
3. I think about what I know to help me understand what I read.					
4. I take an overall view of the text to see what it is about before reading it.					
5. When text becomes difficult, I read aloud to help me understand what I read.					
6. I think about whether the content of the text fits my reading purpose.					
7. I read slowly and carefully to make sure I understand what I am reading.					
8. I review the text first by noting its characteristics like length and organization.					
9. I try to get back on track when I lose concentration.					
10. I underline or circle information in the text to help me remember it.					
11. I adjust my reading speed according to what I am reading.					

12. When reading, I decide what to read closely and what to ignore.					
13. I use reference materials (e.g. a dictionary) to help me understand what I read.					
14. When text becomes difficult, I pay closer attention to what I am reading.					
15. I use tables, figures, and pictures in text to increase my understanding.					
16. I stop from time to time and think about what I am reading.					
17. I use context clues to help me better understand what I am reading.					
18. I paraphrase (restate ideas in my own words) to better understand what I read.					
19. I try to picture or visualize information to help remember what I read.					
20. I use typographical features like bold face and italics to identify key information.					
21. I critically analyze and evaluate the information presented in the text.					
22. I go back and forth in the text to find relationships among ideas in it.					
23. I check my understanding when I come across new information.					
24. I try to guess what the content of the text is about when I read.					
25. When text becomes difficult, I re-read it to increase my understanding.					
26. I ask myself questions I like to have answered in the text.					

27. I check to see if my guesses about the text are right or wrong.					
28. When I read, I guess the meaning of unknown words or phrases.					
29. When reading, I translate from English into my native language.					
30. When reading, I think about information in both English and my mother tongue.					

Global Reading Strategies (GLOB Subscale)	**Problem Solving Strategies (PROB Subscale)**	**Support Reading Strategies (SUP Subscale)**	**Overall Reading Strategies (ORS)**
1. _____ **3. _____** **4. _____** **6. _____** **8. _____** **12. _____** **15. _____** **17. _____** **20. _____** **21. _____** **23. _____** **24. _____** **27. _____**	**7. _____** **9. _____** **11. _____** **14. _____** **16. _____** **19. _____** **25. _____** **28. _____**	**2. _____** **5. _____** **10. _____** **13. _____** **18. _____** **22. _____** **26. _____** **29. _____** **30. _____**	**GLOB _____** **PROB _____** **SUP _____**
_____GLOB Score/13 ____ GLOB Average	____PROB Score/8 _____ PROB Average	____SUP Score/9 _____ SUP Average	____ Overall Score/30 ___ Overall average

KEY TO AVERAGES: 3.5 or higher = High; 2.5 – 3.4 = Medium; 2.4 or lower = Low

B-3 Perceptual Learning Style Preference Questionnaire (PLSPQ) and Survey of Reading Strategies (SORS) (Chinese version)

感知学习风格偏好调查问卷、阅读策略调查问卷

亲爱的同学：我们正在进行一项英语学习的研究，希望你能提供一些宝贵建议。请仔细阅读下面的问题，并在空白处填写或勾选相应的数字。请选择最适合你的情况，而不是你认为应该那样去做，或别人那样做过。本问卷不是考试，答案没有对错之分。得分不会影响你的任何学业成绩。你的信息会绝对保密，调查的结果只用于科研。多谢合作！

一、个人背景信息（请填写或勾选）

班级：_____ 姓名：_____ 学号：_____

性别： □男 □女 年龄：_____

你学习英语多少年了？_____ 年 你上次期末考试的英语成绩：_____

二、感知学习风格偏好调查问卷

本问卷的设计主要是帮助你找到最佳学习方式，即你喜欢的学习方式。请阅读以下各项，以你英语学习中的**实际情况**进行选择，不是你想象的应该怎样做。请对每一句尽快作答，不要经过太多思考。选好后尽量不要改变。请圈出适合你的选项。

