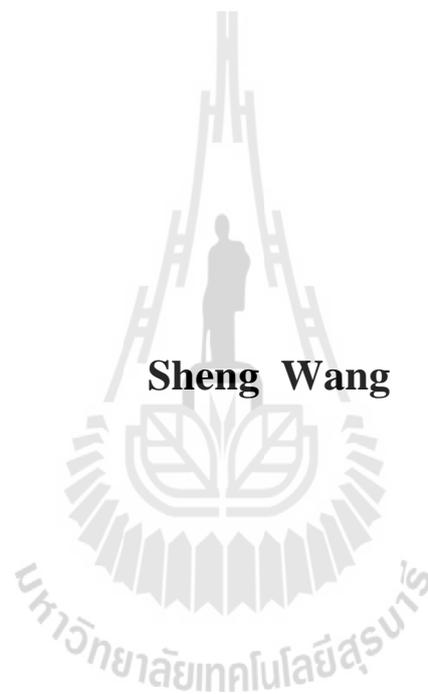


**DEVELOPMENT OF CHINESE EFL LEARNERS’  
CRITICAL THINKING SKILLS THROUGH  
READING-BASED GUIDED INSTRUCTION**



**Sheng Wang**

**A Thesis Submitted in Partial Fulfillment of the Requirements for  
the Degree of Doctor of Philosophy in English Language Studies**

**Suranaree University of Technology**

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การพัฒนาทักษะการคิดเชิงวิพากษ์ของผู้เรียนภาษาอังกฤษชาวจีนในฐานะ  
ภาษาต่างประเทศโดยการสอนแนะด้วยการใช้อ่านเป็นฐาน



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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรดุษฎีบัณฑิต

สาขาวิชาภาษาอังกฤษศึกษา

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ปีการศึกษา 2558

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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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การสอนเกี่ยวกับการคิดเชิงวิพากษ์ได้ถูกจัดเป็นเป้าหมายของการศึกษามานานแล้ว โดยเฉพาะในประเทศตะวันตก แต่ในปัจจุบันประเทศอื่นๆ ก็ได้ให้ความสนใจในเรื่องนี้เป็นอย่างมาก การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาผลของการสอนแนะโดยใช้การอ่านเป็นฐานที่มีต่อการพัฒนาทักษะการคิดเชิงวิพากษ์ของนักศึกษาชาวจีนที่เรียนภาษาอังกฤษในฐานะภาษาต่างประเทศ โดยใช้ระเบียบวิธีวิจัยแบบผสมผสานทั้งเชิงปริมาณและเชิงคุณภาพ นักศึกษาจำนวน ๕๐ คนจากชั้นเรียนการอ่านขั้นสูงจากมหาวิทยาลัยแห่งหนึ่งในประเทศจีน ได้ถูกคัดเลือกให้เข้ารับการฝึกในการวิจัยครั้งนี้ โดยมีวิธีการเก็บข้อมูลดังนี้ แบบทดสอบการคิดเชิงวิพากษ์โดยผ่านการอ่านจำนวน ๓ ฉบับ (เอ บี และซี) ซึ่งจะให้นักศึกษาทดสอบในช่วงก่อน ระหว่างและหลังการฝึก แบบสอบถามความคิดเห็นเกี่ยวกับการฝึกได้ทำในขั้นตอนสุดท้าย นอกจากนี้ นักศึกษาจำนวน ๑๕ คนได้รับการเลือกแบบเจาะจงให้บันทึกส่วนตัวพร้อมกับการสัมภาษณ์

ผลการวิจัยพบว่าการสอนแนะช่วยพัฒนาทักษะด้านการตีความ การสังเคราะห์ การประเมิน ซึ่งเป็นทักษะขั้นพื้นฐานของการคิดเชิงวิพากษ์อย่างมีนัยสำคัญแต่ยกเว้นการคิดเชิงวิเคราะห์ การพัฒนาของทักษะทั้งสี่มีรูปแบบที่แตกต่างกัน ในระหว่างการฝึกพบว่าความรู้ที่จำเป็นในการพัฒนาการคิดเชิงวิพากษ์เพิ่มมากขึ้นซึ่งส่งผลทางบวกต่อการพัฒนาทักษะทั้งหมด แต่การพัฒนาดังกล่าวยังก้าวไปไม่ถึงขั้นของความเป็นอัตโนมัติที่สามารถวิพากษ์ได้ทันที นอกจากนี้ยังพบอีกว่าระดับความสามารถของความคิดเชิงวิพากษ์ที่นักศึกษามีอยู่แล้วก่อนรับการฝึกส่งผลกระทบต่อทางบวกต่อการพัฒนาและวิธีการพัฒนาของทักษะการคิดเชิงวิพากษ์ แต่ในทางตรงกันข้ามกลับพบว่าความสามารถทางด้านภาษาอังกฤษไม่มีผลต่อการพัฒนาทักษะดังกล่าว

ผลของการวิจัยในครั้งนี้สามารถนำไปใช้ในด้านการพัฒนาทักษะการคิดเชิงวิพากษ์ว่ามีความเป็นไปได้กับนักศึกษาที่เรียนภาษาอังกฤษในฐานะภาษาต่างประเทศและอยู่ในวัฒนธรรมอื่นที่แตกต่างไปจากวัฒนธรรมตะวันตก และการพัฒนาทักษะดังกล่าวต้องคำนึงถึงระดับความสามารถของทักษะการคิดเชิงวิพากษ์และระดับความสามารถด้านภาษาต่างประเทศที่นักศึกษามีอยู่แล้วด้วย

สาขาวิชาภาษาต่างประเทศ

ปีการศึกษา 2558

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ลายมือชื่ออาจารย์ที่ปรึกษา \_\_\_\_\_

SHENG WANG : DEVELOPMENT OF CHINESE EFL LEARNERS'  
CRITICAL THINKING SKILLS THROUGH READING-BASED  
GUIDED INSTRUCTION. THESIS ADVISOR :  
SIRINTHORN SEEPHO, Ph.D., 290 PP.

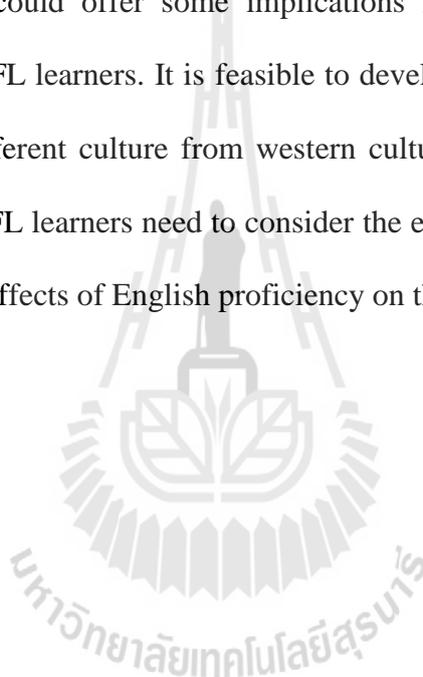
EFL LEARNERS/CONFUCIAN CULTURE/CRITICAL THINKING SKILLS/  
GUIDED INSTRUCTION

The instruction of critical thinking has been undertaken for a long time as the goal of education. However, it was largely confined to native speakers in western culture. Recently, it has stepped into EFL contexts in non-western culture, as a young endeavor. The study aims to examine the instruction of critical thinking skills with EFL learners through reading in China. It employed the mixed research design of quantitative and qualitative techniques. About 50 students in one natural class in one university in China were chosen as sample for the training of critical thinking skills according to critical thinking skills training package in a reading class. Reading-embedded critical thinking skill test Form A, B and C, were administered before, in the middle of and after the training, and perception questionnaire was administered finally. Among them, 15 students were selected by purposeful sampling for learner journals and interviews.

It was found that the guided instruction significantly improved the skills of interpretation, synthesis and evaluation except analysis, on which no significant effects were found. The development of four critical thinking skills presented various patterns. As the training proceeded, the relevant knowledge of the skills could be increased and consolidated, and relevant knowledge played a positive role in the development of the

skills. The development of all the skills was proceeding under knowledge compilation and did not reach the automatic level. The finding showed that EFL learners' different initial levels of critical thinking skills affected growth rates and trajectories of critical thinking skills. No significant differences among participants with low, intermediate and high levels of English proficiency were found in the development of critical thinking skills.

The findings could offer some implications for the instruction of critical thinking skills with EFL learners. It is feasible to develop critical thinking skills with EFL learners in a different culture from western culture. The instruction of critical thinking skills with EFL learners need to consider the effects of initial level of critical thinking and indirect effects of English proficiency on the development.



School of Foreign Languages

Student's Signature \_\_\_\_\_

Academic Year 2015

Advisor's Signature \_\_\_\_\_

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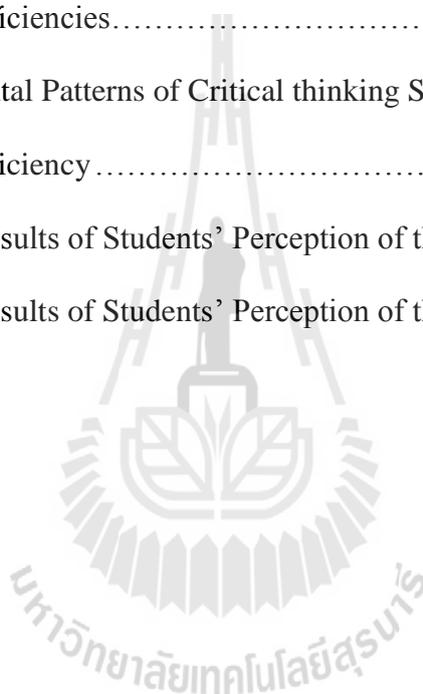
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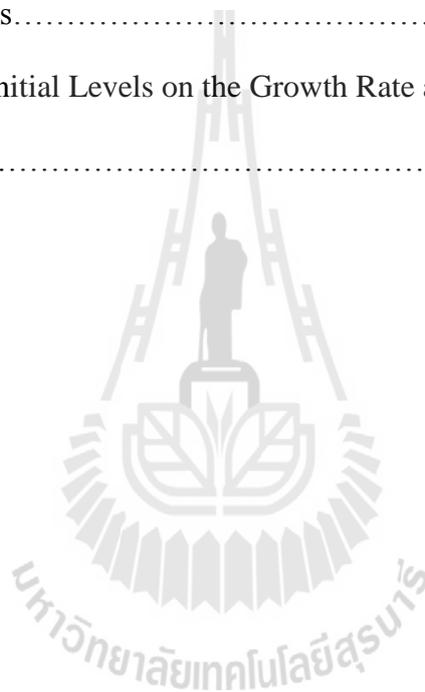


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## LIST OF ABBREVIATIONS

ACT	Adaptive Control of Thought
ANOVA	Analysis of Variance
CCTST	California Critical Thinking Skills Test
CCTT	Cornell Critical Thinking Test
CTSDM	model of development of a critical thinking skill
CTSTP	Critical Thinking Skills Training Package
EFL	English as a Foreign Language
ESL	English as a Second Language
PAF	Presentation-Application-Formation
P-P-P	Presentation-Practice-Production
PPQ	Participant Perception Questionnaire
RCTST	Reading-embedded Critical Thinking Skill Test
SCRE	Scottish Center for Research in Education
SPSS	Statistical Package for the Social Sciences
WGCTA	Watson-Glaser Critical Thinking Appraisal
ZPD	Zone of Proximal Development

# **CHAPTER 1**

## **INTRODUCTION**

This chapter provides introductory information about the study. It begins with the background regarding the research, which focuses on importance of critical thinking skills in learning, profession and personal life. Next, it presents the statements of the research problem. Then, it discusses the reasons why the study was conducted, purpose of the study, research questions, and significance of the study. Finally, definitions of some key terms are provided.

### **1.1 Background of the Research**

The intellectual root of critical thinking can date back to Socratic time in ancient Greece. Since then, a variety of definitions, models and theories on critical thinking have been developed in three strands, i.e., philosophical, psychological and educational (Lai, 2011; Lewis & Smith, 1993; Sternberg, 1986). Three strands place different weights on different aspects of critical thinking, which contribute to the deep understandings of critical thinking. On the other hand, different weights also cause confusion that constitutes the barriers to the instruction and assessment of critical thinking. To reduce confusion and barriers, efforts have been made to explore core commonalities of critical thinking in a Delphi study conducted by the American Philosophical Association (Facione, 1990a). Agreements have been achieved among

critical thinking experts on the definition of critical thinking, specific critical thinking skills and dispositions, and the instruction and assessment of critical thinking.

The intellectual development of critical thinking is in parallel with its instruction which commenced when Socrates attempted to instruct people how to justify their confident claims to knowledge. Consistent commitment to the instruction of critical thinking in its long history is driven by its utility in learning, profession and personal life (Paul & Elder, 2002). In learning, when learners attempt to learn basic principles and concepts of the subject content, they compare and contrast them to the existing ones in their mind, evaluate them, and make a decision whether to accept them, and then interconnect them with the existing ones. When these principles and concepts are interconnected, the logical system of knowledge is created (Elder & Paul, 2008). These activities in learning involve critical thinking which can assist learners in the mastery of basic principles and concepts of the subject content. Moreover, academic debate in learning requires learners to analyze and evaluate different arguments, and thus, necessitates critical thinking. Therefore, critical thinking skills are facilitative to learning (Behar-Horenstein & Niu, 2011).

Critical thinking is also significant in professional life (Facione, Sánchez, Facione, & Gainen, 1995). Solving a problem requires professionals to interpret and analyze information about a problem such as the content, context and nature of the problem, evaluate alternative solutions and courses of action, make decisions about what to do and monitor the process of problem-solving in order to discover and correct mistakes, or alter decisions as necessary. The process of problem solving requires interpretation, analysis, synthesis and evaluation which are the component skills of critical thinking. With critical thinking, professionals can successfully solve recurring

and complex problems, to reduce mistaken decisions and minimize the risk caused by poor or untested judgment.

In addition to learning and profession, critical thinking is significant in the personal and civic life of a member of society (Facione, 1990a). Human beings are sometimes logical and reasonable in using concepts, information, data, ideas and theories to make sense of things and to predict and control things, and sometimes, are illogical and unreasonable when they use concepts, information, data, ideas and theories to deceive, to distort, and become prejudiced and dogmatic. They also have tendencies to be egocentric and to resist considering the points of view of others and admitting the limitations of their own points of view (Paul & Elder, 2008a). The illogical, unreasonable, and egocentric nature of humans demands critical thinking to discipline and direct human mind (Vieira, Tenreiro-Vieira, & Martins, 2011). It is critical thinking that can assist people in attributing meaning to life itself and overcoming empty mind in which they live (Chaffee, 1998, cited in Vieira et al., 2011).

Given the significance of critical thinking in preparing students to deal with challenges which will occur in their lifelong learning, profession and personal life, developing students into ones who are independent enough to think critically has been the aim of education system (Tsui, 2002). Education administrators and employers have taken critical thinking as a demanding part of outcomes of postsecondary education and of quality of graduates (Barnett & Francis, 2011; Davies, 2011; Niu, Behar-Horenstein, & Garvan, 2013).

As early as in 1945, the Harvard Committee took ‘thinking effectively’, which concludes critical thinking, as one of the desirable abilities. Later on, it was endorsed by the US-based Educational Policies Commission, stating that the development of

critical thinking runs through all educational purposes (Kennedy, Fisher, & Ennis, 1991). Recently, critical thinking has been emphasized as one of the essential learning outcomes of higher education preparing students for twenty-first century challenges (The Association of American Colleges and Universities, 2011). It is also emphasized in Foundation Degree that has been built up in UK (DfES, 2003). In Australia, Graduate Skills Assessment listed it as one of the four generic skills (Nelson, 2003). It stressed that “Australia’s future in twenty-first century would rely entirely on the capacity of universities to facilitate critical thinking” (Nelson, 2003, p.3). The Melbourne Declaration (Educational Goals for Young Australians) reiterated it as the goal of education and described successful learners as those who “are able to think deeply and logically, and obtain and evaluate evidence in a disciplined way after they study fundamental subjects” (Kato & Hearfield, 2008, p.8).

In addition to education administrators, employers require education to prepare graduates who can think critically and to enable them to think smart and well (Pithers & Soden, 2000). A survey among employers, conducted on behalf of the Association of American Colleges and Universities, indicates that critical thinking is among the areas which colleges need to focus on (Hart Research Associates, 2010). A majority of employers require colleges to place emphasis on a variety of learning outcomes including critical thinking and analytical reasoning skills. In another survey conducted by Graduate Careers Australia (Davies, 2013), generic critical thinking skills are found to be among employers’ desired skills. The SCRE (Scottish Center for Research in Education) Centre at the University of Glasgow in UK also conducted a study on employers’ perception of employability skills of new graduates (Lowden, Hall, Elliot,

& Lewin, 2011). It was found that employers expect new graduates to exhibit critical thinking as one of a broad range of skills and attributes.

In light of emphasis on critical thinking in higher education in western countries, it comes as no surprise that its importance is emphasized in China. The Chinese education administrators have taken critical thinking as the goal of higher education when she experiences rapid economic development and globalization. Higher Education Law of China (Minister of Education of China, 1998) stipulated that higher education aims to train individuals to be senior specialists with the spirit of creativeness and the ability of practice. Phoutrides (2005) believes that the Chinese government is encouraging educational institutions to educate students to think critically and brainstorm creatively with the purpose to increase levels of participation and prospects for expanding openness and profound reform.

The emphasis on critical thinking has also spread to English education in China's higher education, in which English teaching and learning is set up as one subject of curricula for college students. The syllabus for English majors (National Higher Education Foreign Language Major Teaching Supervisory Committee, 2002) stated that English teaching and learning as a foreign language (EFL) aims to develop students' variety of thinking and problem-solving abilities.

## **1.2 Statement of the Problem**

The instruction of critical thinking has been undertaken for a long time as the goal of education. However, it was largely confined to the first language teaching and learning context in the US (Atkinson, 1997; Day, 2003). It is only in recent years that the instruction of critical thinking has spread to EFL/ESL teaching and learning

contexts. In the EFL/ESL realm, critical thinking was first instructed in composition and then became an important component in the EFL/ESL reading class (Day, 2003). The instruction of critical thinking skills with EFL learners in a reading class is a young endeavor which needs further exploration and deep understandings.

Although the Chinese government values critical thinking as a component of graduate's abilities and curricula and syllabuses have been designed to emphasize critical thinking ability, Chinese learners who study abroad are frequently perceived to be generally deficient in critical thinking (Huang, 2008; Turner, 2006). Difficulties arise when they attempt to evaluate learning strategies and performance among their Chinese group. They show decrease in critical thinking engagement. Some scholars claim that Chinese students' difficulties with critical thinking stem from their cultural educational style shaped by the Confucian culture which is different from western culture (Atkinson, 1997). Atkinson thought that critical thinking is a social practice in individualistic western cultures, which emphasizes rationality and autonomy. Conversely, Chinese learners whose learning style has been shaped by the Confucian thought tend to use memorization and recitation as major learning strategies in the classroom. Classroom activities are dominated by teacher-centered lectures with little questioning or discussion (Huang, 2008). Written examinations which assess Chinese students' achievements neglect the assessment of students' ability to solve practical problems.

In contrast, Paton (2005) believed that "critical thinking is evident in all cultures in that it is through this thinking that humanity survives" (p.9). Chinese students' insufficiency in critical thinking is due to their difficulties in study in English as second, or third language. That is, their English proficiency may affect their English

performance in writing or reading through which critical thinking is developed that, in turn, affects their performance in critical thinking. However, it is still controversial that cultural background or target language proficiency or both imposes influence on the Chinese students' performance in thinking critically. In addition, there is a lack of empirical evidence to support the effect of the Confucian culture on critical thinking (Tian & Low, 2011). This study, which explores the development of critical thinking with EFL learners in the Chinese culture through reading, aims to provide some implications for the controversy.

### **1.3 Rationale of the Study**

There are four reasons for the present study. The first reason is that since instruction of critical thinking commenced in ancient Greece, it is mainly conducted in western educational institutes in western countries such as the United States of America (Atkinson, 1997; Day, 2003). Recently it has stepped into EFL/ESL circles. However, its essential core was built up in western society and its creation, development and instruction were based on western academic tradition. There are differences between western society and eastern society (e.g. China, Korea and Japan, etc.) in terms of value and social structure and relations. Western society is individual-oriented while eastern society is group-oriented (Atkinson, 1997; Day, 2003; Stapleton, 2002). Given the great difference between the West and the East, Atkinson expressed cautions against the development of critical thinking in the realm of EFL/ESL in the East. He believed that critical thinking is a social and cultural practice and therefore, is difficult for EFL/ESL learners to master.

Some scholars expressed their disagreement with Atkinson. Ennis (1998) believed that the basic constitutive skills of critical thinking are not based on and influenced by culture. Similarly, Day (2003) found that students from China, Korea and Japan are receptive to the instruction of critical thinking. They have no difficulties engaging in critical thinking. Disagreement among researchers on whether critical thinking is cultural-biased is due to a dearth of empirical evidence for the instruction of critical thinking in EFL contexts. Therefore, it needs further research. That is a reason why the study on the development of critical thinking skills was conducted with EFL learners within eastern culture.

The second reason is concerned with reading as a means of developing critical thinking. The strong relationship between critical thinking and reading has been well justified in the studies (Day, 2003; Hosseini, Khodaei, Sarfallah, & Dolatabadi, 2012; Wang, 2012). Reading is pertinent to critical thinking and can be used as an effective arena for the development of critical thinking (Commeyras, 1993; Daud & Husin, 2004; Liaw, 2007; Neilsen, 1989). Similar skills of interpretation, analysis, synthesis and evaluation involved in reading comprehension can apply as well to critical thinking (Facione, 2011; Neilsen, 1989). As these skills are used to think critically, they refer to the competent application of reasoning principles, concepts and procedures into interpreting, analyzing, synthesizing and evaluating. Therefore, to a certain extent, the reading process can be accompanied by the process of critical thinking (Aloqaili, 2011). Reading comprehension requires students to engage in thinking critically in the process of meaning construction.

There are three levels of comprehension: literal, inferential and critical comprehension (Fiene & McMahon, 2007; Mohamad, 1999; Parker & Hurry, 2007).

Literal comprehension, also called 'surface' comprehension, refers to the understanding of ideas and information directly stated by words and sentences in a text. Inferential comprehension includes the understandings of implied meanings of ideas and relations among ideas by making inference. Critical comprehension concerns evaluating ideas and information. During inferential and critical comprehension, critical thinking is involved in making inference, synthesizing logical relations among ideas, evaluating the ideas presented in a text. Embedding critical thinking training into reading instruction can help students develop the ability to think critically about complex ideas expressed in a text and at the same time, processing texts involves an integration of deciphering, activating schema and thinking critically. That is the reason why the study on instruction of critical thinking skills was undertaken through reading.

The third reason concerns the focus of the study on critical thinking skills rather than dispositions. Critical thinking disposition refers to "the consistent internal motivation to engage problems and make decisions by using critical thinking" (Facione, 2000, p.65). It is considered to be a tendency to engage in critical thinking (Ennis, 1996; Facione, 2000; Perkins, Jay, & Tishman, 1993; Siegel, 1999). Some scholars believe that critical thinking that focuses exclusively on skills is incomplete and critical thinking dispositions are needed as well (Ennis, 1991; Facione, 2000; Halpern, 1998; Paul & Elder, 2008a; Perkins et al., 1993). Critical thinking dispositions are closely connected to critical thinking skills. However, at the same time, they pointed out that critical thinking disposition is a distinguishable construct from critical thinking skill. Critical thinking dispositions are among distinguishing features of critical thinkers' character. Therefore, it is possible to separate the instruction of critical thinking skills from that of dispositions. Critical thinking skills that a person uses are evidence that the

person is disposed to use them. Yang and Chou (2008) found that the development of critical thinking skills can enhance critical thinking dispositions, while the improvement of critical thinking dispositions cannot necessarily increase critical thinking skills.