1 = 完全不同意 2 = 不同意 3 = 不确定 4 = 同意 5 = 完全同意

	完全不同意	不同意	不确定	同意	完全同意
1.老师告诉我一些指导时，我会更容易明白。	1	2	3	4	5
2. 我更喜欢通过在课堂上做点事情来学习。	1	2	3	4	5
3. 我与别人合作时，完成的事情会更多。	1	2	3	4	5
4. 小组学习能让我学得更多。	1	2	3	4	5
5. 在课堂上，我与其他同学合作时可以学得最好。	1	2	3	4	5
6. 看老师写在黑板上(或打字在屏幕上)，我会学得更好。	1	2	3	4	5
7.当其他人告诉我怎样在课堂上做时，我会学得更好。	1	2	3	4	5
8.当我在课堂上做点什么时，会学得更好。	1	2	3	4	5
9. 与我课堂上阅读过的东西相比，我更能记住在课堂上听过的东西。	1	2	3	4	5
10. 当我阅读一些指示（指引）时，会记得更好。	1	2	3	4	5
11. 如果我能制作某些东西的模型，我会学得更多。	1	2	3	4	5
12. 当我阅读了指示（指引）时，会理解得较好。	1	2	3	4	5
13. 我独自学习时，记忆得更好。	1	2	3	4	5
14. 当我为课堂活动项目制作些东西时，会学得更多。	1	2	3	4	5
15. 我喜欢通过在课堂上做实验来学习。	1	2	3	4	5
16. 我学习时画些东西可以学得更好。	1	2	3	4	5
17. 老师在课堂上讲授，我会学得更好。	1	2	3	4	5
18. 我独自工作时，会学得更好。	1	2	3	4	5
19. 我在课堂上参与角色扮演时，会理解得更好。	1	2	3	4	5
20.在课堂上听别人发言，我会学得更好。	1	2	3	4	5
21. 我喜欢与两三个同学合作一项老师布置的作业。	1	2	3	4	5
22.当我制作某些东西时，我对学过的东西记得较牢。	1	2	3	4	5

23. 我更喜欢与其他人一起学习。	1	2	3	4	5
24. 我自己阅读比听别人讲学得更好。	1	2	3	4	5
25. 我喜欢为课堂活动项目制作一些东西。	1	2	3	4	5
26.在课堂上我若能参与有关的活动，会学得最好。	1	2	3	4	5
27. 在课堂上，我独自工作会做得更好。	1	2	3	4	5
28. 我更喜欢独自从事课堂活动项目。	1	2	3	4	5
29. 我阅读课本比听老师讲授学得更多。	1	2	3	4	5
30. 我更喜欢独自做事。	1	2	3	4	5

三、阅读策略调查问卷

本调查问卷的目的是收集你在阅读与学校有关的英语学术材料时所使用策略的情况（例如，为了做家庭作业或考试而阅读课本，阅读期刊文章，等等）。每个句子后面有 5 个数字，它们所代表的意思是：

1 = 我从不或几乎从不这样做

2 = 我偶尔这样做

3 = 我有时这样做（大概一半的几率会这样做）

4 = 我经常这样做

5 = 我总是或几乎总是这样做

阅读每句后，请圈出**与你的实际情况相符**的一个数字。请注意任何题项的答案均没有对错之分。

	从不或几乎从不	**偶尔**	**有时**	**经常**	**总是或几乎总是**
1. 我会带着目的阅读。	1	2	3	4	5
2. 我阅读的时候做笔记来帮助理解。	1	2	3	4	5
3. 我通过思考已知的东西来帮助理解阅读的内容。	1	2	3	4	5

4. 在阅读之前，我通览全文来看看文章是关于什么的。	1	2	3	4	5
5. 当文章变难的时候，我读出声来帮助理解阅读的内容。	1	2	3	4	5
6. 我思考文章的内容是否符合我的阅读目的。	1	2	3	4	5
7. 我慢慢地仔细地阅读以确保理解所读内容。	1	2	3	4	5
8. 我首先通过留意文章的特征，如长度和结构，来检查文章。	1	2	3	4	5
9. 当我注意力不集中的时候，会努力回到正轨重新看。	1	2	3	4	5
10. 我在文章的信息下面画线或圈出信息来帮助记忆。	1	2	3	4	5
11. 我根据所读的东西来调整阅读速度。	1	2	3	4	5
12. 阅读时，我能判定哪些要仔细读哪些可以忽略。	1	2	3	4	5
13. 我使用参考资料（比如词典）来帮助理解阅读的东西。	1	2	3	4	5
14. 当文章变难时，我对正在阅读的东西会更加全神贯注。	1	2	3	4	5
15. 我利用文章中的表格、图形和图片来增加理解。	1	2	3	4	5
16. 我在阅读时随时停下来思考正在读的东西。	1	2	3	4	5
17. 我利用上下文的线索来帮助自己更好地理解阅读的东西。	1	2	3	4	5
18. 我通过解释（用自己的话复述文中的观点）来更好地理解阅读的东西。	1	2	3	4	5
19. 我尽量通过在头脑中描绘或想象一些情况来帮助自己记住所阅读的东西。	1	2	3	4	5
20. 我利用像粗体及斜体这样的印刷上的特征来识别关键信息。	1	2	3	4	5
21. 我对文章中提供的信息进行批判性分析及评价。	1	2	3	4	5

22. 我来回翻看课文来找出文中各观点之间的关系。	1	2	3	4	5
23. 当碰到新信息的时候，我会检查自己的理解。	1	2	3	4	5
24. 我阅读时尽量猜测课文是关于什么内容的。	1	2	3	4	5
25.当课文变难时，我重新阅读来增加理解。	1	2	3	4	5
26. 我问课文中自己喜欢回答的问题。	1	2	3	4	5
27. 我检查自己对课文的猜测是否正确。	1	2	3	4	5
28. 在阅读时，我猜测不认识的词或短语的意思。	1	2	3	4	5
29. 在阅读时，我会把英语翻译成母语。	1	2	3	4	5
30. 在阅读时，我用英语和母语思考。	1	2	3	4	5

还有你用过但在问卷中没有被列出的英语阅读策略吗？如果有，请列举出来：_____

APPENDIX C

Reading Comprehension Test (RCT)

Part IV Reading Comprehension (Reading in Depth) (60 minutes)

Section A

Directions: In this section, there is a passage with ten blanks. You are required to select one word for each blank from a list of choices given in a word bank following the passage. Reading the passage through carefully before making your choices. Each choice in the bank is identified by a letter. Please mark the corresponding letter for each item on Answer Sheet 2 with a single line through the centre. You may not use any of the words in the bank more than once.

Passage One: Questions 1 to 10 are based on the following passage.

Some years ago I was offered a writing assignment that would require three months of travel through Europe. I had been abroad a couple of times, but I could hardly 1 to know my way around the continent. Moreover, my knowledge of foreign languages was 2 to a little college French.

I hesitated. How would I, unable to speak the language, 3 unfamiliar with local geography or transportation systems, set up 4 and do research? It seemed impossible, and with considerable 5 I sat down to write a letter begging off. Halfway through, a thought can through my mind: *you can learn if you don't try*. So I accepted the assignment.

There were some bad 6 . But by the time I had finished the trip I was an experienced traveler. And ever since, I have never hesitated to head for even the most remote of places, without guiders or even 7 bookings, confident that somehow I will manage.

The point is that the new, the different, is almost by definition 8 . But each time you try something, you learn, and as the learning piles up, the world opens to you.

I've learned to ski at 40, and flown up the Rhine River in a 9 . And I know I'll

go on doing such things. It's not because I'm braver or more daring than others. I'm not. But I'll accept anxiety as another name for challenge and I believe I can__10__ wonders.

A) accomplish	B) advanced	C) balloon	D) claim	E) constantly
F) declare	G) interviews	H) limited	I) manufacture	J) moments
K) news	L) reduced	M) regret	N) scary	O) totally

Passage Two: Questions 11 to 20 are based on the following passage.

A bookless life is an incomplete life. Books influence the depth and breadth of life. They meet the natural__11__for freedom, for expression, for creativity and beauty of life. Learners, therefore, must have books, and the right type of book, for the satisfaction of their need. Readers turn__12__to books because their curiosity concerning all manners of things, their eagerness to share in the experiences of others and their need to__13__from their own limited environment lead them to find in books food for the mind and the spirit. Through their reading they find a deeper significance to life as books acquaint them with life in the world as it was and it is now. They are presented with a__14__of human experiences and come to__15__other ways of thought and living. And while__16__their own relationships and responses to life , the readers often find that the__17__in their stories are going through similar adjustments, which help to clarify and give significance to their own.