The fourth reason is concerned with research methodology and orientation. Since critical thinking stepped into EFL/ESL realm, some studies have been done on the instruction of critical thinking (Gomez, 2010; Tung & Chang, 2009). However, these studies mainly used a pre-post research design which could provide empirical evidence about whether the development of critical thinking took place, but little evidence has been offered about how the development happened, especially in the EFL reading context. These studies are quantitative and product-oriented. It is still unknown how the critical thinking skills can be developed with EFL learners. It needs to explore the process of development of critical thinking skills in the EFL context by using a mixed design of qualitative and quantitative methods.

#### **1.4 Purposes of the Study**

The study stems from concern over EFL learners' difficulties to develop critical thinking skills in eastern society (only in China for the study). It aims to explore the development of critical thinking skills with EFL learners in a reading class. Particularly, the study attempts to achieve the following purposes:

1. to examine the effect of the guided instruction on the development of critical thinking skills and find out, to what extent, critical thinking skills can be developed.

2. to explore how EFL learners develop critical thinking skills, i.e., the developmental process of critical thinking skills.
3. to examine the effect of EFL learners' initial level of critical thinking skills on the development of critical thinking skills.
4. to examine the effect of EFL learners' English proficiency on the development of critical thinking skills.
5. to investigate EFL learners' perceptions of the guided instruction and the development of critical thinking skills.

The achievement of the purposes will provide a sketch of the development of critical thinking skills with EFL learners in eastern culture and of the effects of some potential factors on the development.

### **1.5 Research Questions**

The study explores the development of critical thinking skills with EFL learners in the EFL reading context in eastern culture. It is guided by the following research questions:

1. Does the guided instruction in the EFL reading class help develop EFL learners' critical thinking skills? If so, in what way?
2. How can learners' critical thinking skills be developed under the guided instruction?
3. Does learners' initial level of critical thinking skills affect the change in learners' development of critical thinking skills? If so, in what way?
4. Does learners' English proficiency level affect the development of critical thinking skills? If so, in what way?

5. What are learners' perceptions of the guided instruction?
6. What are learners' perceptions of the development of critical thinking skills?

## **1.6 Significance of the Study**

The study may have several implications for theoretical and educational aspects of critical thinking for higher education in non-western contexts. The fundamental goal of higher education is to nurture students to think critically rather than only to build knowledge (Davies, 2011; Fahim & Masouleh, 2012; Tsui, 2002). However, there is a debate on the validity of teaching critical thinking skills in the EFL/ESL field in non-western contexts (Atkinson, 1997; Day, 2003; Fox, 1995). Central to the debate is that critical thinking skills are culture-specific and therefore inappropriate for instruction in non-western contexts (e.g. China). Many practices of teaching critical thinking skills in the West might be alien for those students from the Confucian culture (Chiu, 2009). Therefore, firstly, the potential findings of the study may provide a possible answer to the question whether it is appropriate and valid to develop Chinese students into critical thinkers, who are taught in the Confucian educational style. It may also offer some information about how Chinese students can be developed into critical thinkers and what factors may affect the development.

Secondly, in the study, the instruction of critical thinking skills was undertaken on the framework model adapted from two famous existing models: Richard Paul's model (Paul & Elder, 2008a) and Benjamin Bloom's taxonomy (Bloom, 1956). It was developed under the assumption that critical thinking skill is instantiated in competently applying reasoning knowledge into performing a task or solve a problem rather than only competent task-performing or problem-solving itself. It explicates relationships among components of critical thinking: critical thinking skills, reasoning knowledge,

elements of thought and standards of thought. The study verified the effectiveness of the model in the development of critical thinking skills with EFL learners in China, which may be used in other EFL contexts.

Thirdly, the instruction of critical thinking was guided by the training package blending the instruction into a EFL reading class. In the package, the training process of a skill is based on Adaptive Control of Thought (ACT) production theory (Anderson, 1982), and went through three stages: presentation, application and formation, corresponding to presentation-practice-production (P-P-P) (Harmer, 2007, cited in Carless, 2009). The guided instruction is designed on the basis of zone of proximal development (ZPD) and scaffolding (Vygotsky, 1978). The instruction is instantiated in a combination of the ACT theory of critical thinking skills development, presentation-practice-production, and the guided instruction model of ZPD and scaffolding. The findings of the study may provide deep understandings of the utilities of such the combination in developing critical thinking skill with EFL learners in non-western context.

Fourthly, infusion approach and some commonly-used teaching strategies such as illustration, questioning, discussion and practice were employed in the guided instruction of critical thinking skills. The teaching approach and strategies have been found to be effective in the development of critical thinking skills in English teaching and learning as the first language. The study may provide deep insights into their effectiveness in the development of critical thinking skills in the EFL context.

Fifthly, most studies on the development of critical thinking used quantitative research design which seldom considered the effects of pedagogical context factors on the development (Tsui, 2002). This study employed a mixed research design, of which

qualitative methods take rich contextual factors into consideration. Therefore, the potential findings of this study may provide multiple-source evidence, to tap into the complex process of the development of critical thinking skills.

## 1.7 Definitions of Key Terms

**Reading comprehension** In the study, reading comprehension is a process of extracting information from print and constructing meaning through the reader's interaction with a text.

**Critical thinking** Operationally, in the study, critical thinking refers to an ability that can be regarded as the competent application of reasoning knowledge in performing a task or solving a problem when reading, and that consists of several skills and each skill consists of sub-skills.

**Critical thinking ability** In the study, critical thinking ability is different from critical thinking skill even though both terms are used interchangeably in the discourse on critical thinking. Critical thinking ability, as an abstract concept, refers to stable and enduring competence to think critically with ideal critical thinkers under the ideal condition. It brings about and underlies critical thinking skill.

**Critical thinking skill** In the study, critical thinking skill refers to the competent application of reasoning knowledge in performing tasks or solving a problem. It is the external manifestation of the internal critical thinking ability to serve a certain purpose.

**Perception** In the study, it refers to EFL learners' thoughts and reflections on the guided instruction and the development of critical thinking skills.

**Guided instruction** In the study, the guided instruction refers to the instruction guided by the 'critical thinking skills training package' (CTSTP) in which the teacher strategically uses questions, feedbacks--informed prompts and cues, direct explanations,

discussion, practice and modeling to guide students to increasingly complex thinking and facilitate students' increased responsibility for task completion. Under the teacher's guide, students engage in productive tasks until they produce individual work independently.

## **1.8 Summary**

The theoretic development and the instruction of critical thinking have a long history. The cultivation of critical thinking is significant for learning, profession and personal life. Therefore, critical thinking is considered as a goal of higher education and a demanding part of graduates' quality. However, most of its instruction happened in first language teaching and learning in western countries. Little research has been done in EFL/ESL context, especially in eastern countries such as China, which prompts this study.

There are four reasons for conducting the present study. First reason is about dispute on whether critical thinking is cultural-biased, which needs further research. The second reason is concerned with the reading as a means to develop critical thinking. The third reason is to examine that critical thinking skills can be developed independently of dispositions. Lastly, it needs a mixed design of qualitative and quantitative methods to explore the development of critical thinking skills in EFL reading context.

The present study is significant in that it may provide the possible answer to the question whether critical thinking can be developed with Chinese students who are taught in the Confucian culture, and deep insights into the instruction of critical thinking skills with EFL learners. Moreover, it may provide multiple-source evidence to tap into the complex process of the development of critical thinking skills and enrich critical thinking theory and education. In addition, research purpose and questions, and definitions of some terms are presented.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter reviews the literature related to critical thinking. It discusses the following general topics: theoretical background of critical thinking, critical thinking instruction, and critical thinking in English reading class. The first topic deals with the critical thinking conceptions and models. It includes the discussion on the alternatives to the concept of critical thinking, the definitions of critical thinking and critical thinking models. The second topic focuses on critical thinking instruction. It explores a dispute on critical thinking instruction, various teaching approaches and strategies, and the training and assessment of critical thinking skills. The last topic is about critical thinking in an English reading class. It mainly discusses the relationship between critical thinking and English reading, the effect of critical thinking on reading comprehension, and critical thinking instruction in an English reading class.

#### **2.1 Theoretical Background: Critical Thinking**

It is essential for the instruction of critical thinking to find out the thread among variant arguments, conceptions and models which have been produced since critical thinking was initially drawn attention in pedagogical practice. This section attempts to clarify critical thinking definitions and models.

### **2.1.1 Alternative Labels for Critical Thinking**

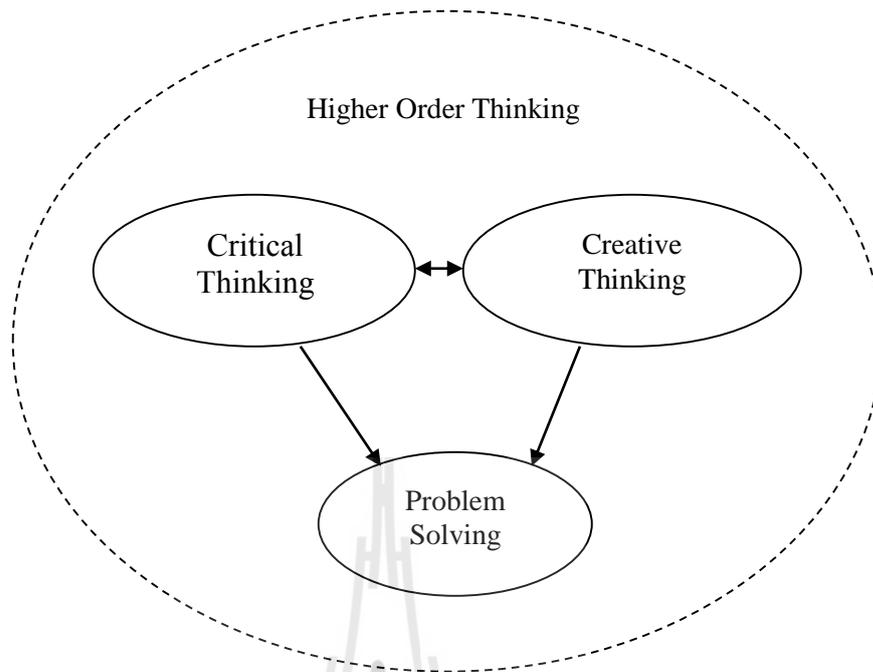
In the discourse on critical thinking, three professional terms--higher order thinking, creative thinking, and problem solving are found to be often interchangeable with critical thinking (Lewis & Smith, 1993). However, there are some subtle differences among these labels. Clarification of similarities and differences among them can contribute to the deep understandings of critical thinking.

First, higher order thinking, as an umbrella concept, includes critical thinking and creative thinking, as well as problem solving (Lewis & Smith, 1993). Newmann (1991) explained that higher order thinking is a broad conception rather than a specific conception as critical thinking. It can be easily recognized when it manifests itself in solving a problem in practice (Lewis & Smith, 1993; Resnick, 1987). To solve a complicated problem, Resnick (1987) argued, higher order thinking is required in considering the cost and benefit of multiple solutions, and developing a novel one. Newmann, Voss, Perkins, and Segal (1991) stated that higher order thinking involves such skills as scrutinizing arguments for logical consistency, distinguishing between relevant and irrelevant information, using metaphor and analogy in solving problems and developing solutions, asking for clarification in a conversation, pressing people to stay with an issue, and summarizing the progress. These skills overlap those concerning critical and creative thinking. Problem solving can be seen as “arenas where critical and creative thinking take place” (Bailin, Case, Coombs, & Daniels, 1999b, p.288).

Second, there are some differences between critical and creative thinking. Paul and Elder (2008b) claimed that critical thinking is a process of evaluating, while creative thinking is a process of producing. Scholars tend to discuss creative thinking in comparison with critical thinking. They view critical and creative thinking as two

distinctive concepts. Critical thinking is analytic and evaluative within a given framework, while creative thinking is imaginative and inventive, and involves generating and inventing new ideas or solutions by transcending framework (Bono, 1876; Glaser, 1985, cited in Bailin, 1987).

Although there are some differences between critical thinking and creative thinking, they are closely connected. Harris (1998) pointed out that in problem-solving, two kinds of thinking work together and are not really independent of each other. In solving a problem, “first, we must analyze the problem; then we must generate possible solutions; next we must choose and implement the best solution; and finally, we must evaluate the effectiveness of the solution” (Harris, 1998, p.2). It is a cyclical process from critical thinking to creative thinking, and then from creative thinking to critical thinking. As Paul and Elder (2008b) stated, although critical thinking and creative thinking can be separated artificially, in practical context, they are interwoven and connected into one. The relationship among the labels is illustrated in Figure 2.1.



**Figure 2.1 Relationship among Labels**

In sum, higher order thinking subsumes critical and creative thinking in problem solving (see Figure 2.1). The problem solving provides an arena where creative thinking develops and creates the effective solution and critical thinking analyzes and evaluates alternative solutions. It is a reciprocal way of thinking to find appropriate solutions to a problem. Since this study places emphasis on the instruction of critical thinking skills, the term “critical thinking” is mainly used throughout the study. However, it does not necessarily exclude creative thinking, because, based on evaluation, the consequence of critical thinking is creative thinking--new ideas or solutions produced and invented. Problem solving provides a stage where students can develop their critical and creative thinking.

### **2.1.2 Conceptualization of Critical Thinking**

Due to a long history of research on critical thinking, it is a hardship for researchers and theorists to reach a consensus on its conception. There are as many

definitions of critical thinking as contemporary scholars who attempt to seek the clarification of definitions. However, continuous endeavor to explicate the concept of critical thinking is undertaken under the assumption that it is conducive to the effective instruction of critical thinking in educational settings. There is agreement among scholars on three approaches to conceptions of critical thinking: philosophy, psychology and education (Bailin, 1998; Cohen, Salas, & Riedel, 2002; Lewis & Smith, 1993; Sternberg, 1986). The next sub-sections mainly discuss them.

### **2.1.2.1 Philosophical Tradition**

Philosophical inquiry into critical thinking extends from the ancient time of Socrates, Plato and Aristotle to the contemporary of Dewey, Ennis and Paul. These scholars have tuned their attention to the nature of critical thinking and devoted much attention to the requirements of formal logical systems rather than the requirements of critical thinking within the educational conditions (Sternberg, 1986). Dewey, an American philosopher, psychologist and educator, is widely considered as the founder of the modern critical thinking movement (Fisher, 2001). He viewed critical thinking as reflective thinking and defined it as "active, persistent and careful consideration of a belief or supposed form of knowledge in light of the grounds that support it, and the further conclusions to which it tends" (Dewey, 1961, p.4). Dewey stressed that belief is established upon a firm basis of reasons. He explained that what is believed or disbelieved depends on something which stands as reasons of belief. If suggested knowledge that occurs is at once accepted, there is no or minimum of reflection. Reflective thinking involves consistent doubt and systematic and perpetuated inquiry in overcoming the inertia that inclines people to accept the suggested form of knowledge at its face value.

Ennis (1962), whose definition is widely accepted in the field, defined critical thinking as “reasonable reflective thinking that is focused on deciding what to believe or do” (Ennis, 1991, p.6). The definition emphasizes the reasonable and reflective nature of critical thinking. Goal of thinking critically is to decide what to believe or do. Ennis’ definition stresses application of reasonable and reflective thinking in decisions. The thrust of critical thinking is propelled from the dimension of thought into that of action (Whitaker, 2002). Scriven and Paul (2008) elaborated critical thinking as:

“Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action” (Scriven & Paul, 2008, p. 1).

The definition regards critical thinking as a process which consists of five skills from “conceptualizing” to “evaluating”. The content which is processed within critical thinking is information obtained by observation, experience, or communication. Similar to Ennis’ definition, Scriven and Paul’s definition emphasizes the purpose of critical thinking as a guide to belief and action.

The philosophical approach to the concept of critical thinking features in enumerating the characteristics of a critical thinker, attaching importance to reasoning skills and processes, and highlighting purposes of critical thinking. In the emphasis of reasoning and logical system, the philosophical definitions imply the qualities of the ideal critical thinker under ideal circumstances in which the limitations on human thought are not in place (Sternberg, 1986).

### **2.1.2.2 Psychological Tradition**

In contrast with the philosophical approach, psychological approach is mainly concerned with the processes and skills of critical thinking in practical context (Moon, 2008). The emphasis of processes and skills of critical thinking aims to make the idea more comprehensible, more usable and more relevant to practice. Moreover, psychological tradition pays attention to the behaviors and actions of critical thinkers within personal and contextual constraints, because behaviors and actions are overt indicators of a person's covert internal unobservable processes.

Psychologist Robert Sternberg (1986) thought that critical thinking consists of “mental processes and strategies” which are utilized to “solve problems, make decisions and learn new concepts” (p.3). He considered the processes and skills as the integral elements of critical thinking, and stressed the importance of problem-solving practice rather than an ideal context. The similar accentuation can be found in Halpern's definition of critical thinking as “the use of cognitive skills or strategies that increase the probability of a desirable outcome” (Halpern, 1999, p.70). Halpern accorded emphasis to desirable outcomes when using skills or strategies to solve problems. In conceptualizing critical thinking, psychological researchers highlight the importance of context and the limitation it can impose on performance of component processes and skills. The practical discipline or professional contexts determine appropriate application of particular component skills of critical thinking.

### **2.1.2.3 Educational Tradition**

Educational tradition to critical thinking is a combination of philosophic and psychological approaches (Sternberg, 1986). Educators are primarily concerned with how to develop students into critical thinkers rather than the process or skill itself

(Moon, 2008). Therefore, educational conceptions of critical thinking mainly emerge from the way in which students are guided into critical thinkers. Processes and skills, which are necessary in the classroom for problem-solving, decision-making, and concept learning, can be taken as components of guidance in nurturing critical thinkers.

Pascarella and Terenzini (1991, cited in Rudd & Baker, 2000) argued that critical thinking can be defined in a number of ways,

“but typically involves the individual’s ability to do some or all of the following: identify central issues and assumptions in an argument, recognize important relationships, make correct inferences from data, deduce conclusions from the information or data provided, interpret whether conclusions are warranted on the basis of the data given, and evaluate evidence or authority” (p.118).

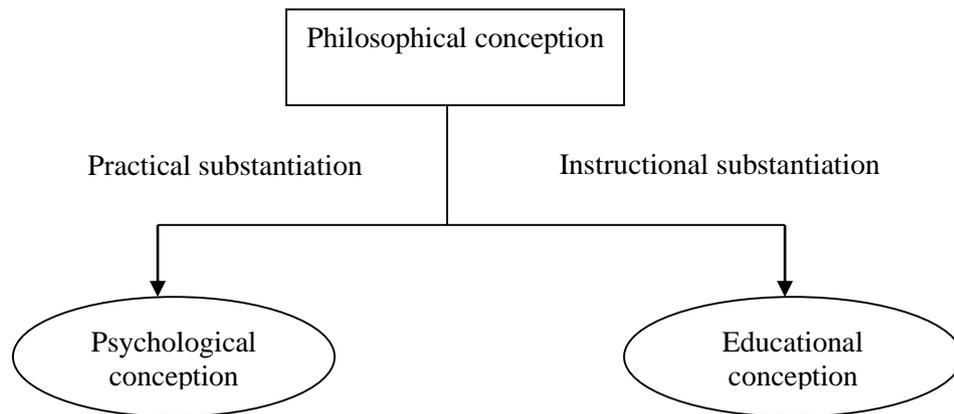
The definition indicates that critical thinking, as reasoning ability, is composed of a variety of skills. It centers on the individual development of reasoning ability, instantiated in specific skills. Pascarella and Terenini (1991, cited in Rudd & Baker, 2000) also stressed that postsecondary education should foster these skills. Tsui (2002) corroborated the reasoning ability in her definition. She defined critical thinking as “students’ abilities to identify issues and assumptions, recognize important relationships, make correct inferences, evaluate evidence or authority, and deduce conclusions” (p.743). The preference for individual development of critical thinking is ascertained in Papastephanou and Angeli’s (2007) definition which interpreted critical thinking as individual’s reflective thinking when involved in problematic situations in any discipline. Reflective thinking that characterizes the individual critical thinker is conceived of as a necessary capability in solving problems..

Educational theories of critical thinking are developed from class observation and experience (Sternberg, 1986). Educational conceptions of critical

thinking are generalized from instructional experiences of cultivating critical thinkers. Critical thinking is primarily conceptualized as an individual's logical and reasoning ability which can be developed with undergraduates and graduates in academic institutions. Educators stress the importance of reasoning ability as a component of critical thinking in the case that students need to be cultivated into critical thinkers in higher education.

#### **2.1.2.4 Implications for the Present Study**

The relationship among three approaches to conceptualization of critical thinking is illustrated in Figure 2.2 below. Philosophical researchers tend to conceptualize critical thinking in an abstract way and emphasize the characteristics and processes of critical thinking which are concerned with ideal critical thinkers under ideal contexts. In contrast, educational conceptualization of critical thinking focuses on how to effectively develop students into critical thinkers in the class, which is crystallized into the development of specific critical thinking skills. Psychological conceptualization of critical thinking emphasizes the importance of skills and their utilization in problem-solving in practice. It stresses the limits imposed by practical constraints. Therefore, to a certain degree, the educational conception of critical thinking is an instructional substantiation of the abstract philosophical conception, and the psychological conception is its practical substantiation.



**Figure 2.2 Relationship among Philosophical, Psychological and Educational Conceptions of Critical Thinking**

The philosophical conception has a preferred weight on the theoretic aspect of critical thinking; the psychological conception on the practical aspect; the educational concept on the instructional aspect. From three different aspects, they attempt to elaborate the concept of critical thinking, which provides the significant implication for the present study. Perfect critical thinking by an ideal critical thinker under the ideal context emphasized in philosophical conceptualization can be not easily obtained in an actual educational setting, and therefore, the teaching and learning of such perfect critical thinking cannot be implemented successfully. Development of critical thinking for undergraduates in educational institutions has to consider the limitations imposed by personal traits and environmental contexts with the ultimate objective of cultivating critical thinkers who can apply critical thinking skills into solving a problem in reality.

### **2.1.2.5 The Convergence of Conceptions of Critical Thinking**

The variations in definitions of critical thinking constitute a barrier to critical thinking instruction and assessment. Efforts to explore core commonalities of critical thinking conceptions intensified in a Delphi study in which a cross-disciplinary panel of 46 experts completed a multi-round, method-strict research project under the sponsorship of the American Philosophical Association (Facione, 1990a). The Delphi study articulated the conception of critical thinking as follows:

“We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (Facione, 1990a, p. 2).

The agreed definition conceives the outcome of critical thinking as judgment, rather than solutions and decisions. Lipman (1988) held that outcomes of critical thinking such as solutions and decisions are too narrow, and that judgment includes solving problems, making decisions and learning new concepts. “All aspects of critical thinking centrally involve judgment” (Bailin, Case, Coombs, & Daniels, 1999a, p.280). The experts in the Delphi study agreed that critical thinking includes five core skills: interpretation, analysis, evaluation, inference and explanation.

### **2.1.2.6 The Conception of Critical Thinking in the Present Study**

In the present study, critical thinking is defined as a reflective, reasonable and intellectually disciplined process of interpreting, analyzing, synthesizing, and evaluating arguments as a guide to making judgments. Critical thinking has its own defining characteristics: reflective, reasonable, and disciplined, which can be employed to distinguish critical thinking from any other kind of thinking. Critical thinking is reflective in that “it involves thinking about a problem at several different levels or from

several different angles all at once” (Hunter, 2009, p.5). Reflective thinkers can analyze their own thinking, notice some imperfection in their thinking, and strive to improve it. When making judgments, reflective thinkers can go beyond their own prejudice and self-delusion and dialogically think over alternative, even opposite points of view (Paul & Elder, 2002). Reflective thinking which characterize the critical thinker are considered as necessary capabilities in making judgments in any specific concern.

Another hallmark of critical thinking, being reasonable, actually refers to critical thinkers’ reasoning ability. Critical thinkers should be able to reason. They would not hurry to draw a conclusion that cannot be supported by evidence and rationality or make a decision to accept a belief without the support of good reasons. Last but not least, critical thinking is intellectually disciplined in the sense that it involves systematically analyzing questions and problems, carefully assessing needed evidence, and holding to critical thinking standards (Paul & Elder, 2002). The disciplined thinkers seek to improve the quality of their thinking and cannot reach an unwarranted conclusion or recognize unrelated evidence.

Critical thinking is regarded as a process of interpreting data and facts, analyzing evidence and grounds, synthesizing reasons and conclusions, and evaluating arguments for the purpose of making judgments on belief or action. Critical thinking is a process that “helps us to arrive at the most likely destinations when evaluating claims” (Braithwaite, 2006, p.1). Process is a journey to the accomplishment of purpose. The purpose of critical thinking is to make judgments (Lipman, 1988).

Operationally, critical thinking, as the ability, consists of skills of interpreting, analyzing, synthesizing and evaluating. Each skill subsumes sub-skills.

These skills are used to achieve ultimate end, i.e., judgment on belief or action. The following is a detailed discussion of these skills (see Table 2.1).

**Table 2.1 Specific Critical Thinking Skills and Sub-skills**

<b>Skill</b>	<b>Sub-skills</b>
Interpretation	<ul style="list-style-type: none"> <li>• Identifying arguments and recognizing explicit premises, reasons and conclusions</li> <li>• Distinguishing argument from description, explanation, and summary</li> <li>• Paraphrasing arguments to others, distinguishing deductive argument from inductive argument</li> </ul>
Analysis	<ul style="list-style-type: none"> <li>• Making inferences about implicit premises, assumptions and conclusions</li> <li>• Detecting flaws in the argument</li> </ul>
Synthesis	<ul style="list-style-type: none"> <li>• Discovering hierarchical interrelations among arguments in support of the main position or view</li> <li>• Diagramming arguments</li> </ul>
Evaluation	<ul style="list-style-type: none"> <li>• Evaluating global structure of thought by using elements of reasoning and criteria of thought</li> <li>• Evaluating local arguments and their relationships by using criteria of thought</li> </ul>

Interpretation, as one of critical thinking skills, refers to understanding and interpreting arguments stated in a written text. It encompasses such sub-skills as: identification, categorization and expression. Identification refers to the skill to identify argument and its components: premise and conclusion, and distinguish argument from non-argument such as description, explanation, and summary. Categorization requires learners to understand and appropriately formulate different types of arguments, and describe and characterize these arguments such as deductive argument and inductive argument. Expression refers to the skill to paraphrase arguments explicitly or implicitly presented in a written text.

Analysis focuses on breaking down arguments into constituents and recognizing the constituents. It includes inference and detection. Although some

arguments have explicitly stated premises and conclusions, some still use implicit assumptions as reasons. Some just jump to conclusions and leave premises implicitly unstated or explicitly state premises and leave conclusions unstated. Inference refers to the skill to make inferences about implicit premises, assumptions and conclusions. Detection refers to the skill to detect flaws in an argument. Flaws include false premises and the flawed reasoning that takes coincidence as causal argument and confuse necessary conditions with sufficient conditions, etc.

In contrast to the skill of analysis, synthesis functions in recombining the analyzed constituents into the whole. However, such recombination is not a simple process of adding parts together into a whole. It emphasizes the uniqueness and originality of the whole which is not being explicitly expressed in a written text. Its first sub-skill is to detect the main position or point of view implicitly expressed in a reading text. It subsumes discovering hierarchical interrelations among the arguments, and how the different types of argument are combined to support the main position or point of view. The second sub-skill is to diagram arguments based on detailed analysis, which makes clear the process of the author's reasoning.

Evaluation refers to the assessment of arguments. The assessment of arguments involves judgment on acceptability and strength of premises and conclusions of a given argument, on whether a given argument is based on doubtful assumptions or presuppositions, and on confirmable strength of a given argument's consequences. It also includes judgment on the globe structure of the whole thought expressed in a written text. The assessment and judgment requires criteria, which are adapted from Paul's model, including elements and standards of thought. Elements of reasoning is only used to evaluate the completion of structure of the whole global thought repressed

in a written text, while the standards functions in evaluation of both local arguments and global thought.

### **2.1.2.7 Differences between Critical Thinking Ability and Skill in the Study**

It is often found that two terms, 'critical thinking ability and critical thinking skill', are often used interchangeably in the literature of critical thinking research. Such interchangeable use of two terms is due to double connotations of 'skill'. As Smith (2002b) argued, 'skill', on the one hand, refers to "skilled performance of tasks", and on the other hand, refers to "acquired ability or capacity" (p.661). The double connotations of 'skill', more or less, mask the differences between ability and skill. There are some subtle differences between the two concepts that need to be clarified. If elucidation of differences between ability and skill is achieved, consequently, differences between critical thinking ability and skill can become clear.

Skill is often defined as a capacity or ability to do something well, to perform competently a task (Bailin, 1998; Bailin et al., 1999a; Smith, 2002a, 2002b). The definition emphasizes something inner in individuals' mind, inner ability, and at the same time, it also focuses on the external manifestation of skill by the competent performance of tasks. Two main points of the definition are confusing and problematic for skill teaching. It is necessary to make a choice among two focuses of the definition: whether skill refers to only inner ability or only performance of tasks. If the choice is made for inner ability, that is, skill and ability can be interchangeable. However, some researchers claim that skill is not equated with ability. Barrow (1984, cited in Griffiths, 1987) disagreed with such a broad sense of skill, and believed that skill is not synonymous with ability but is a sub-class of ability. It is ability that underlies skill and brings out or makes up the skill of an individual.

For the present study, critical thinking skill refers to task-related competent performance, while critical thinking ability focuses on the ideal competence or capability of the ideal thinker. Critical thinking ability is macro while elemental skill of critical thinking is micro (Paul, 1993). Micro-skill can be orchestrated into macro-ability of critical thinking. Critical thinking is a stable and enduring ability developed from the integration of a variety of elemental skills. If learners acquire a mastery of critical thinking skills, they consequently acquire an enduring critical thinking ability.

### **2.1.3 Critical Thinking Model**

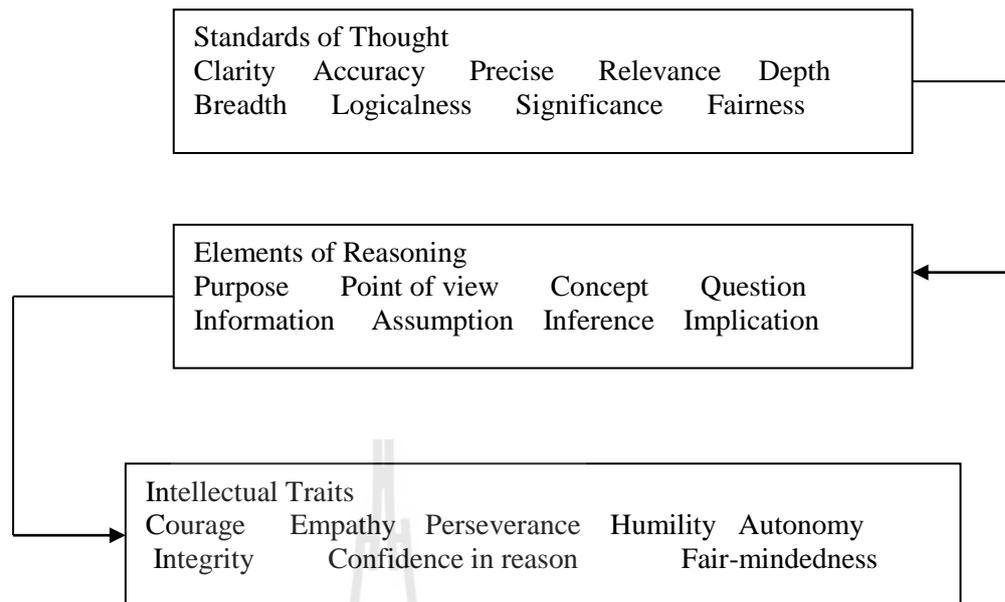
Generally, there are three traditional approaches to critical thinking models, which are in consistence with three traditional conceptions of critical thinking. These academic traditions have developed their own specific models with variant concerns and purposes. The philosophical approach to the critical thinking model articulates reasoning elements and thought standards used to evaluate the elements. The psychological model of critical thinking is concerned with the skills or components in problem-solving. Benjamin Bloom, a typical representative of the educational approach to critical thinking, has developed a model called “Bloom taxonomy” to evaluate thought in educational settings (Irish, 1999). The model of critical thinking skills used in the study is developed on the basis of Richard Paul’s model, the representative of philosophical tradition to critical thinking, and Bloom taxonomy, because, as mentioned before, educational approach to critical thinking is the substantiation of philosophical approach to critical thinking. This section mainly explicates the two models.

### **2.1.3.1 Richard Paul's Model**

Richard Paul's model has been evolved and improved since it was proposed in 1993. The purpose of Paul's model has always been to develop a flexible theory of critical thinking that can be contextualized across various disciplines. As depicted in Figure 2.3, it consists of three parts: elements of reasoning, standards of thought, and intellectual traits (Paul & Elder, 2008a). Critical thinkers habitually employ the standards to assess the elements of reasoning in order to develop intellectual traits.

#### **Elements of reasoning**

There are eight elements of reasoning: purpose, point of view, concept, question, information, assumption, inference, and implication. He referred to them as the fundamental structure of human thought. He maintained that these eight 'parts' are always present in human thought consciously and subconsciously whenever and wherever reasoning is taking place. The ability to identify the elements of reasoning is essential to critical thinking. A person, who is adept at the identification of the elements, can be in a better position to recognize the flaw in this or that part, and thus, can be in a better position to analyze the mistakes in their thinking or in the thinking of others (Paul & Elder, 2002).



**Figure 2.3 Paul's Model (Paul & Elder, 2008a, p.19)**

Paul and Elder summarized the interrelations among the eight elements of reasoning in the following statements:

“Whenever you are reasoning, you are trying to accomplish some purpose, within a point of view, using concepts or ideas. You are focused on some question, issue or problem, using information to come to conclusions, based on assumptions, all of which have implications” (Paul & Elder, 2002, p. 53).

The elements of reasoning function in interdependent fashion, and the way one element functions can influence the manner in which the other element functions. These elements constitute an interrelated system which can be used to analyze the completion of thought whenever and wherever it occurs in any context.

### **Standards of Thought**

There are a range of intellectual standards from which we can choose to evaluate the quality of statements. However, the most fundamental are nine standards as the inclusion of Paul's model, which we routinely use in assessing statements—

clarity, accuracy, precision, relevance, depth, breadth, logicalness, significance, and fairness. Good critical thinking necessitates a command of standards of thought. Paul stressed that these fundamental standards require being infused in all thinking as the guide to better reasoning (Paul & Elder, 2008a).

Paul explained that clarity requires that the statement should be clear, because clarity is a gateway standard and determines accuracy, precision and relevance (Paul & Elder, 2002). However, a clear statement does not mean that the statement is accurate. Being accurate requires that something is represented in accordance with the way it actually is. A statement is both clear and accurate, but not necessarily precise. To be precise is to give the details to students for exactly understanding what is really meant. A statement can be clear, accurate and precise, but may not be relevant to the issue under the investigation. Relevance can be obtained when something is directly connected with the issue.

Paul continued to explain that a statement is clear, accurate, precise and relevant, but not so deep. It can be superficial. A statement lacks depth when it treats a complex issue superficially. They further explained that a line of reasoning can lack breadth even though it is clear, accurate, precise, relevant and deep. If an issue involves alternative perspectives and we fail to consider all the perspectives, we think narrowly, though we can obtain insights into one side of the issue. For logicalness, Paul and Elder explained that when we think, we bring together and combine a variety of views in some order. If combined thoughts are supportive of each other and make sense in combination, the thinking is logical. The thinking can be logical, but not significant, because we fail to recognize the most significant among the ideas or concepts relevant to an issue we think about. As a result, our line of reasoning lacks significance. When

the thinking is logical and significant, we want to make sure that the thinking is also justified. To justify the thinking is to think fairly in accordance with reasons in context.

### **Intellectual traits**

Critical thinking can be employed to serve two incompatible objectives: selfishness and fair-mindedness. Critical thinkers with fair-minded attributes can learn to identify the mistakes in their own thinking and, also in the thinking of others, while those with selfish traits develop critical thinking ability to recognize only the flaw in their opponents' reasoning. Paul referred to selfish thinkers as weak-sense critical thinkers, and fair-minded thinkers as strong-sense critical thinkers. Weak thinking lacks fair-mindedness and fails to consider viewpoints that contradict its own. Strong-sense thinkers work to be fair-minded and make efforts to understand others' point of view (Paul & Elder, 2002).

Critical thinking in fair-minded fashion requires intellectual virtues. These virtues constitute the third dimension of Paul's model. As required, fair-minded critical thinkers strive to develop eight essential intellectual habits that lead to a disciplined mind: intellectual courage, intellectual empathy, intellectual perseverance, intellectual humility, intellectual automaticity, intellectual integrity, confidence in reason, and fair-mindedness. These eight traits of mind are interdependent. The interrelations among the virtues of strong-sense thinking are explicated as follows:

“To become aware of the limits of our knowledge, we need the intellectual courage to face our own prejudices and ignorance. To discover our own prejudices, in turn, we often must intellectually empathize with and reason within points of view with which we fundamentally disagree. To achieve this end, we typically must engage in intellectual perseverance, as learning to empathically enter a point of view against which we are biased takes time and significant effort. That effort will not seem justified unless we have the necessary confidence in reason to believe we will not be tainted

or "taken in" by whatever is false or misleading in the opposing viewpoint" (Paul & Elder, 2002, p. 56).

To actualize fair-mindedness in critical thinking, it demands critical thinkers to be intellectually modest, intellectually courageous, intellectually honest, intellectually determined, intellectually empathetic, and have strong confidence in reason, and intellectually automatic, even though it is challenging and cannot be overtly taught (Paul & Elder, 2002).

Paul's model of critical thinking exemplifies perfections of strong and fair-minded thinking. Elements of reasoning and standards of thought constitute what is essential to critical thinking, while intellectual traits emphasizes what a critical thinker is disposed to be. It is concept-based, not composed of rules, procedures, and steps to follow. As a result, it is extremely flexible and applicable to any discipline and any level of thinking (Moseley, Baumfield, Elliott, Gregson, Higgins, Miller, & Newton, 2005).

#### **2.1.3.2 Benjamin Bloom's Model**

Benjamin Bloom's model--the Taxonomy of Educational Objectives aims to classify goals in the educational system, promoting research on problems and issues related to assessment of learning and on the relationship between assessment and education (Moseley et al., 2005). It intended to be helpful for teachers, administrators, and specialists who cope with curriculum and evaluation problems, not to provide insights into educational philosophy and teaching methods. Although it is not originally designed to enhance critical thinking instruction, its sections on analysis, synthesis and evaluation, contains a wealth of useful information about the instruction (Paul, 1985a).

Bloom's taxonomy consists of six hierarchical levels: knowledge, comprehension, application, analysis, synthesis, and evaluation, from the simple to the complex as the representation of thought. Six categories in the Taxonomy are interconnected in a stepwise manner from lower level 'knowledge' to the higher level 'evaluation'. As the foundation for higher levels, knowledge involves the recall of specific and isolable information and facts, of ways of organizing, judging, and criticizing facts and information, and of patterns, schemes, and structures by which information and facts are systemized (Bloom, 1956). As a precondition, knowledge requires one to comprehend what they remember about facts and information. After one knows and understands something, the next level is to apply them in particular and concrete situations.

The next higher level is to analyze material we understand and apply, breaking down the material into its componential parts and discerning the relationships among the parts and the way they are organized (Bloom, 1956). Still higher up is to synthesize the analyzed constitutes so as to form a whole and discover the patterns or structures not clear before. The highest level is evaluation, which is defined as making judgments about the quality of ideas, works, material, knowledge, and so forth (Bloom, 1956). It involves the utilization of internal criteria such as logic accuracy or consistency, and external standards for appraising the judgments. Bloom's taxonomy is a cumulative hierarchy in which six levels are ordered on a single dimension from simple to complex and from concrete to abstract. There is no overlap among these levels and mastery of lower levels is a prerequisite for mastery of higher ones (Krathwohl, 2002).

Bloom's taxonomy is a well-known framework for classifying a number of educational objectives into clear structures and a coherent framework for classifying

thinking according to levels of complexity. Bloom (1956) intended the Taxonomy to “be a classification of the student behaviors which represent the intended outcomes of the educational processes” (p.12). By depicting differences between the intended behaviors specified by instructional objectives and the actual behaviors as the result of students’ participation in the unit of classroom instruction, one can verify whether instructional objectives have been achieved, and whether a particular intended skill has been learned. Therefore, Bloom’s taxonomy is significantly valuable in education and can be applicable to all the subject-matter content at different levels of education in different schools (Bloom, 1956).

### **2.1.3.3 Implications for the Present Study**

Two models have their significance in developing students’ critical thinking. The elements of reasoning and standards of thought rather than critical thinking dispositions in Paul’s model is borrowed in the model developed in the study due to the fact that the study focus on critical thinking skills rather than dispositions. For learners, the precondition for them to be a critical thinker is to develop the capabilities of singling out the elements of critical thinking implicitly or explicitly expressed in a written text. Subsequently, learners are also required to use standards of thought to audit whether statements expressed in writings are clear, accurate, relevant to questions at issue, logical and detailed. Therefore, in the development of critical thinking through English reading, learners need to be cultivated to evaluate the whole thought and specific arguments presented in a written text by using elements of reasoning and standards of thought proposed in Paul’s model.

The Taxonomy which is a multi-tier model from the simple level to the complex level of thought corresponds to the stages of English reading process and the

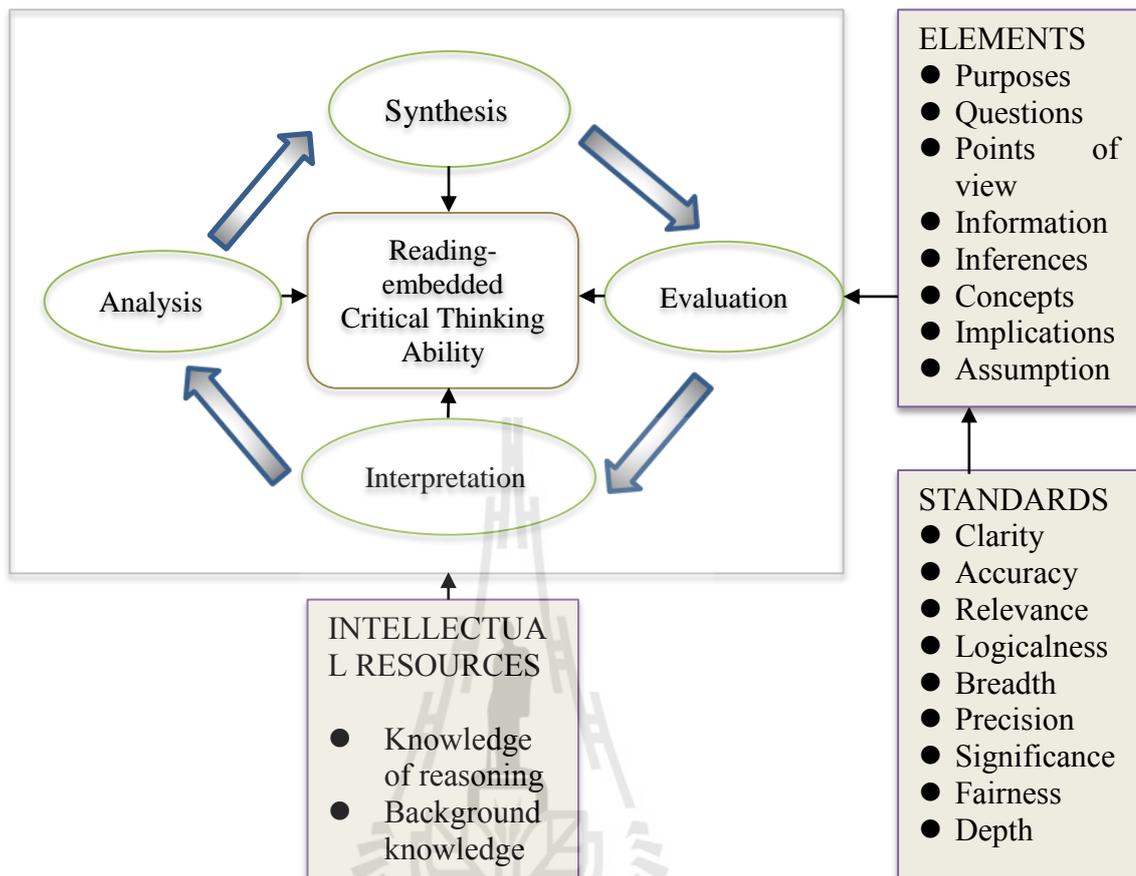
levels of critical thinking skills. In the English reading process, readers employ knowledge learned previously and presented currently in a reading text to reach comprehension, based on which higher levels of critical thinking skill: analysis, synthesis, and evaluation, can be improved. Nevertheless, it notes that the Taxonomy is one-sided hierarchy that limits our understanding of nature of critical thinking (Paul, 1985a). Paul pointed out that gaining knowledge simultaneously entails comprehension, analysis, synthesis, and evaluation. The present study takes the Taxonomy as a cyclical rather than a linear model. The primary part of the model used in the present study is adapted from higher levels of Bloom's taxonomy.

#### **2.1.3.4 Proposed Model for the Present Study**

For the purpose of developing critical thinking through English reading, the model of reading-embedded critical thinking skills (MRCTS) in this study is proposed. It consists of four components: critical thinking ability, elements of reasoning, standards of thought, and intellectual resources (see Figure 2.4). "Ability" component is the core of the model. "Intellectual resources" component provides materials used in 'ability' component; 'standards' component provides criteria against which "elements" component is assessed and criticized; 'elements' component is used to assess and criticize the integrity of thought. Through evaluating elements of reasoning, "standards" component indirectly plays a role in the highest level of critical thinking skills: evaluation.

The primary part of the model, 'ability component' is composed of critical thinking skills, which is developed as the main concern of this study. It draws inspiration and is adapted from Bloom's taxonomy. The development of critical thinking ability can be decomposed into the teaching and learning of critical thinking

skills. The critical thinking ability component subsumes four levels of critical thinking skills from the first, lower and simple level 'interpretation' to the fourth, higher and complex level 'evaluation'. Simple level 'interpretation' is the category for simple behaviors related to a simple problems or tasks (Bloom, 1956). Bloom stated that "a particular simple behavior can integrate with another equally simple behavior to form a complex behavior" (p.18). The complex level is the category for those complex behaviors related to complex problems or tasks. Bloom explained that the simple problems or tasks can be answered correctly and more frequently than complex ones. It is cyclical from interpretation to evaluation. The skills manifest themselves in the application of abstractions stored in "intellectual resources" component to particular and concrete situations. Critical thinking skills can be represented by one's competence at using intellectual resources in particular contexts. Intellectual resources include knowledge of reasoning concepts, principles and procedures used to assess arguments and statements, such as necessary and sufficient conditions, assumptions, presuppositions, premises, inclusions, evidence, deduction and induction, etc., and background knowledge in a particular area of study or practice (Bailin, 1998, p.4).



**Figure 2.4 The Model of Reading-embedded Critical Thinking Skills Adapted from Bloom's Taxonomy and Paul's Model**

In an English reading class, the development of critical thinking skills cannot take place without comprehension of what is presented in a writing text. Comprehension in the study is different from that in Bloom's taxonomy. Bloom (1956) defined comprehension as "a type of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated" (p.204). Bloom used comprehension as a broader term that "is related to a greater variety of communications than that encompassed by written verbal materials" (p.89). In contrast, comprehension in this study is associated with only

written reading comprehension. It refers to understanding or apprehension of what is being presented in a writing product. The understanding or apprehension is an initial step for the development of four levels of critical thinking skills.