Books provide__18__material for readers' imagination to grow. Imagination is a valuable quality and a motivating power, and stimulates achievement. While enriching their imagination, books__19__their outlook, develop a fact-finding attitude and train them to use leisure__20__. The social and educational significance of the readers' books cannot be overestimated in an academic library.

A) Abundant	B) Characters	C) Communicating	D) Completely	E) Derive
F) Desire	G) Diversity	H) Escape	I) Establishing	J) Narrow
K) Naturally	L) Personnel	M) Properly	N) Respect	O) Widen

Section B

Directions: There are 4 passages in this section. Each passage is followed by some questions or unfinished statements. For each of them there are four choices marked [A], [B], [C] and [D]. You should decide on the best choice and mark the corresponding letter on Answer Sheet 2 with a single line through the centre.

Passage Three: Questions 21 to 25 are based on the following passage.

Global warming may or may not be the great environmental crisis of the 21st century, but regardless of whether it is or isn't –we won't do much about it. We will argue over it and may even, as a nation, make some fairly solemn-sounding commitments to avoid it. But the more dramatic and meaningful these commitments seem, the less likely they are to be observed.

Al Gore calls global warming an "inconvenient truth," as if merely recognizing it could put us on a path to a solution. But the real truth is that we don't know enough to relieve global warming, and –without major technological breakthroughs—we can't do much about it.

From 2003 to 2050, the world's population is projected to grow from 6.4 billion to 9.1 billion, a 42% increase. If energy use per person and technology remain the same, total energy use and greenhouse gas emissions (mainly, CO2) will be 42% higher in 2050. but that's too low, because societies that grow richer use more energy. We need economic growth unless we condemn the world's poor to their present poverty and freeze everyone else's living standards. With modest growth, energy use and greenhouse emissions more than double by 2050.

No government will adopt rigid restrictions on economic growth and personal freedom (limits on electricity usage, driving and travel) that might cut back global warming. Still, politicians want to show they're "doing something." Consider the *Kyoto Protocol* (京都议定书). It allowed countries that joined to punish those that didn't. But it hasn't reduced CO2 emissions (up about 25% since 1990), and many *signatories* (签字国) didn't adopt tough enough policies to hit their 2008-2012 targets.

The practical conclusion is that if global warming is a potential disaster, the only solution is new technology. Only an aggressive research and development program might find ways of breaking dependence on fossil fuels or dealing with it.

The trouble with the global warming debate is that it has become a moral problem when it's really an engineering one. The inconvenient truth is that if we don't solve the engineering problem, we're helpless.

21. What is said about global warming in the first paragraph?
A) It may not prove an environmental crisis at all.
B) It is an issue requiring world wide commitments.
C) Serious steps have been taken to avoid or stop it.
D) Very little will be done to bring it under control.

22. According to the author's understanding, what is Al Gore's view on global warming?
A) It is a reality both people and politicians are unaware of.
B) It is a phenomenon that causes us many inconveniences.
C) It is a problem that can be solved once it is recognized.
D) It is an area we actually have little knowledge about.

23. Green house emissions will more than double by 2050 because of _____.
A) economic growth
B) wasteful use of energy
C) the widening gap between the rich and poor
D) the rapid advances of science and technology

24. The author believes that, since the signing of the Kyoto Protocol, _____.
A) politicians have started to do something to better the situation
B) few nations have adopted real tough measures to limit energy use
C) reductions in energy consumption have greatly cut back global warming
D) international cooperation has contributed to solving environmental problems

25. What is the message the author intends to convey?
A) Global warming is more of a moral issue than a practical one.
B) The ultimate solution to global warming lies in new technology
C) The debate over global warming will lead to technological breakthroughs.
D) People have to give up certain material comforts to stop global warming.

Passage Four: Questions 26 to 30 are based on the following passage.

Someday a stranger will read your e-mail without your permission or scan the Websites you've visited. Or perhaps someone will casually glance through your credit card purchase or cell phone bills to find out your shopping preferences or calling habits.