The model of 'reading-embedded critical thinking skills' provides the foundation for the study. It contributes to the development of critical thinking skills training package in a reading class. And also, it plays an important role in the construction of the instrument 'reading-embedded critical thinking skill test'(RCTST).

## **2.2 Critical Thinking Instruction**

Long history of critical thinking instruction has prompted a variety of theories, principles, and approaches and strategies concerned with critical thinking instruction. This section mainly discusses the following topics: disputes on instruction of critical thinking, instructional approaches to critical thinking, and specific instructional strategies for critical thinking.

### **2.2.1 Controversy in Critical Thinking Education**

Since Socrates practiced teaching critical thinking, a variety of principles and concepts have been proposed about instruction of critical thinking. However, no agreement has been achieved on how to teach critical thinking, though all agree that teaching students to be critical in their studies and their future life and work should be the goal of higher education (Moore, 2011). The conflicting debate has been continuing on whether critical thinking can be taught independently of subject-matter or not, which is closely related to the disputable assumption: whether there are general critical thinking skills, and whether general critical thinking skills can be transferred if there are. The assumption of general critical thinking skills hinges on the assumption of the transferability.

### 2.2.1.1 Subject-Independent or Subject-Specific

McPeck (1981, cited in Paul, 1985b) raised a debate on whether critical thinking can be taught independently of subject-matter areas. In challenging the current trend to teaching critical thinking in an independent course, McPeck (1981, cited in Paul, 1985b) argued:

“It is a matter of conceptual truth that thinking is always thinking about X, and that X can never be 'everything in general' but must always be something in particular. Thinking, then, is logically connected to an X. Since this fundamental point is reasonably easy to grasp, it is surprising that critical thinking should have become reified into a curriculum subject and the teaching of it an area of expertise of its own ... “ (Paul, 1985b, p. 36).

McPeck’s conclusion that “critical thinking should become reified into a curriculum subject” is based on the evidence that “thinking is always thinking about something.” McPeck’s view emphasizes the importance of subject matter in teaching critical thinking. Ennis (1989) counted such subject specificity as epistemological subject specificity, in contrast with empirical subject specificity. The defining characteristic of epistemological subject specificity is that critical thinking varies from field to field, while for empirical subject specificity, it is impossible for simple transfer of critical thinking ability from one domain to another domain, and that the transfer can be achieved only through frequent application of critical thinking principles across a variety of domains. McPeck differentiated extreme subject specifist and weaker relativist (Moore, 2004, p.14), with the latter admitting that students can carry their critical thinking skills across disciplinary subjects, but only after these skills are learned in one mother discipline. Extreme subject specifist and weaker relativist have the same belief that critical thinking skills can only be developed within specific subject content.

McPeck's position indicates that the teaching of critical thinking can only be conducted within the content of students' disciplinary studies. McPeck's objection to development of students' critical thinking skills in an independent critical thinking course or program can trace back to Toulmin's ideas on field-dependent standards (Moore, 2004). In the book *the Use of Argument*, Toulmin (2003) argued that "the merits to be demanded of an argument in one field will be found to be absent (in the nature of things) from entirely meritorious arguments in another" (p.235).

In echoing McPeck's argument, Moore (2004) claimed that his analyses of a range of samples provide supportive evidence for a subject-specific approach. However, unlike McPeck who strongly opposes teaching of critical thinking in an independent course or program, Moore believed that critical thinking can be developed as a subject of study in itself. He claimed that the discourse associated with critical thinking training independent of subject matter may be best thought of as not a general discourse at all, because it focuses on a specific knowledge-form, i.e., argument (Moore, 2004, p.13).

McPeck's subject specific approach incurs rebuttal of some famous scholars and researchers. Paul (1985b) directly criticized McPeck's view of critical thinking as "a rarefied form of logical atomism" (p.36), and claimed that McPeck's theoretical underpinnings have some fundamental mistakes. Paul contended that the logic and reasoning we use is less discrete domain specific, but more open and multi-textured. Paul argued that the model of critical think is based on the disciplined generalist, not on the domain-bound individual with subject-specific skills (Paul, 1985b). The knowledge and information that constitutes each discipline have been and continue to be produced by what it means to think critically (Beyer, 2008). Ennis (1989)

pointed out that it is a mistake that critical thinking is about something and can only be taught in school subjects. Quinn (1994) pointed out five weaknesses in McPeck's own critical thinking skills and argued that McPeck's own critical thinking deficiencies could be cured only in an independent critical thinking course.

The debate on teaching critical thinking subject-dependently or independently has been theoretically a stalemate and will continue. In order to acquire a deeper understanding into this issue, it is imperative to explore another closely related issue: whether critical thinking skills are general and transferable.

#### **2.2.1.2 Critical Thinking as a General Skill**

General critical thinking skills have proliferated throughout educational discourse (Johnson, 1998). Skills-centered approaches are advocated under the assumption that critical thinking skills can be generalized, separated, and instructed (Ennis, 1989). Johnson, Siegel & Winch (2010) claimed that there exist some general and transferable critical thinking skills such as identifying assumptions, tracing relationships between premises and conclusions, and identifying standard fallacies. These skills do not require any domain specific content and can apply to diverse contexts and domains. Halpern (1998) echoed that the goal of critical thinking instruction is not only to have students successfully understand and appropriately use critical thinking skills, but also to have them recognize and automatically employ where the critical thinking skills are suitable. A panel of critical thinking experts agreed that, although the application of critical thinking skills in any situation depends upon domain-specific knowledge, the ability to identify, analyze, synthesize and evaluate arguments can transcend specific discipline (Facione, 1990a).

Willingham (2007) used problem-solving as an example to discuss when the transfer of skills can take place. If one knows a problem's deep structure, "the knowledge of how to solve the problem will transfer well" (p.11). He distinguished the surface structure from deep structure of a problem. It is the deep structure of a problem that forms obstacles of transfer of critical thinking skills. One type of problem may have different surface structures, but the same deep structure. Familiarity with surface structure cannot guarantee smooth transfer of learned skills. Such view was also discussed by Halpern (1999) who believed that, in order to improve the generalization and transfer of critical thinking skills, we need to incorporate 'structure training' into the instruction of critical thinking to increase the probability that students can recognize when a specific critical thinking skill is needed. Halpern (1999) pointed out that "structural training" can cultivate students' "structural sensitivity" which can help students develop retrievable cues from structural aspects of a problem or an argument, and then, when these structural aspects in the novel context are discerned, students are able to use the cues to retrieve and employ appropriately necessary critical thinking skills for the novel context.

However, McPeck (1984b) challenged the trend and said that critical thinking has nothing to do with general skills. The notion of general critical thinking ability is conceptually incoherent. Saying there is a general critical thinking ability is just like saying there is a general speed. McPeck explained that we cannot assume a general skill called 'speed' or the like to an individual, because an individual may be speedy or slow in many different ways, such as running, reading, or changing.

McPeck is not the single opponent of general critical thinking skills. His claim is corroborated by some other researchers. Willingham (2007) pointed out that

critical thinking cannot be taught as skills, like riding a bicycle, and that it is not a set of skills which can be employed at any time in any context once learned. He explained that “the process of critical thinking is intertwined with the content of thought” (p.8). There are no general critical thinking skills which are not heavily embedded in domain knowledge. Johnson, Siegel & Winch (2010) believed that, though there seems to be general and transferable critical thinking skills such as identifying unstated assumptions in an argument, they are actually domain-specific. Johnson explained that what appear to be general and transferable critical thinking skills are dependent on domain-specific content knowledge when implementing them, and that, even the same skill such as identifying unstated assumptions of arguments, when applying in different fields such as chemistry and aesthetics, is actually two different skills (p.62). Steve Johnson (1998) goes to an extreme when he says that general context-independent critical thinking skills are entirely illusory and should be abandoned.

As we know, general critical thinking skills are contingent on the assumption of transferability. The discussion of generality of critical thinking skills cannot be separated from that of their transferability. The assumption of general critical thinking skills implies another assumption that, if a battery of general skills is mastered well, these skills can be used in other curriculum areas and personal daily or professional lives. However, some researchers claimed that there is no evidence provided in the studies to justify whether the gain in students’ critical thinking skills can guarantee that students are able to apply the acquired critical thinking skills in a novel context. They cast doubts on the generally transferable critical thinking skills. Perkins and Salomon (1989), after examining relevant studies, reported that no findings lend support to the existence of such transferable critical thinking skills. Singley and

Anderson (1989) also reported that recent studies provide no positive evidence for transferable problem-solving skills across a variety of different problems.

To conclude, the controversy in critical thinking instruction is referred to as the generic vs. discipline-specific debate between the generalists and the specificists. Ennis (1989, 1990, 1997) is considered as the leading defender of the generalist movement, while McPeck (McPeck, 1984a, 1984b, 1985, 1990) is regarded as the leading defender of the specificist movement. The debate centers around the three closed related issues: subject-specificity, general skills, and transfer. These issues are contingent on each other. McPeck criticized the trend of teaching critical thinking as a subject of study in itself and claimed that critical thinking is always about something in particular, and therefore critical thinking must be taught by embedding it into something particular in a curriculum subject. McPeck reiterated that there are no general and transferable critical thinking skills, but subject-specific skills. In contrast, Ennis and other generalists (Higgins & Baumfield, 1998; Johnson et al., 2010; Paul, 1985b; Quinn, 1994) assert that there exist indeed general and transferable critical thinking skills which can apply across disciplines and fields. These skills must be taught in a general course where they are not overshadowed by subject content.

Although the importance of subject-specific knowledge is not ignored, it is contended that there are some general critical thinking skills unrelated to subject-content. Subject-specific knowledge is not a sufficient condition for thinking critically (Ennis, 1989). Even if we accept the important role of subject-specific knowledge in thinking critically, there are still some areas within different subjects that are “sufficiently similar or overlapping as to make general thinking skills possible, especially during the process of schooling” (Higgins & Baumfield, 1998, p.396).

### **2.2.1.3 Implications for the Present Study**

In essence, the debate between the generalists and the specificists is like two sides of one coin: the generalist movement focuses on the mental aspect of critical thinking, i.e. logical principles of reasoning independent of subject matter; the specificist movement emphasizes the practical aspect of critical thinking, i.e. application of reasoning principles in subject matter (Bailin, 1998; Bailin et al., 1999b). The difference between the generalist and the specificist is actually the range of application of intellectual resources rather than general and transferable critical thinking skills themselves. Intellectual resources include background knowledge and reasoning principles, concepts and procedures (Bailin, 1998). The researcher believes that emphasis on one end of reasoning principles, concepts and procedures does not imply the ignorance of the other end of the application along the continuum. It is different focuses that matter. This study places emphasis on both of reasoning principles, concepts and procedures and their application to professional and daily lives. The competent application of reasoning principles, concepts and procedures is an attribute of critical thinking skill. Therefore, the development of general critical thinking skills is actually to develop students' competent application of reasoning resources in various practical contexts.

### **2.2.2 Confucian Culture and Critical Thinking**

The Confucian culture imposes great influence on Chinese style of teaching and learning (Day, 2003; Huang, 2008; Turner, 2006; Yang, Zheng, & Li, 2006). Hu (2002) believed that there are some culturally-rooted assumptions of education in Chinese society. Firstly, the Confucian tradition emphasizes the importance of education in tuning an ordinary person into a superior one. Education is taken as a means of

strengthening a nation. Secondly, education does not improve only intellectual development, but also moral qualities. It is a combination of moral and intellectual cultivation. Thirdly, education is regarded as a process of accumulation of knowledge rather than a practical process of using knowledge for immediate purposes. Finally, innate intelligence and ability are not determinants of education achievements. Everybody can be educable and educated to be perfect.

These assumptions have traditionally shaped Chinese style of teaching and learning (Hu, 2002). There is a maxim for a qualified teacher. 'If the teacher wants to give a student a bowl of water, they need to have a bucket of water'. It implies that the learner learns knowledge by imitating and repeating others (mainly the teacher) rather than by thinking critically (Shi, 2006). A stereotype of teaching process begins with the teacher's selection of points of knowledge from the textbook, and then, with the teacher's explanation, analyses and elaboration of these points, and finally, with the delivery of a carefully sequenced bowl of knowledge for learners to understand and memorize. The focus of the teaching is not on how to create, construct and apply knowledge, but on how to transmit and internalize authoritative knowledge in an efficient way (Hu, 2002). Accordingly, the learner needs to be receptive and embrace the knowledge from the teacher or books. They are expected to respect and not challenge the authoritative such as the teacher, well-known scholars, and not express their own independent ideas until they obtain sufficient knowledge to make reasonable judgments (Hu, 2002).

Chinese students who are educated in the Confucian culture are found to be insufficient in critical thinking (Atkinson, 1997; Turner, 2006). They are reluctant to criticize the articles written by authoritative scholars, engage in classroom discussion

and debate, and evaluate their peers' and teachers' performance. Chinese students' inactive and passive participation in classroom activities are often interpreted as lack of critical thinking and analytical skills (Lun, Fischer, & Ward, 2010). Atkinson claims that critical thinking is a cultural and social practice and thus its instruction cannot be easily achieved with EFL/ESL learners. However, some scholars express their doubts on the claim. Huang (2008) interviewed ten Chinese students in UK and found that students experienced some difficulties in applying critical thinking into their learning. The first difficulty is their weak English proficiency which makes it difficult to apply critical thinking. The second difficulty is their unclear understanding of critical thinking. Lun et al. (2010) also found that insufficient English proficiency discourages Chinese students to overtly express their critical thinking in the classroom even though they want to do.

It is controversial that Chinese students' insufficiency in critical thinking is due to their culture: the Confucian culture. One possibility is that indeed, Chinese students cannot express their critical thinking or apply critical thinking in their learning due to their culture background. Alternative possibility is that Chinese students cannot express or apply critical thinking because their poor English proficiency prevents them to do.

### **2.2.3 Approaches to Critical Thinking Education**

The debate on whether critical thinking can be cultivated independently or not leads to different instructional interventions in critical thinking development. In particular, dispute on whether critical thinking is subject-specific or not brings about four main types of instructional approach to critical thinking: general critical thinking course, infusion, immersion and mixed approach of general approach with infusion or immersion (Ennis, 1989). In addition to the instructional approaches, there is another

type of instructional intervention: the whole academic degree program where effects of complete degree programs on the development of critical thinking skills are investigated (Behar-Horenstein & Niu, 2011; Niu et al., 2013). Niu et al. (2013) considered whole academic degree program as “holistic approach”. Due to its long duration of non-obvious and indirect instruction, holistic approach is discussed independently of the other instructional approaches.

### **2.2.3.1 Holistic Approach**

Holistic approach normally lasts for at least one year, even more than two or three years. The approach mostly uses pretest and posttest to measure the utility or efficiency of an academic program in the development of critical thinking. In a study conducted by McMullen and McMullen (2009), graduate nurse participants from three successive classes were drawn to explore the effect of a two-year nursing program on the improvement of participants’ critical thinking skills. The program is composed of first-year core and theoretical didactic courses and second-year practices in the clinical setting. No direct instruction of critical thinking took place. California Critical Thinking Skills Test (CCTST) was employed to assess participants’ critical thinking at program entry and three times during the program. The result indicated that the growth on participants’ critical thinking skills was not linear, but quadratic, and that students at higher and median skill levels at the program entry showed a modest increase in evaluation skills, a sharp decrease in analytic skills and unchanged inference skills, while those at lower skill levels showed substantial increase in all three critical thinking skills. However, as McMullen and McMullen themselves pointed out, one independent sample without a control group restricts us to claim a causal relationship between the growth in participants’ critical thinking and their participation in the two-year program.

Given the threat to internal validity due to the lack of a control group, Kaddoura (2011) included one control group in a study to examine students' critical thinking development in three-year programs. One group enrolled in a case-based and student-centered nursing program, while the other a teacher-centered and didactic nursing program. Both groups have not received direct instruction of critical thinking. At the end of third year, participants' critical thinking was assessed with California Critical Thinking Skills Test (CCTST). Kaddoura found that participants in case-based group performed better than those in traditional didactic group in the total critical thinking score and all the critical thinking subscales. Kaddoura thought that the case-based programmatic intervention may be more effective in improving critical thinking skills than traditional lecture-based one.

However, researchers admit that length of programmatic approach, a threat to validity, is an intervening factor which poses some confounding effects on the consequence of the program. Moreover, no control group or non-random selection, inherent defects in the programmatic approach, impose another threat to internal validity when a claim is made that a certain programmatic intervention causes improved changes in students' critical thinking. Behar-Horenstein and Niu (2011) pointed out that, among these studies, few have made efforts to address these threats in programmatic intervention. In spite of these defects inherent in instructional program, it is undeniable that, to a certain extent, these studies suggest a positive effect of programmatic intervention in critical thinking development.

### **2.2.3.2 Alternative Instructional Approaches**

There are two camps of instructional approaches to critical thinking. One camp, defended by Ennis and then by Davies, advocates for explicit instruction of

critical thinking under the assumption that critical thinking can be defined as a set of skills and these skills are specific, teachable through description and practicing, and that, once learned, they can be used for a variety of issues (Davies, 2006, 2011; Ennis, 1991). In compliance with this view, critical thinking can be taught explicitly as a subject of study itself (general approach), or by being infused into a subject (infusion), or combination of general approach with infusion or immersion (mixed approach). The other camp with proponents—McPeck and Moore, upholds that critical thinking can be regarded as a subject-specific skill which can be learned and practiced only in particular subject matter (McPeck, 1985; Moore, 2011). Therefore, leading figures in this camp advocate for the immersion approach to critical thinking instruction. Moore advocates that critical thinking can be developed only through prolonged immersion in the content of discipline, and that exposure to and participation in a variety of subject matter instructions can result in an automatic critical thinker.

Ennis (1989) elaborated four instructional approaches to critical thinking. General approach is that critical thinking can be taught in separation from the presentation of content of existing subject matter; infusion refers to an approach that instruction of critical thinking abilities is embedded into existing subject matter in which general principles of critical thinking are made explicit; immersion is similar to infusion except that general principles are not made explicit; for the mixed approach, general principles of critical thinking are taught in a separate course in parallel with subject-specific critical thinking instruction. Ennis claimed that views on general and transferable critical thinking skills determine what approach is chosen by researchers and the approach chosen implies the support with the generalist or the specificist. Therefore, the author has to make it clear that a certain instructional approach chosen

to be employed in this study does not imply the author's alignment with either side of the debate.

Among studies on effectiveness of instructional interventions in the improvement of critical thinking skills, the author believes that no evidence has sufficiently persuasive power than what is drawn from meta-analysis studies. Behar-Horenstein and Niu (2011) reviewed 61 empirical studies published from 1994 to 2009, which focused on the improvement of college students' critical thinking skills through instructional interventions, and found that the first frequently used approach (52% of the studies reviewed) is immersion; the second one is holistic approach (19%), and the other three approaches have an equal rank as the third (each 9.5%). Immersion is reported to yield lowest growth of students' critical thinking out of all the approaches. Abrami, Bernard, Borokhovski, Wade, Surkes, Tamim, and Zhang (2008) conducted a meta-analysis of instructional interventions affecting critical thinking skills with 117 empirical studies published from 1960s through 2005 and found that the mixed approach outperforms and the immersion underperforms the other three instructional approaches significantly. General approach and infusion are found to have moderate effects. Infusion and immersion are employed more frequently than the other two approaches. In another meta-analysis of effects of instructional interventions on college students' critical thinking skills, in which immersion is the first frequently used approach and holistic approach is second, Niu et al. (2013) found that a single intervention longer than 12 weeks is more effective than single interventions shorter than 12 weeks or the holistic approach. It can be inferred from such findings that the effect of a single intervention is confounded with length of exposure to that intervention. The longer exposure to a single intervention, the more effective such single intervention is.

### **2.2.3.3 Implications for the Present Study**

The aforementioned research reviews indicate that, among five instructional approaches to critical thinking, immersion which is used most frequently has the smallest effect. Holistic approach also has a small effect, though better than immersion. Mixed approach is reported to be most effective in improving students' critical thinking ability. General approach and infusion both have a moderate effect. Another finding is that effect of a particular approach is influenced by length of exposure to the approach. The longer the exposure is to one single approach, the more effective the approach is found to be. Although, the duration of 12 weeks was found to be a determinant of effects of a single approach, it is not reasonable to make a conclusion that the length of exposure of at least 12 weeks is a threshold for effects of a single approach.

Although mixed approach was found to be the most effective in developing students' critical thinking skills, it is impossible to change the curriculum for EFL English majors to set up a new course of critical thinking in this study. The change of the curriculum needs the permission of educational administration and it is not so easy to obtain such permission. Therefore, in this study, the approach 'infusion' was employed, because it was found to be more effective than immersion and holistic approach, even though not more than mixed approach.

### **2.2.4 Teaching Strategies for Critical Thinking**

In addition to teaching approaches, educators and researchers attempt to deploy a variety of specific teaching strategies to develop critical thinking. Among the most frequently used strategies are group discussion, concept mapping, and questioning (Lee, Chiang, Liao, Lee, Chen, & Liang, 2012; Qatipi, 2011; Savage, 1998; Walker, 2003).

These three teaching strategies were used in the development of critical thinking skills in this study. This section mainly discusses them.

#### **2.2.4.1 Group Discussion**

Many studies have been conducted to examine the effects of group discussion on critical thinking development. It has been found to be an effective teaching strategy for the development of critical thinking. Some studies discussed and elaborated group discussion used in their courses (Bucy, 2006; Sionti, Ai, Rosé, & Resnick, 2011); some conducted empirical studies to investigate effects of group discussion (Chiu, 2009; Pena & Almaguer, 2012; Yang, 2008), which could provide more persuasive evidence.

Hudgins and Edelman (1986) conducted a study with the duration of six weeks to examine the effect of group discussion on critical thinking development. Ten classes in five primary schools were chosen as a sample and in each class students were assigned into two groups: experimental group and control group. The instrument 'Test of Critical Thinking' developed by the researchers was employed in pretest and posttest to assess participants' critical thinking. The results showed that there is no significant increase in children's critical thinking ability in the experimental group compared to the control group. The difference is negligible. Hudgins and Edelman explained that no significant increase is due to a short period of six weeks, and that more lessons and longer discussion could bring about significant improvement of critical thinking.

Hayes and Devitt (2008) conducted a study with the duration of sixteen weeks in a college. The ACT-CAAP critical thinking test was administered in pretest and posttest to measure participants' critical thinking skills in two groups. The results showed that group discussion in small classes can significantly improve critical

thinking skills more than in large classes. Another important finding is that non-native English speakers acquired a significant improvement of their critical thinking skills, which was not found for native English speakers, though native English speakers have higher scores of critical thinking skills in both pretest and posttest than non-native English speakers. Hayes and Devitt explained that native English speakers have higher scores because of their higher reading ability. In addition, the reason why non-native English speakers obtained significant improvement of critical thinking skills while native English speakers did not is that familiarity with new terminology and frequently practicing of group discussion contributes to the development of critical thinking skills.

The empirical evidence indicates that group discussion is more effective for college students than for the students in the primary school. That is, it can impose greater influence on the improvement of critical thinking with learners who have grown up intellectually and cognitively. Its positive effects on development of critical thinking also depend on the length of discussion treatment.

#### **2.2.4.2 Concept Mapping**

In addition to group discussion, a concept map has been found to be also effective in the development of critical thinking. Vacek (2009) introduced concept mapping as a teaching tool to facilitate critical thinking. He believed it would improve the use of various critical thinking skills. However, Vacek provided no experimental evidence to support such an assertion, and no description of how to use concept mapping in a particular context. The empirical evidence for the effect of concept mapping on improvement of critical thinking can be found in the study conducted by Wilgis & McConnell (2008). There is a small convenience sample of fourteen 'Novice Graduate Nurses' and a two-day treatment intervention in the study with only one

treatment group. Concept mapping was employed as both a teaching strategy and evaluation of critical thinking. Concept mapping was found to be effective in accelerating participants' critical thinking ability to synthesize and prioritize information, make appropriate plans and make judicious decisions. However we can still cast some doubts on the findings because of short-time treatment, no control group, and implausible instruments.

The convincing and persuasive empirical evidence is offered in the study by Lee et al. (2012). The study used quasi-experimental design in a two-year registered nurse baccalaureate program. The results showed that, although there is non-significant decrease of critical thinking in both groups, participants in the experimental group significantly outperformed the control group in inference and deduction among five critical thinking abilities and have higher growth rates of these two skills. Lee explained that the decrease of critical thinking for participants in both groups is due to regression effects with higher initial scores. As mentioned earlier, it is actually long duration of the holistic approach that confounds the effect of concept mapping.

The above studies are conducted on the basis of the content of nursing training, and thus, it may be effective only in the nursing educational setting. It needs to some studies conducted in an EFL educational situation to justify whether concept mapping is similarly plausible for EFL learners' development of critical thinking. For that reason, Khodadady & Ghanizadeh (2011) conducted a study with the aim to investigate the influence of concept mapping on the development of critical thinking ability with EFL learners. Thirty-six students at upper intermediate and advanced levels were chosen and randomly assigned to treatment and control groups. Treatment intervention consists of concept mapping after reading each text and formulation of

required post-reading activities during the three-month session. "Watson-Glaser Critical Thinking Appraisal" (CTA) was employed to measure participants' critical thinking ability. The results showed that concept maps significantly foster EFL learners' critical thinking ability in the reading class. This study suggests that concept mapping as a teaching strategy is effective across specific disciplines in improvement of critical thinking.

#### **2.2.4.3 Questioning**

Asking right and critical questions can stimulate and direct critical thinking and push us forward towards the continuous exploration of opinions, insights and judgments (Browne & Keeley, 2007). Seker & Komur (2008) investigated the relationship between critical thinking skills and in-class questioning behaviors of students. Twenty second-year students of an English language teaching department were chosen and assigned to a higher-level group and a lower-level group in terms of critical thinking ability. A reading text was used to elicit information about questions asked by participants and the "Ennis-Weir Critical Thinking Essay Test" was used to measure critical thinking ability. It was found that students with lower-level of critical thinking ability ask less questions than those with higher-level, and that students with higher-level ask more questions concerning comprehension, application, analysis, synthesis and evaluation when compared to questions concerning knowledge asked by those with lower-level. This study proved that critical thinking ability has an important influence on the types of questions asked by participants. However, it did not provide direct evidence about effects of questioning on critical thinking development.

Alexander, Commander, Greenberg, and Ward (2010) explored the effects of a 'four-question teaching technique' on the enhancement of critical thinking

in online discussion. The study used the combination of two strategies: questioning and group online discussion. Twenty-four students were chosen to participate in online discussion forums. There were three asynchronous discussion forums with topics about three different cases studies on behaviorism, social cognitivism and metacognition. The first forum was conducted during the second week of the course. The second and last forums were conducted at the middle and end of the course, respectively. The participants were randomly assigned to groups of 5 or 6, but they were not always in the same group for each forum. The four-question technique was employed for three forums, but completed only for the second discussion forum, not for others. The instrument 'Washington State University Critical and Integrative Thinking Scale (WSUCITS)' was used to measure critical thinking. The four-question technique was found to have a positive role in improving participants' critical thinking. The same effective results were found in another study by Barnett & Francis (2011). The difference is that written questions, not oral ones, were used in the study. It was found that the students receiving quizzes which contain written high order thinking questions performed significantly better than those receiving quizzes which do not contain such questions.

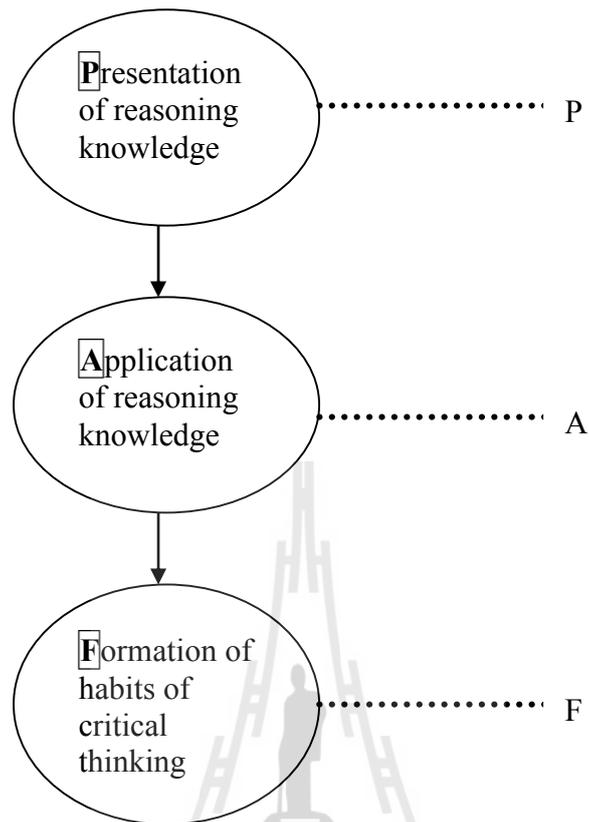
The evidence provided in the above studies proves that there is a close correlation between learners' critical thinking ability and the type of question. Students with higher critical thinking ability tend to ask more questions than those with lower critical thinking ability. Questioning plays a significant role in developing critical thinking.

### **2.2.5 Critical Thinking Skills Training**

This section mainly discusses practical training of critical thinking skills in EFL reading class. It includes model of guided instruction of critical thinking skills, model of critical thinking skills development and instructional sequence of critical thinking skills.

#### **2.2.5.1 Instructional Sequence of Critical Thinking Skills**

Well-established presentation-practice-production (P-P-P) sequence stands as a useful teaching procedure (Harmer, 2007). In presentation stage, the teacher presents new instructional items; in practice stage, with the teacher and peers' assistance, students practice the items through gap-filling task, question-answer exercise, diagramming, discussion and so forth; in production stage, students are independent to produce the items by themselves. The procedure of presentation-practice-production is not necessarily followed rigidly and it depends on students' level and need, and teaching materials (Byrne, 1986). P-P-P allows the teacher control the instructional content and pace (Klapper, 2003). With more practice, the teacher's control gradually reduces and students become freer until they are independent of the teacher's control completely. It substantiates the notion of "practice-make-perfect", common in development of many skills (Carless, 2009).



**Figure 2.5 Sequences of the Critical Thinking Skills Training**

Based on P-P-P, the instructional sequence of critical thinking skills in a reading class consists of three stages: presentation, application, and formation of habit (P-A-F) (see Figure 2.5), which corresponds to the three developmental stages of a cognitive skill elaborated in ACT theory: declarative knowledge, knowledge compilation and procedural knowledge. The first stage is to explain reasoning principles, concepts and procedures; the second stage is to apply reasoning principles, concepts and procedures in interpreting, analyzing, synthesizing and evaluating information. The third stage is to form the habit of using skills to guide behavior and belief through practice.

### **2.2.5.2 Model of Guided Instruction of Critical Thinking Skills**

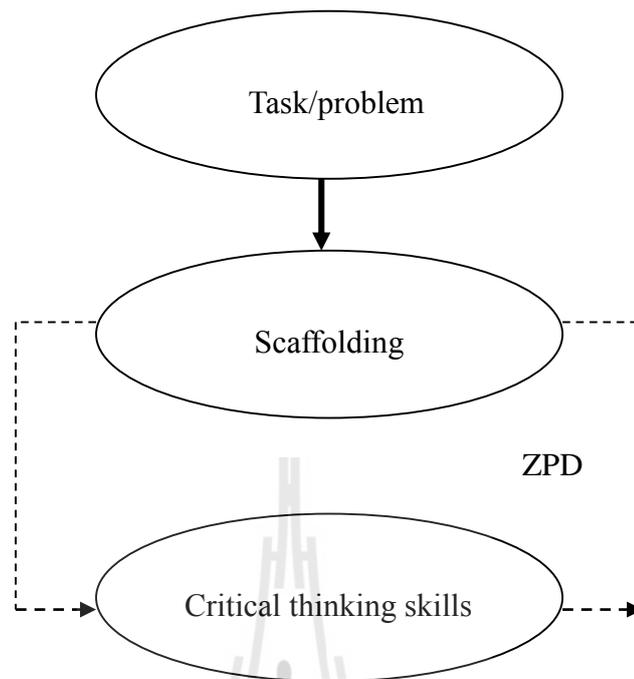
The term 'Zone of Proximal Development' (ZPD) is firstly introduced in Vygotsky's sociocultural theory. Vygotsky (1978) explained ZPD as the distance between the actual developmental level and the potential developmental level. The actual developmental level represents the mental abilities by which learners can solve a problem or perform a task of a certain level of difficulty independently. It is end products of development and indicates what learners have achieved developmentally. In contrast, ZPD represents what learners will achieve with help from others. Zone of proximal development today will become the actual developmental level tomorrow. That is, what learners can do with help today can develop into what they can do by themselves. The gap between the current developmental level and the potential developmental level can be filled with assistance from more capable peers and teachers.

Wood, Bruner, and Ross (1976) introduced the concept of 'scaffolding' for assistance from more capable peers and teachers. Scaffolding, as a metaphor, represents a form of assistance rendered by teachers and peers. Learners can be guided or supported through scaffolding to solve a difficult problem or task which cannot be achieved alone. Therefore, practically, it functions as various strategies that can increase or withdraw guidance or support according to the zone of proximal development of learners. After reviewing literature on scaffolding, Rafik-Galea and Nair (2007) found five types of scaffolding strategies. They are 'modeling', 'feedback', 'questioning', 'cognitive structure' and 'ask for participation'. However, in teaching practices, what scaffolding strategy is employed depends on teaching content and learners' ZPD. Although some general scaffolding strategies can be predetermined,

they are susceptible to change in response to the actual developing level of learners in the classroom.

The aim of teaching is to fill the gap between actual development level and potential development level, not ZPD itself. Therefore, scaffolding has more implications on teaching practice than ZPD (Chaiklin, 2003). The term 'Zone of Proximal Development' refers to the learning and development phenomenon, while the term 'scaffolding' refers to assistance from others. The assistance provided by teachers and peers is not development-oriented, but oriented to problem-solving or task-performing. As a result, it is applicable for educators to distinguish ZPD from scaffolding before they are desired to base the teaching on ZPD and scaffolding.

This study takes Vygotsky's Zone of Proximal Development (ZPD) as the theoretic foundation for the guided instruction of critical thinking skills and utilizes scaffolding to assist EFL learners in the development of critical thinking skills and reading comprehension. For the utility of scaffolding, two principles need to be elaborated and followed, which are adapted from Commeyras (1990) and Wood et al. (1976). The first principle is to avoid traditional teacher-learner interaction where the teacher has the right answer and the learner attempts to figure out the right answer through the interaction, because such traditional interaction inhibits learners thinking and establishes the teacher as the authority. The second one is to allow learners to do as much as possible for themselves. Only when learners fail to follow the teacher's instruction, the teacher can scaffold directly. The teacher's next instruction is determined by the learner's success or failure in solving a problem or performing a task.



**Figure 2.6 Model of Guided Instruction of Critical Thinking Skills**

The model of the guided instruction of critical thinking skills with EFL learners was proposed in the study (see Figure 2.6). Based on comprehension improved by necessary scaffolding, learners are assigned with a task to complete or a problem to solve, which involves application of reasoning principles, concepts and procedures. The teaching of critical thinking skills can take place in the zone of proximal development. In ZPD, at the beginning, learners can apply knowledge of reasoning they have learned before into the independent task-performing or problem-solving, and then, if they cannot perform a task or solve a problem independently, through scaffolding they gain assistance from the teacher and their peers.

It is a cyclical process through which learners can develop their critical thinking skills. Therefore, scaffolding plays a significant role in the instruction of reasoning principles, concepts and procedures, and in the application of these principles, concepts and procedures into interpreting, analyzing, synthesizing and evaluating

arguments presented in the text. The task and problem stimulated by questioning provide the arena where learners can practice critical thinking skills through scaffolding offered by the teacher and the peer.

### **2.2.5.3 Critical Thinking Skills development Model**

Anderson's Adaptive Control Theory (ACT) is a theory on acquisition of cognitive skills (Anderson, 1982). Declarative knowledge and procedural knowledge stored in mind are considered as fundamental for the acquisition of skills in ACT. Declarative knowledge is the representation of knowledge of skills, while procedural knowledge is the representation of procedures and steps of skills.

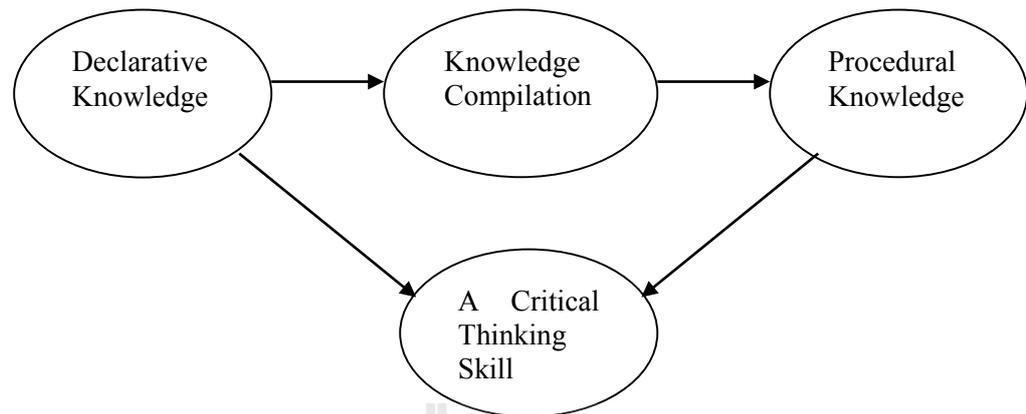
According to ACT, the process of development of a skill goes through three stages. The first stage is 'declarative stage' in which learners receive instruction of information about a skill. Information is encoded as facts and concepts which are stored in the form of networks as the essentials of declarative knowledge. The second stage is 'knowledge compilation' in which declarative knowledge is converted into procedural form in procedural knowledge through repeated practice. The third stage is 'procedural stage' in which procedural knowledge is tuned and refined so that it can be applied appropriately and automatically. It is a process of speedup and appropriateness.

Knowledge from instructions is described in declarative form and then, is used interpretatively. That is, declarative knowledge is received by learners declaratively and is used interpretatively. Procedural knowledge is represented as productions. Productions operate on the declarative facts and concepts. Each production consists of a primitive rule, a condition, and an action. The primitive rule specifies when a skill should be applied; the condition specifies the environment under which a skill can be applied; the action defines what should be done when the production is

implemented. The sequence of productions corresponds to cognitive steps when performing a skill. Actually, procedural knowledge is composed of methods and procedures for the implementations of skills.

There is a gap between declarative knowledge and procedural knowledge, which is bridged by knowledge compilation (Anderson, 1982). Knowledge compilation has two subprocesses: composition and proceduralization. Composition is used to compress the sequences of productions into one. However, composition requires the retrieval of specific declarative information represented in declarative knowledge. Proceduralization can be used to build the production that no longer requires the retrieval of declarative information, because the result of retrieval operation has been built into the production. Through continuous composition and proceduralization, a speedy and unitary production can be produced. Each application of productions can lead to the decreasing number of sequence of productions. It notes that forming a new production does not imply the loss of declarative information represented in declarative knowledge. Declarative knowledge can affect the application of production, but indirectly, through interpretation.

Adapted from ACT, the model of development of a critical thinking skill (CTSDM) is developed (see Figure 2.7). The model consists of four elements: declarative knowledge, knowledge compilation, procedural knowledge and a critical thinking skill. Among the important elements are declarative and procedural knowledge that are significant for the development of a critical thinking skill.



**Figure 2.7 Critical Thinking Skills Development Model**

Critical thinking can be considered as a stable and enduring ability that is instantiated into a variety of critical thinking skills, that is, critical thinking skills can transform into critical thinking ability through training and practice. Each type of critical thinking skill is composed of and substantiated by application of knowledge from declarative knowledge and procedures from procedural knowledge to performance of certain tasks. Declarative knowledge can be developed by teaching reasoning principles and concepts, and procedures, of which, reasoning procedures can be converted into procedural knowledge gradually through knowledge compilation by practice. The remaining reasoning principles and concepts in declarative knowledge can be consolidated through practice. Knowledge compilation separates the knowledge of reasoning procedures from the other in declarative knowledge and transfers it into procedural knowledge. Through composition and proceduralization, knowledge compilation produces productions for the transferred procedural knowledge of reasoning procedures, stating conditions, time and action for applying a critical thinking skill.

In a word, the development of a critical thinking skill starts with the declarative reasoning principles and concepts and procedures. These principles and concepts are stored in a network form and can be retained and consolidated with training and practice, while procedures can be converted into procedural knowledge through knowledge compilation. Once declarative knowledge is proceduralized, the knowledge needs to be tuned and refined further (Anderson, 1982, p.370). It involves the choice of method and the search among alternate paths of steps for performing certain tasks. Concomitantly, there is a gradual process of speedup. In terms of application of a critical thinking skill in performing certain tasks, proceduralized knowledge and the corresponding declarative knowledge are retrieved and impose significant influence on the implementation of a critical thinking skill.

To conclude, instructional sequence of critical thinking skills describes general instructional stages of critical thinking skills; model of guided instruction is about assistance and guidance offered by the teacher and peers when students develop their critical thinking skills; model of critical thinking skills development describes the internal process of developing a critical thinking skill. There are close relationships among P-A-F instructional sequence, the model of critical thinking skills development, and the model of guided instruction of critical thinking skills. In the presentation stage, declarative knowledge in model of critical thinking skills development is creating. In the application stage, knowledge compilation in the model of critical thinking skills development is applied and the model of guided instruction is put into use. In addition, three teaching strategies of group discussion, concept mapping and questioning are employed. In the formation stage, procedural knowledge in the model of critical thinking skills development is built and refined, and declarative knowledge is consolidated.

### 2.2.6 Assessment of Critical Thinking Skills

Among the most commonly used tests of critical thinking skills are California Critical Thinking Skills Test, Watson-Glaser Critical Thinking Appraisal, and the Cornell Critical Thinking Test (Abrami et al., 2008; Fawkes, O'meara, Weber, & Flage, 2005; Niu et al., 2013). The California Critical Thinking Skills Test (CCTST) is a standardized, 34-item, multiple-choice test with the aim to assess three core critical thinking skills: analysis, evaluation, and inference; and two traditional reasoning skills: deduction and induction.

To examine whether the California Critical Thinking Skills Test (CCTST) measured the enhancement of critical thinking skills gained by students after they completed critical thinking courses, Facione (1990b) conducted four experiments and found that CCTST can detect the growth in critical thinking skills achieved by the students. CCTST has shown to be reliable and valid, and been widely used to assess college students critical thinking skills (Phillips, Chesnut, & Rospond, 2004). The Watson-Glaser Critical Thinking Appraisal (WGCTA) and the Cornell Critical Thinking Test (CCTT) also enjoy high popularity among researchers. Both of them are standardized, multiple-choice tests and have been proved to have high reliability and validity. However, a standardized multiple-choice test has inherent weakness.

Multiple-choice tests can only reveal test-takers' recognition of knowledge, not their underlying reasoning ability (Ku, 2009). Norris (1988) cautioned that multiple-choice critical thinking tests cannot distinguish "variance in scores due to the differences in the background beliefs of examinees which are not part of ability to thinking critically from variance due to differences in critical thinking ability" (p. 2). The reason is that alternative solutions to a problem and alternative approaches to

reaching a solution which are the nature of critical thinking bring about difficulties for the multiple-choice tests. This type of format structure, as Yeh (2001) pointed out, cannot assess respondents' ability to weigh various claims according to available evidence, and decide which claim is well supported and why alternative claims are not well supported, even though respondents can perform well.

Ennis (1993) suggested an open-ended, but focused approach to the assessment of critical thinking skills, which reiterates his earlier suggestions of viable alternatives to multiple-choice tests, such as the addition of justification requests to multiple-choice items, essay testing and performance assessment. Therefore, a test that requires test-takers to read and evaluate arguments through written essay is considered as authentic assessment of critical thinking, such as 'The Ennis-Weir Critical Thinking Essay Test' and 'the ICAT Critical Thinking Essay Test'.

It is noticeable that there are some differences between the test through reading a written essay and through writing an essay, even though they both belong to an essay test of critical thinking. The test that requires test-takers to read and evaluate arguments through written essay can be designated as a 'receptive test', while the test that requires test-takers to apply their critical thinking into writing an essay as a 'productive test' (Hinkel, 2011). Receptive tests place emphasis on application of knowledge of reasoning into recognition, analysis, synthesis, and evaluation of arguments with more weight on declarative knowledge than procedural knowledge. The range of expected responses in receptive tests is limited due to limited arguments from input texts. In contrast, productive tests focus on application of knowledge of reasoning into reasonable and logical expression of points of view with more weight on procedural

knowledge than declarative knowledge. The range of expected responses in the productive test is larger than in the receptive test.

The commonly used tests-CCTST, WGCTA, and CCTT are the examples of a receptive test, while the ICAT Critical Thinking Essay Test and the Ennis-Weir Critical Thinking Essay Test is an example of a productive test. Whether receptive test or productive test, these essay tests are time-consuming and not appropriate for large-scale assessment. Therefore, to achieve cost-effective balance, it is better to combine multiple-choice and giving reasons for choice.

In empirical practice, aforementioned tests have to be translated into different versions when they are employed in non-English speaking contexts. Instrument translation poses some threats to validity of the translated instrument (Maneesriwongul & Dixon, 2004; Peña, 2007; Rode, 2005; Sripusanapan, 2001; van Widenfelt, Treffers, Beurs, Siebelink, & Koudijs, 2005). Bias is a direct threat to validity. There are some types of bias, in particular, cultural bias, which translation cannot smooth away.

There are two procedures of instrument translation in order to reduce potential threat as much as possible. One is translation-back-translation procedure that is commonly used to guard against potential threat to validity of translated instruments. However, linguistic translation-back-translation is not sufficient to effectively remove cultural bias. Linguistic equivalence in the translation of research instruments cannot remove potential differences which lead to different patterns of response, due to different cultural interpretations (Peña, 2007). It is the carefully crafted and culturally appropriate translations that can ensure that examinees' performance on the measure is most likely and accurately to be reflective of their critical thinking. However, given the great difference between the western and eastern culture, it is not an amiable task to

achieve culturally appropriate translation. Therefore, in practice, adaptation is commonly used in conjunction with partial translation to change, or reword, even create new questions and items so that the original cultural flavor can be maintained to a greater extent.

Another procedure is 'multidisciplinary committee approach' through which a group of people from different areas prepare translation (van de Vijver & Tanzer, 2004). It can enhance quality of translation through collective efforts and, especially, in the case when they have complementary expertise of different areas. However, it is practically unfeasible to group people with different areas of expertise, such as psychological, linguistic, and cultural.

In conclusion, given the weaknesses of standardized multiple-choice and essay tests, this study develops the essay test for the assessment of EFL learners' critical thinking skills in the format that combines the answer to the question and giving reasons for the answer. A complete translation of the whole instrument is avoided, due to the threat of cultural bias to the validity of the test. Another reason for avoidance of translation of the entire test is that critical thinking skills are taught with EFL learners by using an English version of reading materials and the teaching is mostly undertaken in English. Hence, translation from English to Chinese may distort the results of tests and learners' performance on tests is not likely to be indicative of their real critical thinking skills due to the great difference between the western and eastern cultures.