In fact, it's likely some of these things have already happened to you. Who would watch you without your permission? It might be a spouse, a girlfriend, a marketing company, a boss, a cop or a criminal. Whoever it is, they will see you in a way you never intended to be seen — the 21st century equivalent of being caught naked.

Psychologists tell us boundaries are healthy, that it's important to reveal yourself to friends, family and lovers in stages, at appropriate times. But few boundaries remain. The digital bread *crumbs* (碎屑) you leave everywhere make it easy for strangers to reconstruct who you are, where you are and what you like. In some cases, a simple Google search can reveal what you think. Like it or not, increasingly we live in a world where you simply cannot keep a secret.

The key question is: Does that matter?

When opinion polls ask Americans about privacy, most say they are concerned about losing it. A survey found an overwhelming pessimism about privacy, with 60 percent of respondents saying they feel their privacy is "slipping away, and that bothers me."

But people say one thing and do another. Only a tiny fraction of Americans change any behaviors in an effort to preserve their privacy. Few people turn down a discount at *tollbooths* (收费站) to avoid using the EZ-Pass system that can track automobile movements. And few turn down supermarket loyalty cards. Privacy economist Alessandro Acquisti has run a series of tests that reveal people will surrender personal information like Social Security numbers just to get their hands on a pitiful 50-cents-off *coupon* (优惠券).

But privacy does matter – at least sometimes. It's like health: When you have it, you don't notice it. Only when it's gone do you wish you'd done more to protect it.

26. What does the author mean by saying “the 21st century equivalent of being caught naked ” (Lines 3-4, Para.2)?

A) People’s personal information is easily accessed without their knowledge.

B) In the 21st century people try every means to look into others’ secrets.

C) People tend to be more frank with each other in the information age.

D) Criminals are easily caught on the spot with advanced technology.

27. What would psychologists advise on the relationships between friends?

A) Friends should open their hearts to each other.

B) Friends should always be faithful to each other.

C) There should be a distance even between friends.

D) There should be fewer disputes between friends.

28. Why does the author say “we live in a world where you simply cannot keep a secret” (Line 5, Para.3)?

A) Modern society has finally evolved into an open society.

B) People leave traces around when using modern technology.

C) There are always people who are curious about others’ affairs.

D) Many search engines profit by revealing people’s identities.

29. What do most Americans do with regard to privacy protection?

A) They change behaviors that might disclose their identity.

B) They use various loyalty cards for business transactions.

C) They rely more and more on electronic devices.

D) They talk a lot but hardly do anything about it.

30. According to the passage, privacy is like health in that _____.

A) people will make every effort to keep it

B) its importance is rarely understood

C) it is something that can easily be lost

D) people don’t cherish it until they lose it

Passage Five: Questions 31 to 35 are based on the following passage.

If you are a male and you are reading this ,congratulations: you are a survivor .According to statistics .you are more than twice as likely to die of skin cancer than a woman ,and nine times more likely to die of AIDS. Assuming you make it to the end of your natural term, about 78 years for men in Australia, you will die on average five years before a woman.

There are many reasons for this-typically, men take more risks than woman and are more likely to drink and smoke but perhaps more importantly, men don't go to the doctor.

"Men aren't seeing doctors as often as they should," says Dr. Gullotta, "This is particularly so for the over-40s, when diseases tend to strike."

Gullotta says a healthy man should visit the doctor every year or two. For those over 45,it should be at least once a year.

Two months ago Gullotta saw a 50-year-old man who had delayed doing anything about his smoker's cough for a year.

"When I finally saw him it had already spread and he has since died from lung cancer" he says, "Earlier detection and treatment may not have cured him, but it would have prolonged this life"

According to a recent survey, 95%of women aged between 15 and early 40s see a doctor once a year, compared to 70% of men in the same age group.

"A lot of men think they are invincible （不可战胜的）"Gullotta says "They only come in when a friend drops dead on the golf course and they think" Geez, if it could happen to him.

Then there is the ostrich approach," some men are scared of what might be there and would rather not know," says Dr. Ross Cartmill.

"Most men get their cars serviced more regularly than they service their bodies," Cartmill says .He believes most diseases that commonly affect men could be addressed by preventive check-ups.