## **2.3 Critical Thinking Skills in an English Reading Class**

The research on critical thinking and reading is a recent endeavor. Generally, there are three main concerns as the focus of previous studies: the relationship between critical thinking and reading, the effects of critical thinking on reading comprehension, and critical thinking teaching in reading. Before further discussion, it is advisable to explicate the similarities and differences between critical reading and critical thinking and reading comprehension instruction. Afterwards, it mainly discusses the relationship between critical thinking and reading, effects of critical thinking on reading comprehension, and the teaching of critical thinking embedded into English reading.

### **2.3.1 Similarities and Differences of Critical Reading and Critical Thinking**

Development of critical thinking through reading necessitates the clarification of differences between critical reading and critical thinking. Socially and culturally, Shannon (cited in Taglieber, 2000) defined critical reading as the understanding of one's history and culture beyond the lines and their connection to the reader's current history and culture. Critical reading is the ability to analyze what a writer says and the method that the writer uses to express the idea (Zabihi & Pordel, 2011). In comparison with aforementioned definitions of critical thinking, critical reading focuses on reading comprehension, a kind of deep comprehension beyond the lines to discover effects of social and cultural context on the ideas and messages expressed in writings. In contrast, critical thinking emphasizes evaluation and judgment on arguments and thoughts expressed in writings by using reasoning knowledge.

The difference between critical reading and critical thinking does not deny close relations between what is read critically and what is thought critically. Critical reading and critical thinking share such skills as interpretation, analysis, and inference

(Taglieber, 2000). However, the difference is that these skills serve different purposes. The skills in critical reading are used to gain information in the written text, especially the information beyond the lines, such as the main idea, writers' purposes and the like, and to discover ideology underpinning the writer's points of view and purposes and its relation to the reader's own ideology (Zabihi & Pordel, 2011). They do not involve application of reasoning principles, concepts and procedures in deep comprehension. Critical reading aims to obtain the deep comprehension of what is expressed in a written text (Wall & Wall, 2005). In contrast, critical thinking skills are employed to make judgments or decisions about what to do or believe when reading. They require the application of reasoning principles, concepts and procedures to evaluate arguments and thoughts, on the basis of which, judgment can be made.

To conclude, there are some differences and similarities between critical reading and critical thinking. They are similar in their use of skills involved. They are different in terms of purpose achieved and knowledge used. Critical reading skills aim to obtain deep comprehension of the author's purpose and the underlining ideology, while critical thinking skills are used to evaluate the arguments and thoughts in writings and make judgment on what to believe. Moreover, different knowledge is used in the utilization of skills. Critical reading utilizes knowledge of the author's social and cultural reality besides linguistic knowledge, while critical thinking employs knowledge of reasoning. Critical thinking is general and can be used in different areas of human activity, while critical reading is only concerned with reading comprehension (Vaseghi, Gholami, & Barjesteh, 2012). Critical reading is a prerequisite for critical thinking. Deep comprehension contributes to the development of critical thinking and in turn, critical thinking enhances critical reading.

### 2.3.2 Reading Comprehension Instruction

There are three orientations to reading comprehension instruction: comprehension-as-outcome, comprehension-as-procedure and comprehension-as-sensemaking (Aukerman, 2013). Comprehension-as-outcome pedagogy attempts to have students figure out ‘right’ meanings of texts. In order to arrive at predetermined correct textual understanding, the classroom instruction is often organized by verbal questions that “primarily assess whether students have reached that understanding” (Aukerman, 2013, p.3). Comprehension-as-procedure pedagogy focuses on doing the right kind of reading in pre-specified ways. Reading strategy instruction is one key instantiation of this orientation. Comprehension-as-sensemaking pedagogy emphasizes actual meanings readers make of texts, not concerning ‘rightness’. Aukerman further divided the last orientation into expressivist comprehension-as-sensemaking pedagogy and dialogic comprehension-as-sensemaking pedagogy. The main difference between the two comprehension-as-sensemaking pedagogies is that the former “does not identify a major role for the interplay of different readers’ interpretations”, while the latter does (Aukerman, 2013, p.6).

Aukerman (2013) argued that, although comprehension-as-outcome pedagogy dominates reading instruction, reading researchers and educators should attempt to make dialogic comprehension-as-sensemaking pedagogy as dominant. Reading comprehension is a fluid, dynamic and context sensitive process of meaning construction that requires a dynamic and flexible approach to reading comprehension instruction. Meaning construction is fundamentally unfinished, contingent work that centrally depends on the dialogue of multiple voices (Bakhtin, 1981). The research on dialogic orientation to reading comprehension instruction identifies four major

approaches: content-rich instruction, discussion, argumentation and intertextuality (Wilkinson & Son, 2011). The key feature of these approaches is that “the juxtaposition of multiple perspectives or discourses from different readers gives rise to tension and sometimes conflicts among different voices”, from which “meaning and understanding merge” ((Wilkinson & Son, 2011, p.367).

However, the dominance of dialogic comprehension-as-sensemaking pedagogy in classroom reading instruction practice does not imply the denial of comprehension-as-outcome pedagogy and comprehension-as-procedure pedagogy. As Aukerman (2013) pointed out, comprehension-as-outcome pedagogy and comprehension-as-procedure pedagogy can be invited to support ongoing interpersonal and intrapersonal dialogue about meaning construction of texts. In that case, these two pedagogies are subordinate to the focus of dialogic comprehension-as-sensemaking pedagogy in actual classroom practice and complement dialogic approaches rather than compete with them.

### **2.3.3 Relationship between Critical Thinking and Reading**

Critical thinking is a kind of higher order thinking which can help readers act critically while reading. Likewise, reading is a process which requires thinking on the parts of readers. Reading comprehension requires the reader to think critically about and evaluate alternative interpretations and determine the meaning of a text, while critical thinking is the process in which the reader uses reasoning to determine which interpretation is consistent with evidence from the text and background (Commeyras, 1990). Some empirical evidence lends support to the idea that reading comprehension calls for critical thinking and critical thinking through reading needs comprehension.

Mansoor, Marzieh, and Minoos (2010) conducted a study on the relationship between test-takers' critical thinking and their performance in the reading section of

paper-based TOEFL (PBT). Eighty-three female advanced EFL learners from a variety of academic backgrounds, who were learning English in a private institute in Iran, were chosen as the participants of the study. They were administered three tests: the reading section of a 2002 version of General Training IELTS, the Reading Section of PBT, and Watson–Glaser Critical Thinking Appraisal-Form A. The results indicated that there is a high positive correlation between test takers' critical thinking ability and their performance in the reading section of PBT.

In another study, Kamali and Mansoor (2011) examined the relationship between critical thinking ability, resilience, and reading comprehension of texts containing unknown vocabulary items. Sixty-three intermediate Iranian EFL learners were selected to take part in the study. Peter Honey's (2004, cited in Kamali & Mansoor, 2011) 30-item critical thinking questionnaire was used to measure critical thinking skills. Kamali and Mansoor found that there is a significant relationship between critical thinking ability, resilience when facing unfamiliar vocabulary, and reading comprehension. Participants' critical thinking ability has a significant effect on resilience and reading comprehension, and resilience also has a significant effect on reading comprehension.

The study conducted by Hosseini et al. (2012) corroborate the close relationship between critical thinking and reading comprehension. Seventy junior and senior EFL students majoring in English Literature and English Translation were randomly selected to participate in the study. Two instruments—TOEFL Reading Comprehension Test and California Critical Thinking Skill Tests (CCTST)-Form B, were used to assess participants' reading comprehension and critical thinking ability, respectively. Pearson

product-moment correlation analysis indicated that there is a large, positive relationship between participants' reading comprehension and critical thinking.

These studies provide persuasive evidence of the close relationship between critical thinking ability and reading. Aloqaili (2011) claimed that the literature shows an agreement among researchers and educators that there is a strong relationship between critical thinking and reading comprehension.

#### **2.3.4 Effects of Critical Thinking on Reading Comprehension**

The effects of teaching critical thinking on reading comprehension was examined by Fahim and Sa'eepour (2011). They selected sixty intermediate female Iranian EFL learners with similar educational backgrounds, family and social status, and homogenized them through a Nelson test. These participants were assigned to two groups: treatment group and control group. The treatment group received eight sessions of treatment using group debate as a dominant teaching activity. The results indicated that incorporating the teaching of critical thinking skills can help the participants improve their reading comprehension though it is not significant.

Fahim, Barjesteh, and Aseghi (2012) conducted a similar study to further explore the effects of critical thinking strategies training on male/female EFL learners' reading comprehension. They selected all two hundred and forty male/female college sophomores majoring in English language and literature as participants. These participants were assigned to two groups according to their English proficiency level of low and high based on TOEFL scores. Each proficiency group was then divided into critical and non-critical groups. Each critical and non-critical group was further divided into male and female groups. Critical groups were provided with critical thinking skills training during eight sessions with each lasting one and a half hours. Only reading

comprehension tests were used in the study. The results showed that critical thinking skills treatment significantly improves participants' reading comprehension performance. However, they found that different language proficiency levels do not cause variances in the effects of critical thinking strategies training.

The above studies indicate that critical thinking has a positive effect on reading comprehension. However, quantitative research design can offer no information on how critical thinking influences reading comprehension. Some researchers attempt to explain the process of the effect of critical thinking on reading comprehension. Norris and Phillips (1987) held that critical thinking provides an explanation for reading process. Reading is more than understanding what is on the page. It involves thinking. Critical thinking works as an effective means to activate schemata and create new ones by comparing ideas and connecting to the existing one (Aloqaili, 2011). After a schema is activated, one has to analyze it into what constitutes the schema, and make judgments about which constituent is desirable for generating alternative interpretations. One can utilize critical thinking ability to synthesize the data and information understood from the text and to evaluate the association of activated schemata with surface structure fragments of the text. As Norris and Philips (1987) pointed out, critical thinking is a process which the reader uses to make decision and accept alternative explanations.

### **2.3.5 Critical Thinking Teaching Through English Reading**

The English classroom is an appropriate place for the actualization and application of critical thinking skills (Gomez, 2010). The language class is one of the venues for developing critical thinking skills (Daud & Husin, 2004). Out of his experience of infusing critical thinking into reading instruction, Commeyras (1993) developed one instructional approach to improve critical thinking in elementary school

reading instruction—dialogic-thinking reading lesson (D-TRL). The long-term goal of this approach is to engage students in reflective thinking when reading in order to foster their critical thinking ability.

Daud and Husin (2004) conducted the study to examine the improvement of computer software used in a literary class on developing critical thinking skills. Two intact classes with a total of forty undergraduate students with a lower intermediate English proficiency level were chosen as an experimental group and a control group, respectively. The experimental group was permitted to use a computer concordancer to analyze *Othello* in an extended reading course, while the control group had to search for word frequency manually for the analysis of *Othello*. The results indicated that there is a significant difference in critical thinking skills between the experimental group and the control group after treatment, and that the concordancer significantly contributes to the difference between the two groups, although small. The finding shows that the combination of the text with other teaching methods can be more effective in developing critical thinking skills.

A similar study was conducted with EFL learners in a college by Gomez (2010), with the aim to explore the effect of structured reading instruction on the development of critical thinking skills in contrast with traditional reading instruction. Eighty-three college students across a variety of disciplines who take the first level of English as part of their undergraduate program were chosen and randomly assigned to treatment group and control group. The only difference between the two groups was that the treatment group was given extra activities for each lesson of the English textbook to complete their work with reading exercises. These extra activities were designed to activate critical thinking skills and to apply them in the expansion of reading exercises. The

Spanish version of California Critical Thinking Skills Test (CCTST) was used as the data collection instrument in the study. The results indicated that the treatment intervention did not lead to a significant gain in the development of critical thinking skills. The researcher explained that the reasons for non-significant results may be lack of development of critical thinking for students in previous instruction, and the translation of the Spanish version of CCTST. However, the subsequent informal survey reported that the students in the treatment group acknowledged the improvement of their critical thinking skills through exposure to extra reading exercises.

These studies, which are dominantly concerned with the development of critical thinking skills, provide evidence to support the development of critical thinking in reading instruction from different perspectives.

## **2.4 Summary**

Given a long history of critical thinking theory and instruction, a variety of concepts and principles about its definitions, models and instruction have been proposed and developed. Some focus on its philosophical aspect; some on its psychological aspect; some on its educational aspect. Among the models proposed, Bloom's taxonomy has been dominant in critical thinking instruction with emphasis on higher order thinking skills of analysis, synthesis and evaluation. By criticizing Bloom's model, Paul proposed his own model which consists of elements of reasoning, evaluation of reasoning and dispositions. Based on Bloom's and Paul's models, an adapted model is developed for the present study.

It is a controversial issue on the pedagogical principle of critical thinking between the generalist and the specificist. Some argue for context-free teaching, while

some for context-dependent teaching. Correspondingly, different educational approaches have been proposed and developed. In an attempt to solve the debate between the generalist and the specificist, Bailin (1998) proposed the ‘intellectual resources’ and claimed that the dispute between the generalist and specificist is not about the issue on whether critical thinking skills are general and transferable, but on the range of application of the intellectual resources.

In pedagogical practice, critical thinking is primarily taught as critical thinking skills. A variety of instructional approaches and specific teaching strategies have been developed and experimented with, among which immersion and the holistic approach are found to be less effective in improving critical thinking skills. Group discussion, concept mapping and questioning are teaching strategies that are commonly used in practice, and proved to be effective at varying degrees. Based on Vygotsky’s ZPD and Johnson’s ACT, the model of instruction of critical thinking skills and the model of critical thinking skills development are developed, respectively.

With respect to critical thinking development in English reading, a few studies are conducted in the EFL setting, particularly, in English reading instruction. These studies prove that there is a close relationship between critical thinking and reading comprehension. Critical thinking has a positive effect on reading comprehension. The studies provide strong evidence to support the development of critical thinking in English reading instruction.

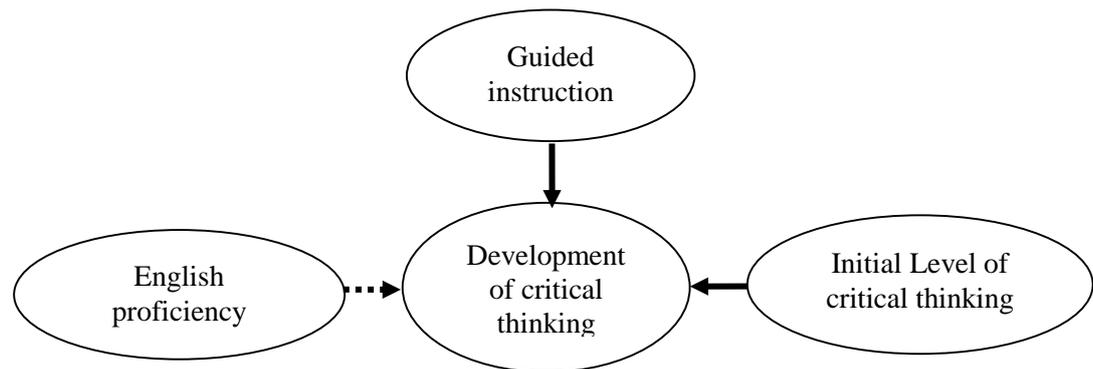
## **CHAPTER 3**

### **METHODOLOGY**

This chapter discusses research design to address the research questions. It provides a detailed explanation of conceptual framework that provides the paradigm for inquiry. Then, it describes the mixed research design of qualitative and quantitative methods, including population and sample, data collection instruments, critical thinking skills training package, data collection procedure and data analysis. Finally, ethical consideration, pilot study and summary are presented.

#### **3.1 Conceptual Framework**

The study explores not only the development of critical thinking skills in the EFL reading class, but also potential effects of factors on the development. Besides the guided instruction, the factors of participants' initial level of critical thinking skills and their EFL proficiency could affect the development. The relationships among them are presented in Figure 3.1.



**Figure 3.1 Conceptual Framework for the Development of Critical Thinking Skills**

In the EFL reading class, participants' critical thinking was developed under the guided instruction. Two factors could have potential effects on the development of their critical thinking skills: English proficiency and initial level of critical thinking. Although some empirical studies indicate that English proficiency does not make any difference in the results of critical thinking skills training (Fahim et al., 2012; Rafik-Galea & Nair, 2007), English proficiency is a positive predictor of EFL reading comprehension (Koda, 2005), which is the necessary basis for the development of critical thinking skills. Therefore, EFL English proficiency could indirectly affect the development of critical thinking skills through reading comprehension (represented by dashed line). In addition, it was found that participants with different initial levels of critical thinking skills exhibited different growth rates and trajectories in the development of critical thinking skills (McMullen & McMullen, 2009). Therefore, participants' initial level of critical thinking skills could have direct effects on the development of critical thinking skills.

### 3.2 Research Design

The present study employed the mixed design of quantitative and qualitative methods. The choice of research methods is guided and determined by the research questions. Exploratory and confirmatory research questions in the present study necessitate the research design of mixed methods that can provide insights and understandings into the main concerns under investigation. Confirmatory questions such as whether the development of learners' critical thinking skills really happens and whether learners' English proficiency and initial level of critical thinking skills affect the development, need quantitative research techniques to provide confirmatory answers. Exploratory questions, such as how learners' critical thinking skills are developed, and what learners' perception of the instruction and the development is, make qualitative techniques necessary. Investigation of all these aspects of the development of critical thinking skills can not offer reliable and deep insights if only one research method is used. As a result, the issues under investigation in the present study require a combination of quantitative and qualitative methods.

Mixed design can provide a range of techniques to collect and analyze data. These data collected and analyzed by different quantitative and qualitative techniques are complementary, providing different levels of insights into different aspects of the main issue, i.e. the development of critical thinking skills. Inclusion of quantitative data can assist in making up for insufficiency of qualitative data in that the findings can be typically generalized, while inclusion of qualitative data enables the investigator to explore processes underlying the findings emergent from quantitative data (Onwuegbuzie & Leech, 2004). Therefore, convergence and corroboration of findings

from quantitative and qualitative data can provide strong evidence for the conclusion that learners' critical thinking skills develop if they really take place.

### **3.3 Research Participants**

The present study was conducted in Tongling University in China East, where the researcher works as an English teacher. The selection of the setting for the study is determined by the fact that the study focuses on the development of critical thinking skills with EFL learners in the Confucian culture. The other reasons include the researcher's accessibility to participants in the study and the researcher's familiarity with the instructional system of the setting. In the university, English is taught as a foreign language with English majors and non-English majors. This study was conducted in the school of foreign languages with EFL English majors.

For English majors, an English reading course is compulsory for freshmen and sophomores. There are four classes in total: two classes of freshmen and two classes of sophomores. The researcher instructed freshmen in different academic years. In one academic year, the researcher taught two classes of freshmen, and in the other academic year, the researcher taught only one class of freshmen. One of two classes of freshmen in one academic year was chosen for the pilot study; one class of 50 freshmen in the other academic year was chosen as sample for the main study, participating in reading-embedded critical thinking skill test Form A, B and C, critical thinking skills training package, learner's journal, and perception questionnaire.. It is mainly the purposeful sampling. The reason for purposeful sampling is that the study explores the effects of English proficiency and initial level of critical thinking skills on the development of critical thinking skills, and therefore, selecting freshmen as sample rather than

sophomores can mostly facilitates such exploration because they have the similar learning experiences in senior middle school and have not been greatly influenced by a distinctive learning context in university.

For learner's journal and semi-structured interview, participants were also chosen by purposeful sampling. Firstly, according to the results of Form A of the RCTST, students were classified into three groups with three initial levels of critical thinking—lower, intermediate and higher. Afterwards, for each level, five students were chosen purposefully from three groups, respectively. The main reason for purposeful sampling is to explore the development of critical thinking skills with a broad range of subjects and to guarantee variation on phenomenon under exploration. The researcher has to make sure that the prime components of sampling are represented and diversity is subsumed so that the process of development of critical thinking skills with EFL learners can be inquired in details in the specified setting.

Participants were college students of ages of 18-20. Most of them were female. From primary school to college, they were taught mostly in the teacher-centered teaching context. They began to study English when they were in the third grade in their elementary school and continued to study it until they graduated from high school. The participants had studied English as a foreign language for about nine years before they obtained admission to the university. After having enrolled at university, they were required to study English for four years as English majors to develop the five English skills: reading, writing, listening, speaking and translating, besides the mastery of knowledge of literature and culture about English-speaking countries. English reading, as a compulsory course for EFL English majors, aims to develop their reading ability.

### 3.4 Data Collection Instruments

Research questions guide and determine the choice of research methods and in turn, specify the type of data. Given the fact that mixed methods were employed in the study, there were two types of data collected through quantitative and qualitative techniques: quantitative data and qualitative data, which required different instruments.

The data collection instruments were actually divided into two types: quantitative data collection instruments and qualitative data collection instruments. Instruments used to collect quantitative data include reading-embedded critical thinking skill test and national higher education entrance examination, while those for qualitative data collection contain learner's journal and semi-structured interview. Participant perception questionnaire (PPQ) was used to collect both quantitative and qualitative data. These instruments collected the relevant data for correspondingly answering different research questions (see Table 3.1). The following is a detailed discussion of each instrument.

**Table 3.1 The Instruments for Corresponding Research Questions**

Research Questions	Themes of Questions	Instruments
Question 1	Whether guided instruction in an English reading class develop learners' critical thinking skills	<ul style="list-style-type: none"> <li>• Reading-embedded critical thinking skill test—Form A, B and C</li> </ul>
Question 2	Process of development of learners' critical thinking skills	<ul style="list-style-type: none"> <li>• Learner's journal</li> <li>• Semi-structured interview</li> </ul>
Question 3	Effects of learners' initial level of critical thinking skills on the development of critical thinking skills	<ul style="list-style-type: none"> <li>• Reading-embedded critical thinking skill test—Form A, B and C</li> </ul>
Question 4	Effects of learners' English proficiency on the development of critical thinking skills	<ul style="list-style-type: none"> <li>• Reading-embedded critical thinking skill test—Form A, B and C</li> <li>• National higher education entrance examination</li> </ul>
Question 5	Learners' perception of the guided instruction	<ul style="list-style-type: none"> <li>• Semi-structured interview</li> <li>• Perception questionnaire</li> </ul>
Question 6	Learners' perception of the improvement of critical thinking skills	<ul style="list-style-type: none"> <li>• Semi-structured interview</li> <li>• Perception questionnaire</li> </ul>

### **3.4.1 Reading-Embedded Critical Thinking Skill Test**

Since the instruction of critical thinking was commenced, a number of critical thinking tests have been developed in order to diagnose the level of students' critical thinking and verify the success of teachers' efforts in teaching students to think critically. Ennis (2009) divided these tests into three types: 1) general-content, multi-aspect critical thinking test, 2) general-content, aspect-specific critical thinking test, 3) subject-specific, multi-aspect critical thinking test. Ennis explicated that general-content refers to the content adapted from a number of subject matter areas and/or daily life experiences, while subject-specific content is adapted from one subject matter area; multi-aspect means that critical thinking tests assess more than one aspect of critical thinking, while aspect-specific means the assessment of one aspect of critical thinking. No subject-specific, aspect-specific tests have been found. Most tests have a heavy reliance on multiple-choice testing format. However, some researchers believe that the multiple-choice format does not provide direct evidence for critical thinking (Ku, 2009; Norris, 1988, 1989). The instrument used to assess participants' development of critical thinking skills in this study is a general-content, multi-aspect critical thinking test and avoided a multiple-choice testing format (see Appendix A).

The instrument for assessing critical thinking skills in the study—reading-embedded critical thinking skill test, was adapted from existing assessment instruments and the exercises in books on critical thinking. It had three forms: Form A, B and C, and was constructed in a format structure of questions and giving reasons for answers to the questions, which attempted to elicit participants' real ideas without guessing. The RCTST consisted of short and long written passages, each followed by one or several

questions. Based on the comprehension of the passages, test-takers were required to answer the questions and offer reasons for the answers.