Regular check-ups for men would inevitably place strain on the public purse, Cartmill says." But prevention is cheaper in the long run than having to treat the diseases. Besides, the ultimate cost is far greater: it is called premature death."

31. Why does the author congratulate his male readers at the beginning of the passage?

A) They are more likely to survive serious diseases today.

B) Their average life span has been considerably extended.

C) They have lived long enough to read this article.

D) They are sure to enjoy a longer and happier live.

32. What does the author state is the most important reason men die five years earlier on average than women?

A) men drink and smoke much more than women

B) men don't seek medical care as often as women

C) men aren't as cautions as women in face of danger

D) men are more likely to suffer from fatal diseases

33. Which of the following best completes the sentence "Geez, if it could happen to him…' (Line 2, Para. 8)?

A) it could happen to me, too

B) I should avoid playing golf

C) I should consider myself lucky

D) it would be a big misfortune

34. What does Dr. Ross Cartmill mean by "the ostrich approach"(line q para.9)

A) a casual attitude towards one's health conditions

B) a new therapy for certain psychological problems

C) refusal to get medical treatment for fear of the pain involved

D) unwillingness to find out about one's disease because of fear

35. What does Cartmill say about regular check-ups for men?

A) They may increase public expenses

B) They will save money in the long run

C) They may cause psychological strains on men

D) They will enable men to live as long as women

Passage Six: Questions 36 to 40 are based on the following passage.

High-quality customer service is preached(宣扬) by many ,but actually keeping customers happy is easier said than done

Shoppers seldom complain to the manager or owner of a retail store, but instead will alert their friends, relatives, co-workers, strangers-and anyone who will listen.

Store managers are often the last to hear complaints, and often find out only when their regular customers decide t frequent their competitors, according to a study jointly conducted by Verde group and Wharton school

"Storytelling hurts retailers and entertains consumers," said Paula Courtney, President of the Verde group." the store loses the customer, but the shopper must also find a replacement."

On average, every unhappy customer will complain to at least four other, and will no longer visit the specific store for every dissatisfied customer, a store will lose up to three more due to negative reviews. The resulting "snowball effect" can be disastrous to retailers.

According to the research, shoppers who purchased clothing encountered the most problems. ranked second and third were grocery and electronics customers.

The most common complaints include filled parking lots, cluttered (塞满了的) shelves, overloaded racks, out-of-stock items, long check-out lines, and rude salespeople.

During peak shopping hours, some retailers solved the parking problems by getting moonlighting（业余兼职的）local police to work as parking attendants. Some hired flag wavers to direct customers to empty parking spaces. This guidance eliminated the need for customers to circle the parking lot endlessly, and avoided confrontation between those eyeing the same parking space.

Retailers can relieve the headaches by redesigning store layouts, pre-stocking sales items, hiring speedy and experienced cashiers, and having sales representatives on hand to answer questions.

Most importantly, salespeople should be diplomatic and polite with angry customers.

"Retailers who're responsive and friendly are more likely to smooth over issues than those who aren't so friendly." said Professor Stephen Hoch. "Maybe something as simple as a greeter at the store entrance would help."

Customers can also improve future shopping experiences by filing complaints to the retailer, instead of complaining to the rest of the world. Retailers are hard-pressed to improve when they have no idea what is wrong.

36. Why are store managers often the last to hear complaints?

A) Most customers won't bother to complain even if they have had unhappy experiences.

B) Customers would rather relate their unhappy experiences to people around them.

C) Few customers believe the service will be improved.

D) Customers have no easy access to store managers.

37. What does Paula Courtney imply by saying " … the shopper must also find a replacement" (Line 2, Para. 4)?

A) New customers are bound to replace old ones.

B) It is not likely the shopper can find the same products in other stores.

C) Most stores provide the same

D) Not complaining to the manager causes the shopper some trouble too.

38. Shop owners often hire moonlighting police as parking attendants so that shoppers_____

A) can stay longer browsing in the store

B) won't have trouble parking their cars

C) won't have any worries about security

D) can find their cars easily after shopping

39. What contributes most to smoothing over issues with customers?

A) Manners of the salespeople

B) Hiring of efficient employees

C) Huge supply of goods for sale

D) Design of the store layout.