The passages and questions was selected and, if necessary, adapted from the existing assessment instrument of critical thinking skills: *The international critical thinking reading & writing test* (Paul & Elder, 2006), and two books: *Critical thinking skills: Developing effective analysis and argument* (Cottrell, 2005) and *Critical thinking (9th ed.)* (Moore & Parker, 2008). Paul and Elder's (2006) test aims to assess learners' ability to "think in a disciplined and skilled way" and "to determine the extent to which learners have and have not learned fundamental critical thinking, reading and writing skills" (p.4). They considered critical thinking skills as essential to reading and writing and believed that through reading, readers can recognize elements of reasoning and use standards of thought to evaluate them. Similarly, in writing, students have to present elements of reasoning and consistently use standards of thought to examine the elements in their writings. Paul and Elder thought that there are five levels of proficiency from reading and writing to critical thinking. For reading, that is Level 1—paraphrasing a text sentence by sentence, Level 2—explicating the thesis of a text, Level 3—analyzing elements of reasoning in a text, Level 4—evaluating the elements in a text by using standards of thought, and Level 5—role playing the voice of the writer in a text.

Paul and Elder (2006) provides three long passages and each passage assesses test-takers' five levels. In light of the purpose of this study, three long passages and corresponding questions were selected for three forms of the RCTST, each passage for each form. Each passage was used to assess only two levels: Level 3—analyzing elements of reasoning and Level 4—evaluating the elements by using standards of thought.

The short passages in the test were selected from the activities and exercises in the two books, and the corresponding questions were developed by the researcher. The book *Critical thinking skills: Developing effective analysis and argument* contains examples and activities of using critical thinking skills based on reading comprehension, which is appropriate for this study in terms of development of critical thinking skills through reading. Most of short passages were selected from this book. The other book *Critical thinking (9th ed.)* contains examples and activities about how to diagram arguments, from which three short passages were selected, each for each form of the RCTST.

The RCTST had three forms which were administered three times, each with one form. The reason for three forms is that they can provide information about the patterns of the development of critical thinking skills. Each form had the same format structure: several short passages for assessing interpretation, analysis and synthesis, and one long passage for assessing evaluation including the elements of reasoning and standards of thought. Most passages in each form contained arguments, except some used for assessing participants' skill to distinguish argument from explanation, description and summary. Each short passage was followed by one question, and participants were required to answer the question and then give reasons for their answers. Long passage had several questions and test-takers were required to answer the questions, but not give their reasons for their answers. Items 1-4 were used to assess interpretation skill; items 5-10 were used to assess analysis skill; item 11 were used to assess synthesis skill; items 12-25 were used to assess evaluation skill (items 12-17 for elements of thought, items 18-25 for standards of thought). The instrument was validated by experts and piloted. After that, it was administered with participants for the main study.

The instrument used the passages to assess critical thinking skills rather than reading skills. Reading comprehension was the prerequisite for the assessment. Whether the reading materials are used to assess critical thinking skills or reading skills depends on corresponding questions for reading materials. If questions need to be answered by using specific reasoning principles, concepts and procedures, the questions can be regarded as assessing critical thinking skills. If answers to questions do not involve the application of knowledge of reasoning, but information expressed in reading materials, the questions can be considered as assessing reading skills. The following excerpt illustrates how the questions assess critical thinking skills.

The article outlined the difference between individual yawns and infectious yawning. It referred particularly to research by Professor Platek which suggests that only humans and great apes yawn sympathetically. The article went on to say that people who yawn more easily in response to other people's yawns are also more likely to be good at inferring other people's states of mind. Finally, the article indicates some social benefits of yawning, suggesting that contagious yawning might have helped groups to synchronise their behaviour. (selected from Cottrell, 2005, p.56)

Question 1: whether there is an argument, a description, an explanation, or a summary? Please give your reasons for the answer.

Question 2: What is the difference between individual yawns and infectious yawning?

In order to answer Question 1, test-takers have to use knowledge of reasoning about what constitute an argument and about differences among argument, description, explanation and summary, on the basis of understanding the passage. However, only understanding itself cannot ensure that participants can answer Question 1 unless they have relevant reasoning knowledge. In contrast, if participants can understand the passage, they can answer Question 2 by using information expressed in the passage, not

requiring and therefore involving any application of reasoning principles, concepts and procedures. The illustration emphatically indicates the importance of corresponding questions involving application of reasoning principles, concepts and procedures rather than only the reading material itself in the assessment of critical thinking skills through reading.

Based on Facione and Facione (1994) *Holistic Critical Thinking Scoring Rubric* and Insight Assessment (2013) *CCTST manual*, Reading-embedded Critical Thinking Skill Scoring Rubric was developed by the researcher (see Appendix B). The total scores were 70 points for each form of the RCTST. Sub-scale scores for interpretation, analysis, synthesis and evaluation were, respectively, 20 points, 28 points, 8 points and 14 points.

According to “Reading-embedded critical thinking skill test Scoring Rubric,” the overall score described participants’ overall strength of critical thinking skills. There were five levels of strength from inferior to superior. In total, scoring below 14 points was considered as inferior level; scoring 15-28 points as weak level; scoring 29-39 points as moderate level; scoring 40-59 points as strong level; scoring 60-70 as superior level.

1. For inferior level, participants can do few of the following:
2. For weak level, participants can do some of the following:
3. For moderate level, participants can clearly or accurately do many the following:
4. For strong level, participants can clearly and accurately can most of the following:

5. For superior level, participants can clearly and accurately do all or almost of the following:
- Express the defining features of an argument, a description, an explanation, or a summary and use them to support the choice.
  - Express the implicit assumptions or the argument.
  - Express reasons.
  - Identify and express flaws.
  - Identify premises and conclusions.
  - Diagram the relations among all the premises and conclusions.
  - Recognize elements of reasoning.
  - Use standards of thought to evaluate elements of reasoning.

For sub-scale, there were three levels of strength from weak to strong. For interpretation, score of 0-8 was considered as weak level; score of 9-16 as moderate level; score of 17-20 as strong level. For analysis, score of 0-11 was considered as weak level; score of 12-23 as moderate level; score of 24-28 as strong level. For synthesis, score of 0-3 was considered as weak level; score of 5-6 as moderate level; score of 7-8 as strong level. For evaluation, 0-5 was considered as weak level; score of 6-9 as moderate level; score of 10-14 as strong.

For weak, moderate, and strong levels, participants can do some, clearly or accurately do many, clearly and accurately do all or almost the following activities, respectively:

- Express the defining features of an argument, a description, an explanation, or a summary and use them to support the choice.

- Express the implicit assumptions or the argument.
- Express reasons.
- Identify and express flaws.
- Identify premises and conclusions.
- Diagram the relations among all the premises and conclusions.
- Recognize elements of reasoning.
- Use standards of thought to evaluate elements of reasoning.

Reading-embedded critical thinking skill test was piloted to evaluate its weakness and if necessary, make some revisions.

#### **3.4.2 Higher Education Entrance Examination**

The national higher education entrance examination is annually administered in the People's Republic of China. It is the prerequisite for all Chinese students in their last year of senior high school to obtain admission to all the higher education institutes at undergraduate level. Although the examination is administered simultaneously at the beginning of June, the administration of the examination is uniform only within each province and direct-controlled municipality, not across the country.

The national higher education entrance examination takes three subjects as mandatory across the country: Chinese, mathematics and a foreign language—usually English. Two other subjects include a science integrated test and a humanities integrated test. That is, three science subjects—physics, chemistry and biology, are integrated into one test; two humanities subjects—history and geography, are integrated into another test. Test-takers can choose either of the two integrated tests according to their interest in science or humanities. The overall mark for a student is generally a

weighted sum of score of each subject. The maximum possible mark for admission to college and university varies from year to year and from province to province.

The participants in the study had taken the national higher education entrance examination administered in Anhui province in China. The entrance examination for English consists of four parts: listening, grammar and structure, reading and writing. It aims to assess students' English proficiency after they graduate from high school. It was used as a norm-referenced test in the study, in which a participant's score of the entrance examination for English was taken as criteria for assessing the level of his/her English proficiency relative to others'. Overall score is 150 points, of which at least 90 points are required for admission to School of Foreign Languages in the university. Actually, lowest and highest score of students was 105 points and 137 points, respectively. Therefore, by the statistical standard, scoring of 105-118 points was counted as low level of English proficiency; scoring of 119-122 as intermediate level; scoring of 123-137 as high level.

The reason for employing the national higher education entrance examination is that it is authoritative because it is administered across the country by government, and that the results are accepted by all the higher education institutes in China. The other reason is that it has recognizable reliability and validity. When participants were enrolled in the university, their scores of English were kept in the School of Foreign Languages. As an English teacher, the researcher had access to the scores.

### **3.4.3 Learner's Journal**

Learner's journal, as a qualitative data collection instrument, was used to collect data on participants' experiences and reflection of the development of critical thinking skills. The obvious strength of learner's journal is that it can provide natural and

powerful data on how participants develop critical thinking skills. Another reason for the learner's journal is that it can encourage participants to reflect on their own experiences of developing critical thinking skills. Therefore, it can contribute to deep understandings of the developmental process of critical thinking skills. Last but not least, data from learner's journal can provide guidance for other data collection. For instance, if the data provide significant information about some facets of research that proposed questions of semi-structured interviews have missed, then some adjustments have to be made for further interviews.

The participants were required to write their journals after every two lessons, because two lessons were taught consecutively. In the journals, they wrote about their own experiences of critical thinking skills development and thoughts about the development and the guided instruction. It is not necessary to cover all the activities in the classroom. Guided questions were provided to guide their attention to the aspects that need to record.

Learner's journal had a consistent format (see Appendix C). The first part was about personal information; the second part about experiences of critical thinking skills development; the third part about thoughts on critical thinking skills development and the guide instruction. There was no clear-cut boundary between the last two parts when participants actually wrote journals. The experiences included what they understood, what they did not understand and why, what they could or could not apply what they had learned and why, what they found puzzling, difficult or confusing, and what they needed to know more about; thoughts subsumed thoughts on content of guided instruction, agreement or disagreement with the content, its effectiveness, teaching strategies and so on. The final part allowed them to provide suggestions for the guided instruction.

The journals were written in whatever language the participants liked—Chinese or English or the combination of the two. It had nine entries. For each entry, the journals were handed in for once and the researcher gave feedback to ensure that participants' development of critical thinking skills was monitored timely. Since the researcher thought that learners' journals were very important to assess their progress, strength and weakness in the development of critical thinking skills, and in order to reduce Hawthorne Effect and elicit authentic data, every participant was required to write journals. For data analysis, only 15 participants' journals (high/moderate/low levels of critical thinking skills according to results of Form A of the RCTST) were purposefully chosen for this study.

#### **3.4.4 Semi-structured Interview**

Semi-structured interview was employed to elicit information about how participants developed their critical thinking skills. It was also used to collect data about participants' perceptions of the guided instruction and the development of critical thinking skills. Semi-structured interview, as a qualitative data collection strategy, can help the researcher gain a full detailed account of experiences and thoughts under investigation. Although semi-structured interview is conducted by guiding questions, it can allow the researcher to follow the responses of informants and probe into some areas that arise during the interview. Therefore, while keeping its focus on certain inquiries, the semi-structured interview can build its flexibility through probe questions, which can assist in a deep understanding of the process of participants' development of critical thinking skills and their thoughts on the development and the guided instruction of critical thinking skills.

The semi-structured interview was conducted after each critical thinking skill was taught. In total, there were four critical thinking skills. Therefore, the semi-

structured interview was conducted four times. The guiding questions for the interview were planned according to the results of the RCTST and learner's journal. The same sample for learner's journal was used for interviews. Each of them was interviewed for about 20 minutes.

The four forms of the semi-structured interview had a consistent format, i.e. it consisted of two parts (see Appendix D). The first part included the questions about participants' experiences of and thoughts on critical thinking skills development, e.g. could you please say something about critical thinking? could you please describe your activities when you learn critical thinking in a reading class? what have you learned about critical thinking so far? what do you think of critical thinking? and so on. The second part contained the questions about participants' thoughts on the guided instruction of critical thinking skills, e.g. in what way did the teaching in a reading class help you think critically? how did the teaching in a reading class help to identify, analyze, synthesize, and evaluate arguments in a reading text? And so forth. These guided questions were subtly varied from one form to another form on the basis of different results of each test of critical thinking skills.

#### **3.4.5 Perception Questionnaire**

Participant perception questionnaire was developed by the researcher. Some of the questions were adapted from the 'self-evaluation questionnaire' developed by Cottrell (2005). Cottrell's questionnaire was used to assess students' level of critical thinking skills when they developed their critical thinking skills through reading. It is appropriate for this study with a similar training purpose. It consisted of two formats: Likert-like four-point scale and open-closed questions, which served two objectives:

self-perceived development of critical thinking skills and perception of the instruction of critical thinking skills (see Appendix E).

The questionnaire consisted of four sections. The first section aimed to elicit information on participants' self-perceived development of critical thinking skills. It included 11 Likert-like four-point statements. The second section had the purpose of drawing out information on participants' perception of the guided instruction of critical thinking skills. It contained nine Likert-like four-point statements. The reason why the four-point rather than five-point scale was used is that Chinese EFL learners have a tendency to be modest in evaluating how good their own critical thinking skills are and to show respect for the teacher when evaluating teaching activities in class, and therefore, tend to choose the undecided in a five-point scale if possible. In order to avoid such tendency, a four-point scale was employed.

The third section had seven open-ended questions used to elicit information about participants' perception of the guided instruction and development of critical thinking skills. Open-ended questions can provide respondents with freedom of expression, and therefore, can obtain rich information. The fourth section intended to collect some demographic information about participants with hope that it may be helpful to understand the relation between participants' background and their responses.

The questionnaire was piloted and the results were analyzed to assess its reliability and validity. Each item was examined carefully for its wordings according to the results. Suggestions from peers and experts were consulted, and the rewording and deletion of some items were made.

### **3.5 Critical Thinking Skills Training Package**

The development of critical thinking skills was embedded into EFL reading teaching and guided by the critical thinking skills training package. Based on “the Model of Reading-Embedded Critical Thinking Skills” (see Figure 2.4 in Chapter 2), the critical thinking skills training package was constructed and then used to develop EFL learners’ critical thinking skills in an English reading class (see Appendix F). The instructional sequence of training critical thinking skills consisted of three stages: presentation, application and formation (see Figure 2.5 in Chapter 2). Therefore, the package was called “P(resentation) A(pplication) F(ormation) of Critical Thinking Skills Training Package. The three stages corresponded to declarative knowledge, knowledge compilation and procedural knowledge in the development of a critical thinking skill. In the second stage—application, the model of the guided instruction and teaching strategies were implemented. The content, teaching approach and strategy and instructional sequence in the package are mainly discussed.

#### **3.5.1 Critical Thinking Skills Training Content**

The content of PAF Critical Thinking Skills Training Package included critical thinking skills and corresponding sub-skills, the estimated number of lessons for the instruction, materials used for the instruction, and performance criteria. All the reading materials used for training critical thinking skills were selected from the extensive reading textbooks for the ‘English reading course’. In addition, there were 12 handouts, which explained reasoning principles, concepts and procedures (see Appendix F).

Table 3.2 shows the specific schedule for the training content and performance criteria.

**Table 3.2 Schedule for Training Content and Performance Criteria**

Critical thinking skill	Sub-skill (Lesson)	Material	Performance criteria
Interpretation	Sub-skill 1 (Four lessons)	Handout 1	Students can identify arguments and the components: premises and conclusions between the lines.
	Sub-skill 2 (Four lessons)	Handout 2	Students can distinguish arguments from descriptions, explanations and summaries and decide whether a given paragraph is about an argument, or a description, or an explanation, or a summary.
	Sub-skill 3 (Four lessons)	Handout 3	Students can paraphrase an argument and its components, and decide whether it is a deductive argument or an inductive argument.
Analysis	Sub-skill 1 (Six lessons)	Handout 4	Students can give implicit premises and conclusions beyond the lines based on explicit information.
	Sub-skill 2 (Six lessons)	Handout 5	Students can find the flaws in an argument because of invalid comparisons or false correlation.
		Handout 6 Handout 7	Students can find the flaw in an argument because of unnecessary or insufficient premises. Students can realize that the author may use some rhetoric devices to persuade rather than reasoning and find such flaws in an argument.
Synthesis	Sub-skill 1 (Six lessons)	Handout 8 Handout 9	Students know the differences between a single argument and chain arguments. For a given argument, they can decide whether it is a single argument or chain arguments. Students know an argument with multiple-conclusion and can recognize it in a paragraph.
	Sub-skill 2 (Six lessons)	Handout 10	Students can use a diagram to clearly present the structure of a single argument, chain arguments, extended argument and an argument with multiple conclusions.
Evaluation	Sub-skill 1 (Six lessons)	Handout 11	Students can find the author's purpose in a reading text, the most important question, problem, or issue in the text, the most fundamental assumptions of the text, and the author's point of view in the text. The students can find the most significant information or data in the text, the most basic concept, theory, or idea in the text, the most basic conclusion in the text, and the most significant implication of the text.
	Sub-skill 2 (Six lessons)	Handout 12	Students can make judgments on whether the author's statement is vague or clear, whether the author's claims are distorted or accurate, whether the author provides details and specifics and whether these details are relevant, whether the author introduce irrelevant information, whether the author has got into the important complexities in the subject. Students can make judgments on whether the author considers alternative views, whether the author's reasoning is consistent and logic or contradictory, whether the author focuses on important or trivial aspects of the subject, whether the author takes a justifiable or one-sided approach.

There were 12 lessons for the guided instruction of each critical thinking skill. In total, 48 lessons were needed for four skills. Each lesson lasted for forty-five minutes. In presentation stage, handouts were given to participants. After each lesson, assignments were provided to check the results of guided instruction according to performance criteria.

### **3.5.2 Infusing the Training of Critical Thinking Skills into a Reading Lesson**

The guided instruction of critical thinking skills adopted the 'infusion' approach and some major strategies: questioning, group discussion and concept mapping. These strategies were piloted and if necessary, revised. The infusion approach to the training of critical thinking skills functioned in a direct and explicit manner along with the training of reading skills. As a result, the smooth and appropriate incorporation of the development of critical thinking skills into the development of reading skills could be achieved. There were two methods of the incorporation that were used for argumentative texts and narrative texts, respectively. The main difference between two types of incorporation was that, when using argumentative texts as teaching materials, the training was conducted intermittently after the comprehension of certain parts of the entire text was achieved, while for the narrative text, after the comprehension of the whole text was completed, the training of critical thinking skills started. However, whether it was an argumentative text or a narrative text, reading comprehension was taken as the precondition for the training of critical thinking skills.

In the training of critical thinking skills, three major teaching strategies were proposed to be used: questioning, group discussion and concept mapping. For different critical thinking skills, different specific questions were built to fire up learners' critical thinking skills (see Table 3.3). These questions were employed to stimulate learners to

think critically and thus, develop their critical thinking skills. Questioning is the process of inquiring issues about the reasonableness of arguments and requiring strong evidence or counter-evidence (Ikuenobe, 2001). The process can help learners to explore issues and reflect on claims and beliefs critically. Actually, questioning functions as a process of critical thinking and is regarded as an effective strategy to develop critical thinking.

**Table 3.3 Questions for Different Critical Thinking Skills**

Critical Thinking Skill	Questions
Interpretation	What is the author's claim in the paragraph/s? Can you find the evidence/reasons relevant to the claim? Do you think there is an argument or explanation or definition or summary in the paragraph/s? If there is, how do you know that?
Analysis	Based on what we know so far, what conclusion can be drawn? What additional evidence is needed for the claim in the paragraph/s? What does the evidence imply? Do you think the argument has all the constituents? If not, what is the possible constituent? What assumptions must we make to accept the conclusion? How is the claim justified? Do you think the argument has a fallacy? If no/yes, why?
Synthesis	How many claims are made by the author? What are similarities and differences among these claims? Can we combine the similar claims into a big one? Are there some conflicting claims? How can we reconcile these conflicting claims? What other conclusions can support this conclusion? How can we visualize the relationship between these claims?
Evaluation	How credible is that claim? How strong is that argument? Why do you trust what that person claims? Why do you accept what that person concludes? Do you think the text has all the elements of reasoning? If not, what elements are missing? Do you think the elements of reasoning presented in the text are consistent with criteria of thought? Why?

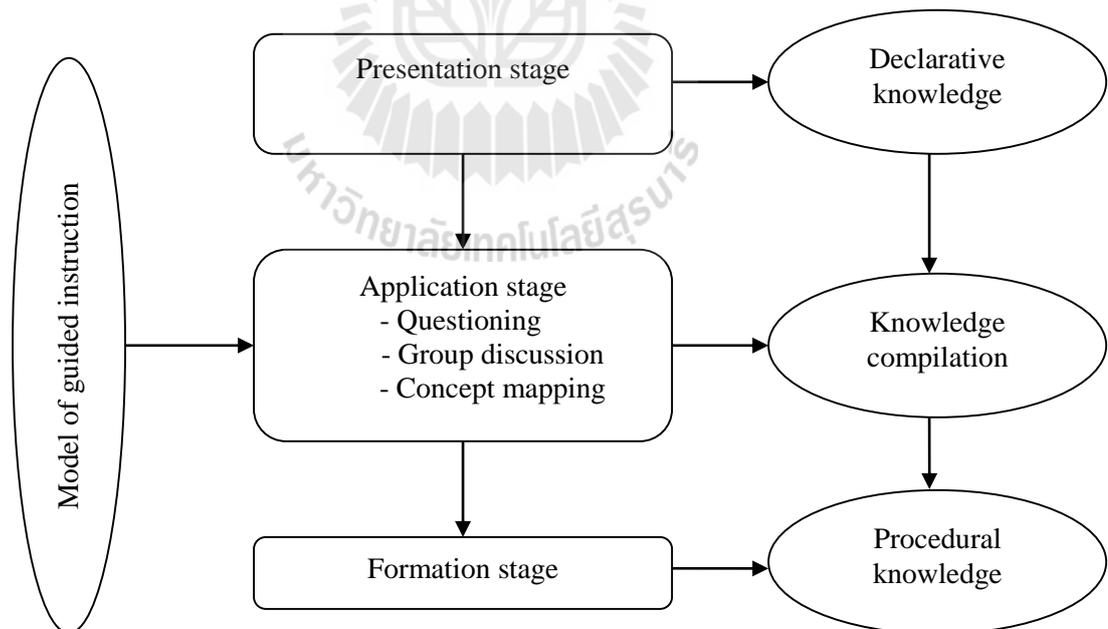
For an argumentative text, group discussion was commenced after comprehension of each major argument expressed in a reading text was achieved. The procedure of group discussion was adapted from Commeyras (1993). Before group discussion, a central question and two hypothesized conclusions were introduced. And then, learners were required to state their positions on either hypothesized conclusion. Based on learners' positions, they were divided into two groups. Learners in each group had to give their reasons to support each hypothesized conclusion. The reasons had to be identified in the text. The teacher listed all the reasons on the blackboard, including those that seemed sensible as well as those that seemed insensible. After all the reasons were identified and listed on the blackboard, learners were required to evaluate the truth and relevance of these reasons. They were also asked to compare and contrast the reasons and determine which reasons could best support either hypothesized conclusion. Finally, learners were given opportunities to express what they believed about the central question and two hypothesized conclusions, and make a decision about which hypothesized conclusion was the best answer to the central question.

In contrast with the argumentative text, in a narrative text which consisted of plotted events, the author's views, feelings and thoughts were presented implicitly. As a result, these views, feelings and thoughts had to be generalized and classified before analysis, synthesis and evaluation began. Sometimes, it was impossible to generalize and classify them because the author narrated a story as a bystander. Therefore, it is appropriate that the training of critical thinking skills was undertaken after the whole text was understood completely, and therefore, group discussion might be the best of the three teaching strategies. The procedure of group discussion were similar to that used for the argumentative text.