40. To achieve better shopping experiences, customers are advised to _____.

A) exert pressure on stores to improve their service

B) settle their disputes with stores in a diplomatic way

C) voice their dissatisfaction to store managers directly

D) shop around and make comparisons between stores

Have you ever read one or more of the above passages? If yes, circle the corresponding numbers of the passage(s) you have read.

I have read Passage: One Two Three Four Five Six

NO, I have never read the passages.

Keys to Reading Comprehension Test (RCT)

1. D) claim	2. H) limited	3. O) totally	4. G) interviews	5. M) regret
6. J) moments	7. B) advanced	8. N) scary	9. C) balloon	10.A)accomplish
11. F) desire	12. K) naturally	13. H) escape	14. G) diversity	15. N) respect
16.I) establishing	17. B) characters	18. A) abundant	19. O) widen	20. M) properly

21. D) Very little will be done to bring it under control.
22. C) It is a problem that can be solved once it is recognized.
23. A) economic growth.
24. B) few nations have adopted real tough measures to limit energy use.
25. B) The ultimate solution to global warming lies in new technology.
26. A) People's personal information is easily accessed without their knowledge.
27. C) There should be a distance even between friends.
28. B) People leave traces around when using modern technology.
29. D) They talk a lot but hardly do anything about it.
30. D) People don't cherish it until they lost it.
31. A) they are more likely to survive serious diseases today.
32. B) men don't seek medical care as often as women,
33. A) it could happen to me, too
34. D) unwillingness to find out about one's decease because of fear.
35. B) they will save money in the long run.
36. B) customer would rather relate their unhappy experiences to people around them.
37. C) most stores provide the same kind of service.
38. B) won't have to trouble parking their cars.
39. A) manners of the salespeople
40. C) voice their dissatisfaction to store managers directly.

APPENDIX D

IOC Analysis for the Chinese Translation of

Perceptual Learning Style Preference Questionnaire (items 1-30)

and Survey of Reading Strategies (items 31-60)

Items	Expert No. 1	Expert No. 2	Result
1	1	1	√
2	1	1	√
3	1	1	√
4	1	1	√
5	1	1	√
6	1	1	√
7	1	1	√
8	1	1	√
9	1	1	√
10	1	1	√
11	1	1	√
12	1	1	√
13	-1	1	√
14	1	1	√
15	1	1	√
16	1	1	√
17	1	1	√
18	1	1	√
19	1	1	√
20	1	1	√
21	1	1	√
22	1	0	√
23	1	1	√
24	1	1	√
25	1	1	√
26	1	1	√
27	1	1	√
28	1	-1	√
29	1	1	√
30	1	1	√
31	1	1	√

32	1	1	√
33	1	1	√
34	1	1	√
35	1	1	√
36	1	0	√
37	1	1	√
38	1	-1	√
39	1	1	√
40	1	1	√
41	1	1	√
42	1	1	√
43	1	1	√
44	1	1	√
45	1	1	√
46	1	1	√
47	1	1	√
48	1	1	√
49	1	1	√
50	1	1	√
51	1	1	√
52	1	1	√
53	1	1	√
54	1	1	√
55	0	1	√
56	1	0	√
57	1	1	√
58	1	1	√
59	1	1	√
60	1	1	√

- *Notes*: 1. *"1" for the item is congruence with objective;* 2. *"-1" for the item is not congruence with objective;* 3. *"0" for the expert uncertain about this item*

- ***Result of IOC:***

(IOC = $\sum$R/ N)

Item number: 60

R=58+56=114 (Scores given by experts)

N=2 (Number of experts)

IOC=114/2=57

Percentage: 57/60x100%=95%

APPENDIX E

IOC Analysis for Working Memory Capacity Test

Items	Expert No. 1	Expert No. 2	Result
1	1	1	√
2	1	1	√
3	1	1	√
4	1	1	√
5	1	1	√
6	1	1	√
7	1	1	√
8	1	1	√
9	1	1	√
10	1	1	√
11	1	1	√
12	1	1	√
13	1	1	√
14	1	1	√
15	1	1	√
16	1	1	√
17	-1	0	√
18	1	1	√
19	1	1	√
20	1	1	√
21	1	1	√
22	1	1	√
23	1	1	√
24	1	1	√
25	1	1	√
26	1	1	√
27	1	1	√
28	-1	0	√
29	1	1	√
30	1	1	√
31	1	1	√
32	1	1	√
33	1	1	√
34	1	1	√
35	1	1	√
36	1	1	√

37	1	1	√
38	1	1	√
39	1	1	√
40	1	1	√
41	1	1	√
42	-1	-1	×
43	1	1	√
44	1	1	√
45	1	1	√
46	1	1	√
47	1	1	√
48	1	1	√
49	1	1	√
50	1	1	√
51	1	1	√
52	1	1	√
53	1	1	√
54	1	1	√
55	1	1	√
56	1	1	√
57	1	1	√
58	1	1	√
59	1	1	√
60	1	1	√
61	1	1	√
62	1	1	√
63	1	1	√
64	1	1	√
65	-1	-1	×
66	1	1	√
67	1	1	√
68	1	1	√
69	1	1	√
70	1	1	√
71	1	1	√
72	1	1	√
73	1	1	√
74	1	1	√
75	1	1	√
76	1	1	√
77	0	-1	×
78	1	1	√
79	1	1	√
80	1	1	√
81	1	1	√
82	1	1	√

83	1	1	√
84	1	1	√
85	1	1	√
86	1	1	√
87	1	1	√
88	1	0	√
89	1	1	√
90	1	1	√
91	1	1	√
92	1	1	√
93	-1	-1	×
94	1	1	√
95	1	1	√
96	1	1	√
56	1	1	√
97	1	1	√
98	1	1	√
99	1	1	√
100	1	1	√

- Notes: 1. "*1" for the item is congruence with objective;* 2. *"-1" for the item is not congruence with objective;* 3. *"0" for the expert uncertain about this item*

- ***Result of IOC:***

(IOC = $\sum$R/ N)

Item number: 100

R=94+93=187 (Scores given by experts)

N=2 (Number of experts)

IOC=187/2=96

Percentage: 96/100x100%=93.5%

APPENDIX F

Interview Questions for the Main Study

Are you XX in X class? Thank you for taking part in the interview. I would like to know your opinions about English learning.

1. Do you like (learning) English?
2. What do you think is your English level?
3. How much time do you spend on learning English every week?
4. What do you usually do in your English reading class?
5. Do you like activities in English reading class? Do you actively participate in the activities?
6. What ways do you usually use to help understand English texts?
7. How do you usually do with English reading exercises?
8. How did you do in the Working Memory Capacity Test?
9. Do you think memory can influence English reading comprehension?
10. What do you usually do to improve your English in general?

Interview Questions for the Main Study (Chinese version)

访谈问题

你是 X 班的 XX 吗？首先感谢你接受我的访问。我想了解你对有关英语学习的几个问题的看法。

一、你喜欢(学)英语吗？

二、你觉得自己的英语水平怎么样？

三、你每周课外学习英语的时间有多少?

四、你通常在阅读课上是怎么做（听课）的？

五、你喜欢英语阅读课上的活动吗？会积极参加吗？

六、你在阅读英语文章时是用什么方法去理解文章内容的？

七、你通常是怎么处理英语阅读练习的？

八、你在工作记忆测试的时候是怎么做的？

九、你认为记忆能力会影响英语阅读水平吗？

十、你通常会怎么做来提高自己的英语水平？.

CURRICULUM VITAE

Xiangyang Zhang was born on October 11, 1971 in Anhui Province, China. She received her Bachelor of Arts degree in English (Education) from Fuyang Teachers' College in 2002. She graduated from Guizhou University with Master of Arts degree in English Language and Literature in 2006.

In 2012, she enrolled in the Ph.D. program of English Language Studies at the School of Foreign Languages, Institute of Social Technology, Suranaree University of Technology, Thailand. From then on, she had been studying there until she earned her Ph.D. degree in English Language Studies in the academic year of 2015 from Suranaree University of Technology, Thailand.

She is currently a lecturer at School of Foreign Languages, Anhui University of Finance and Economics, China. Her research interests include foreign language learners' individual differences and foreign language teaching.