Concept mapping was also employed in the training of critical thinking skills. It can help learners understand a complex argument and relations among arguments in a reading text. Learners were required to draw a diagram to show the internal structure of an argument and external structure among arguments on the blackboard. Differences among diagrams presented by learners were pointed out and discussed until an appropriate one was built.

### 3.5.3 Procedure of a Lesson

As depicted in Figure 3.2, the model of critical thinking skills development (see Figure 2.7 in Chapter 2) and the model of guided instruction (see Figure 2.6 in Chapter 2) were incorporated into the instructional sequence of a lesson (see Figure 2.5 in Chapter 2). All the lessons followed the same instructional sequence.



**Figure 3.2 Procedure of a Lesson**

Each lesson began with presentation stage in which, firstly, handouts were given to participants. Handouts contained knowledge of reasoning related to sub-skills that were trained. Participants read handouts in order to acquire a general idea about the content and then the teacher presented knowledge of reasoning that includes concepts, principles and procedures with some examples offered. Through presentation of the knowledge, participants built their initial declarative knowledge which needed to be further used and consolidated in application stage.

Application stage began after acquisition of reasoning knowledge was finished. Participants applied declarative knowledge into identifying, analyzing, synthesizing and evaluating arguments expressed in a reading text. First, the teacher asked questions which had to be answered by using declarative knowledge, such as, “can you find an argument in this paragraph” and “what are the components of the argument?” and some analytical questions, such as, “based on what we know so far, what conclusion can be drawn?”, “what additional evidence is needed for the claim in the paragraph/s?” and “how is the claim justified?”. And then, tasks were assigned to participants. For instance, they were required to identify implied assumptions. Second, participants discussed with their classmates or asked the teacher for help when they found it difficult to answer the question or to perform the task. Third, participants presented the results of their tasks, and compared and discussed them. For some complex arguments, they could draw a diagram to show them on the blackboard. Through practice and training, knowledge compilation happened and some parts of declarative knowledge could be transformed into procedural knowledge, that is, habits of critical thinking skills could be built. The remaining parts of declarative knowledge could be consolidated.

In habit formation stage, extra exercises were assigned to participants in order to develop the established procedural knowledge into a speedy and automatic one. Another reading text was provided with corresponding exercises which participants had to complete after class. In the next lesson, the extra exercises were presented and discussed.

The procedure of a lesson was not linear but cyclical. The steps of the procedure were interwoven and interrelated. Each stage was based on preceding stage.

### **3.6 Data Collection Procedure**

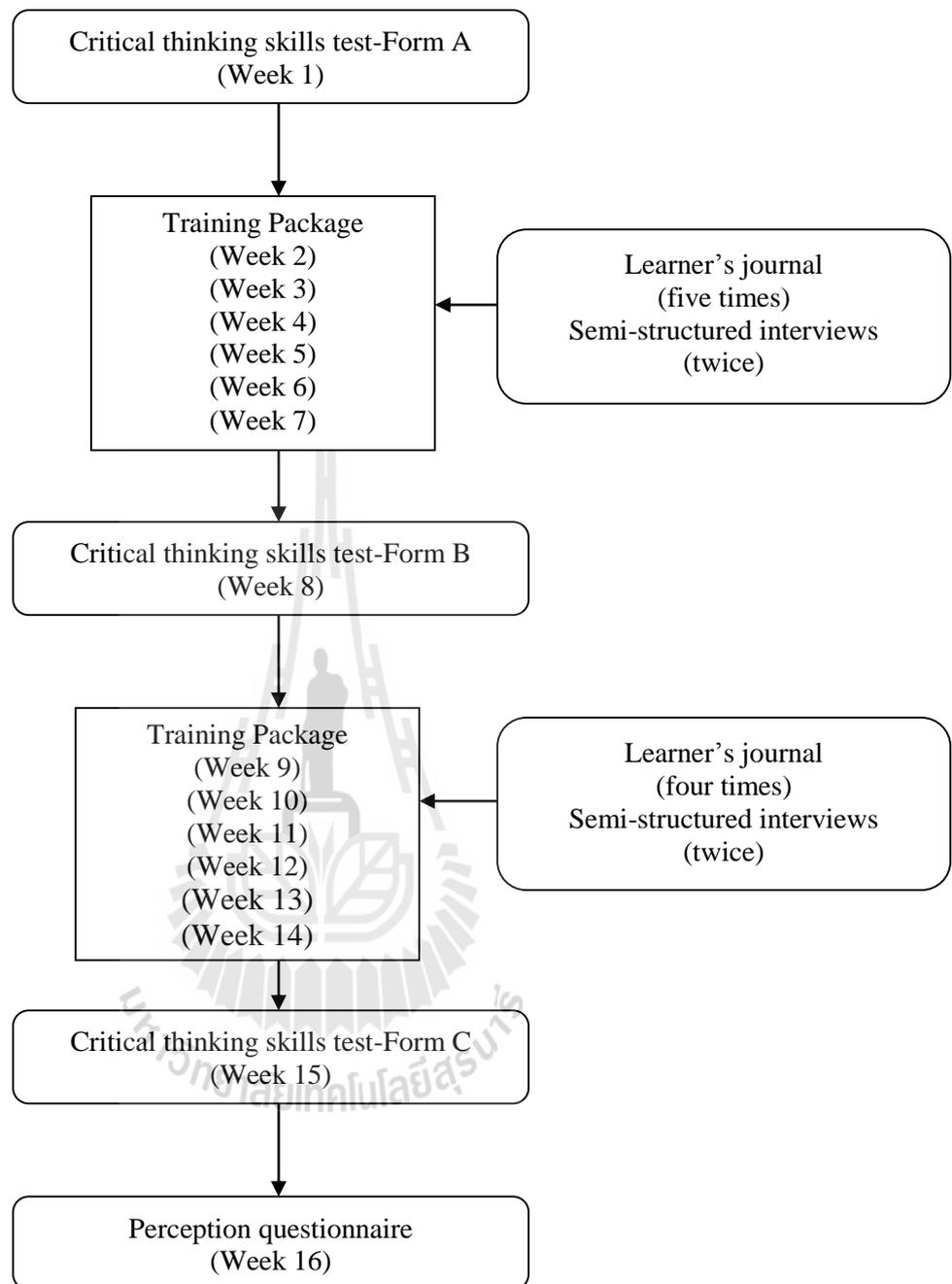
After the pilot was completed at the end of the spring 2014 semester, the main study was conducted during the fall 2014 semester in the university where the researcher has been working. At the beginning of the semester, the researcher, also as an instructor, introduced the study and explained the purpose and significance of the study to all the students whom the researcher taught English reading. They were informed that they would participate in a study with purpose to develop them into critical thinkers, and tests of critical thinking skills, learner's journal, interviews, and in-class reading activities that incorporated the instructional activities of critical thinking skills. They were also informed that the data they provided would be kept confidential and they had the right to refuse to take part in it. Informed consent was assigned to and collected from the students who agreed to participate in the study.

The data collection began with 'reading-embedded critical thinking skill test—Form A' (see

Figure 3.3). The 'reading-embedded critical thinking skill test—Form A' was administered with participants selected for the main study. Afterwards, the 'critical

thinking skills training package' began in the second week of the semester of sixteen weeks. During implementation of the critical thinking skills training package, participants were required to write down their journals and the researcher conducted semi-structured interviews. After each critical thinking skill was taught, interviews were conducted. The reading-embedded critical thinking skill test—Form B was administered after the first two critical thinking skills were taught in the eighth week. And then, the critical thinking skills training package continued. The journals and semi-structured interviews continued, too. After all the critical thinking skills were taught, reading-embedded critical thinking skill test—Form C was administered in the fifteenth week. Finally, the perception questionnaire was administered in the sixteenth week.





**Figure 3.3 Data Collection Procedure**

### 3.7 Data Analysis

Data collected through qualitative and quantitative methods were analyzed in different ways (see Table 3.4). Data elicited by ‘learner’s journal’, ‘semi-structured interview’, and the open-ended questions of ‘perception questionnaire’ were analyzed qualitatively, while data by ‘reading-embedded critical thinking skill test’ and the Likert-like four-point scale of ‘perception questionnaire’ were analyzed quantitatively.

**Table 3.4 Data Analysis for Data Collected by Different Instruments**

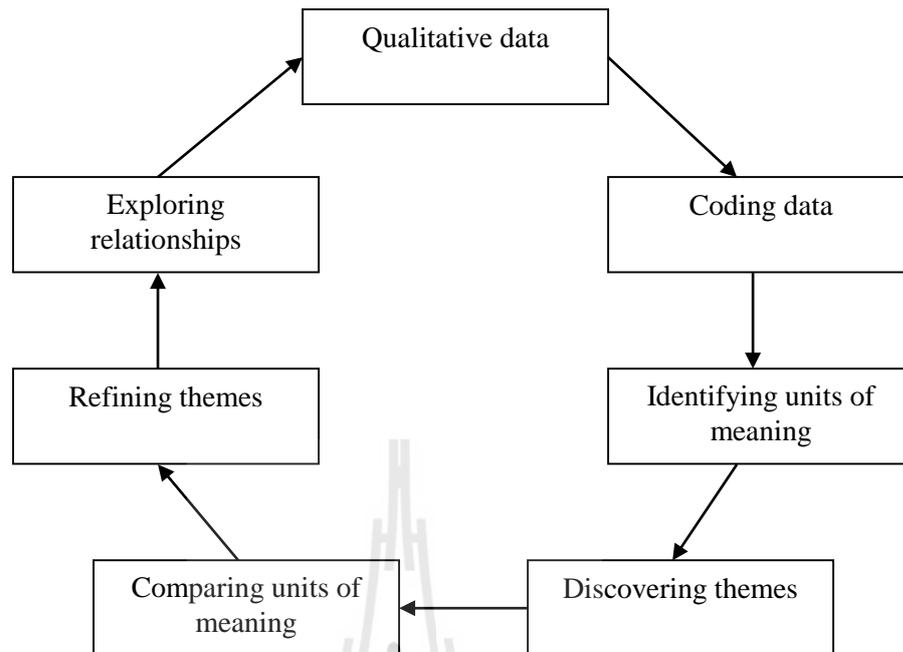
Instrument	Data	Analysis
Reading-embedded critical thinking skill test	Scores	Descriptive analysis T-test ANOVA Multilevel modeling
Higher education entrance examination	Scores	ANOVA
Learner’s journal	Descriptive data	Content analysis Thematic analysis
Semi-structured interview	Descriptive data	Content analysis Thematic analysis
Perception questionnaire	Closed-ended section	Scores Descriptive analysis
	Open-ended section	Descriptive data Content analysis Thematic analysis

#### 3.7.1 Qualitative Data Analysis

Among different approaches to qualitative data analysis that have been proposed, for instance, content analysis, narrative analysis, thematic analysis and constant comparative analysis, there appears to be core commonalities: description and interpretation of qualitative data. Approaches to qualitative data analysis differentiate in placing weight on description or interpretation. The present study aims to explore how EFL learners develop their critical thinking skills. It places emphasis on the description of process of the development. And based on the description, the theoretic insight into the process of the development can be achieved, which, as a result, would

contribute theoretically to the existing proposition about the development of critical thinking. In the study, thematic analysis and content analysis were used. Content analysis which is usually employed in phenomenology requires generalization and categorization from the data and relating categories to context, and therefore can help researchers gain the detailed description of the phenomenon under investigation (Downe-Wamboldt, 1992; Elo & Kyngäs, 2008). Thematic analysis attempts to discover patterns among categories and interpret themes, and therefore, help researchers gain deep insights into the interpretation of the phenomenon (Attride-Stirling, 2001; Buetow, 2010; Vaismoradi, Turunen, & Bondas, 2013).

The procedure of data analysis consisted of coding data, identifying chunks or units of meaning in the data, discovering themes, comparing units of meaning across themes, refining themes, and exploring relationships among themes (see Figure 3.4). Data analysis did not proceed lineally through these main steps, but iteratively. For the audio-taped interview, it was transcribed before the analysis. And then, textual data from the learner's journal, transcribed interview, and the open-ended questions of the perception questionnaire were coded. Before coding, coding framework was designed. The framework consisted of two parts: the code indicating the source of the data and the label for the code. Numbers and letters were used for the source of the data, for instance, S/T -5, 'S' for 'the interviewee 'Sheng'', 'T' stands for 'transcribed interview', '5' for the fifth page of Sheng's transcribed interview. The label for a code was the recurring main concept in the data, normally, in a word or phrase in the data. The object of coding data was to divide the textual data into text segments. Each segment can be taken as a unit of meaning. Therefore, searching for a label for a code and identifying units of meaning in the data were conducted concurrently.



**Figure 3.4 General Procedure of Qualitative Data Analysis**

At the beginning, smaller units of meaning were identified as the basis for the larger ones. Each unit of meaning in the data must be understandable without additional information, that is, it must stand by itself. Text segments were read and reread and similar codes were grouped into categories. Salient, common and significant themes were extracted from grouped categories. When a theme was generated, the other categories were compared with the generated theme. If a category fit the generated theme, it was included under the theme. If it did not fit the generated theme, it was taken as another provisional theme. Through the comparison between categories in the data, all the potential themes could be generated. The rule for inclusion into a theme needed to be written down as a propositional statement that conveyed the main idea of the theme. When all the categories were included into the respective themes, careful scrutiny of themes was conducted for overlap and ambiguity.

When all the themes were produced, the next step was to compare these themes and discover the similarities and differences among them. Similar themes were then grouped into larger ones. As a result, all the themes were organized as hierarchy from basic themes to global themes. The relationships and patterns could be discovered among them.

### **3.7.2 Quantitative Data Analysis**

The data elicited through ‘reading-embedded critical thinking skill test Form A, B and C’ and the Likert-like four-point scale of ‘perception questionnaire’ were analyzed by using the SPSS software program. The significance level was set at .05. Descriptive statistic analysis was conducted to explore the central tendency and dispersion of the data. For the data by ‘reading-embedded critical thinking skill test Form A, B and C’, paired-samples t-test was used to test whether there is a significant difference between pretest (Form A) and posttest (Form C); Repeat-measures ANOVA was conducted to test patterns of the development of critical thinking skills and mixed ANOVA was to examine whether there is a significant difference among the participants with low, intermediate and high levels of English proficiency in the development of critical thinking skills. In order to examine whether there is a significant difference among the participants with low, intermediate and high levels of critical thinking skills in the growth rates and trajectories of critical thinking skills, multilevel modeling was employed. For the data by ‘perception questionnaire’, descriptive analysis and frequency analysis were conducted to describe and summarize the data.

### **3.8 Ethical Considerations**

Before the research was conducted, some procedures needed to be followed for ethical permissions from the university and the school where the research took place. A written outline and description of the research were submitted to the administration, which described the procedure and timeline of the research and explained the practical implication of the research. It also ensured that the normal procedure and content of the English reading course was maintained, though additional content of teaching of critical thinking skills was added.

Participants' confidentiality needed to be respected and their privacy be protected. Therefore, before the study was conducted, the researcher introduced the research to all the students selected for the research and told them what would happen to them if they participated. Each participant received an informed letter that described the purpose of the research and the use of the collected data. Only the data for which written consent was obtained were included in the study. Participants' names and student ID numbers were replaced with codes to ensure participant anonymity.

### **3.9 The Pilot Study**

The pilot study aims to detect and correct any problems before the main study is carried out. It was employed to revise and refine the proposed procedures, materials, instruments, and methods used in the main study for the purpose to minimize mistakes which you could make. Mackey and Gass (2005) pointed out that "a pilot study is an important means of assessing the feasibility and usefulness of the data collection instruments and making any necessary revisions before they are used with the research participants" (p. 43).

The pilot study was implemented in Tongling University where the researcher, from May 12th to June 15th, 2014, piloted the PAF Critical Thinking Skills Training Package, the Reading-Embedded Critical Thinking Skill Test and the Participant Perception Questionnaire, and, from October 8th to 12th, 2014, learner's journal. The aim was to identify the weakness in the procedures and protocols of the methodology, the instruments, and the Package, and to check the feasibility of the methodology, the Package and the instruments in the main study.

The reason for piloting learner's journal in a different period is to ensure that the participants in the pilot study are same as, yet not similar to those in the main study. Because the practice of writing journals can effectively make participants recognize and pay attention to, and then, to avoid the weakness of their journals, if the participants in the pilot study were similar to, but different from those in the main study, the participants in the main study would have no opportunity to practice writing journals, and thus, to recognize and avoid the weakness of their journals, although they could be told how to write journals by the researcher.

The following sections discuss how the pilot study was carried out, including participants, data collection, data analysis, and implications for the main study.

### **3.9.1 Participants**

A small-scale sample that was similar to that in the main study participated in the pilot study. By a convenient sampling, a natural class of 35 freshmen in the second term of the academic year 2013-2014 in Tongling University was selected as the participants in the pilot study. They were English majors who were taking the English Extensive Reading as a compulsory course. Among 35 participants, there were 29 female students and six male students, mostly aged 18-21. On average, they spent about

nine years on learning English from primary school to senior high school before they were enrolled into the university. No one had ever learned English abroad.

Participants in piloting learner's journal were selected by a purposeful sampling from another natural class of 50 freshmen in the first term of the academic year 2014-2015 in Tongling University. They participated in the main study. However, before that, they were chosen to pilot the journals and through the practice of journal-writing, the researcher and they themselves could find what should be written in the journals and how to write the journals.

### **3.9.2 Data Collection**

For the PAF Critical Thinking Skills Training Package, two experts, who are both doctor professors in research on teaching and learning of EFL reading, were required to check the Package and offer their professional advice on its revision and refinement before it was piloted. And then, the RCTST Form A was assigned to participants who were permitted to look up news words and expressions, and spend as much time as they can on finishing it. The permission can guarantee participants' literal understanding of English-version items in the Test. After the testing, the participants were required to give their opinions and suggestions on the quality of the Test. Afterwards, the researcher began the implementation of the Package.

Four sub-skills were selected to be piloted: identifying an argument, distinguishing argument from explanation, description and summary, making inferences about assumptions, and detecting flaws in an argument. Four lessons were planned and a video recording was shot for each sub-skill. After the two sub-skills were implemented, the RCTST Form B was assigned to participants. The participants were required to give their opinions and suggestions on translation of items. And then, the

instruction of the other two sub-skills continued. Finally, the participants were required to finish the RCTST Form C and the PPQ. And then their opinions and suggestions on the combination of the questions for the last item in Form C were obtained.

The piloting of learner's journal began with the participants in the main study before the main study actually started, and finished within one week. There were four of EFL reading lessons a week. The participants were required to write down in their journals what they had learned, what they felt difficult and gave the reasons, and what they felt easy and gave the reasons, and their opinions and suggestions on the researcher-teacher's teaching. Participants submitted their journals after two lessons and then, the researcher-teacher gave feedbacks. After learners' journals were piloted, the main study began.

### **3.9.3 Results and Implications for the Main Study**

This section mainly discusses the results of the pilot study and the implications for refinements of the Package and the instruments which would be used in the main study.

#### **3.9.3.1 The PAF Critical Thinking Skills Training Package**

After careful examination and assessment of the Package, two experts (designated as Expert 1 and Expert 2) offered their suggestions on the defects of the Package and some revisions. Their judgments are presented in Table 3.5.

**Table 3.5 Expert Judgment on the PAF Critical Thinking Skills Training Package**

<b>Content</b>	<b>Expert 1</b>	<b>Expert 2</b>
Theoretical foundation	Need to be justified. (15%)	Very good
Teaching strategy	Beginning with questioning is a surprise to students. (31%)	Very good
Handout	Handouts should be systematic and structured, and relevant to critical thinking skills. (46%)	Very good
Concept	Critical thinking skills are similar to reasoning knowledge and inconsistent with critical thinking. (8%)	Very good
Lesson plan	Five suggestions offered, but three of them related to ‘Teaching strategies’ and two of them to ‘Handouts’.	Time should be allocated for each step.

For Expert 2’s suggestion “Time should be allocated for each step” in the lesson plan, the video recordings show that it was practically unfeasible due to immediate changes of time allocation according to students’ responses and performance in the class. Most of the suggestions given by Expert 1 were concerned with ‘handout’ (46% of all the suggestions)—“Handouts should be systematic and structured”, according to which handouts had been refined. For the suggestions concerning ‘theoretical foundation’ and ‘concepts’, it had been justified and explained in Chapter 2. For those concerning ‘teaching strategies’, the order in the list of teaching strategies does not mean that they would be implemented correspondingly in the order of the list, but refers to the major teaching strategies which would be used collaboratively. The video recordings indicate that the teaching strategy “concept mapping” was seldom used and instead, “illustration” was often used, and in addition, practice of the discovery was mostly used as task performing in application stage.

In summary, handouts of the Package were refined and main teaching strategies were changed: illustration in presentation stage, and questioning, group discussion and practice in application stage.

### 3.9.3.2 The Reading-Embedded Critical Thinking Skill Test

Item analysis was conducted and the results are presented in Table 3.6. For index of difficulty, it is acceptable if index value is between 0.20 to 0.80 (Jha, 2014); it is considered difficult if index value is less than 0.20; it is easy if index value is more than 0.80. On average, difficulty index for Form A (0.24), B (0.21) and C (0.37) were all acceptable. For index of discrimination, Form A ( $t = 7.89, p < .001$ ), B ( $t = 7.67, p < .001$ ) and C ( $t = 14.14, p < .001$ ) could effectively distinguish the test-takers with higher level of critical thinking skills from those with lower level.

**Table 3.6 Index of Difficulty and Discrimination Index for the RCTST—Form**

**A, B, C**

	Difficulty Index	Discrimination Index	
		<i>t</i>	<i>p</i>
<b>Form A</b>	0.24	7.89	< .001
<b>Form B</b>	0.21	7.67	< .001
<b>Form C</b>	0.37	14.14	< .001

The opinions and suggestions provided by test-takers after each form of the RCTST mainly concerned ‘*Directions*’ describing how to take the test for each section, ‘understandings of passages’, ‘critical thinking skills’, and ‘the following questions for the last item’. Around 31% of 32 participants’ valid responses after the testing of the Form A thought that they could not understand ‘*Directions*’ and suggested that it had better to translate them into Chinese. About 66% of 32 participants’ valid responses after the Form A thought it very difficult to understand complex sentences and the long passage and suggested that new words and some complex sentences

needed to be given explanations or Chinese translations. However, about 62% of 34 participants' valid responses after the testing of the Form B believed that it was unnecessary to translate the entire test into Chinese and about 64% of 22 participants' valid responses after the testing of the Form C suggested only Chinese translation of new words.

About 56% of 32 participants' valid responses after the Form A pointed out that they could not have any idea about an argument or differences among an argument, an explanation, a description and a summary, and therefore, they could not identify an argument or distinguish an argument from an explanation, a description, and a summary. They suggested that the teacher should help them obtain a clear idea about them and provide some examples to show how to find them.

With respect to the questions used in the last item in the RCTST, about 32 % of 34 participants' valid responses after the Form B and 82% of 22 participants' valid responses after the Form C thought that there were too many similar questions for the last item and they needed to be reduced and to be clear, and then they gave suggestions on how to reduce. As a result, the nine standards of thought were reduced into eight: clarity, accuracy, precision, relevance, depth, breadth, logicalness, and significance; eight reasoning elements into six: point of view, conclusion, information, basic ideas/concepts, assumptions, and implication.

As a result, Chinese translations of new words were offered in the RCTST. The questions for the last item in three forms of the RCTST were reduced and their wordings were refined clearly. Illustration, as a teaching strategy, was employed in presentation stage.

### 3.9.3.3 The Participant Perception Questionnaire

Factor analysis and reliability analysis were conducted for the PPQ. For factor analysis, two factors were extracted because Likert-like items were used to elicit the participants' perception of the improvement of critical thinking skills and the participants' perception of the guided instruction of critical thinking skills. The results show that the items for factor 1 which measures the participants' perception of the guided instruction were interspersed with item 1, 6, 8 which are supposed to measure participants' perception of the improvement of critical thinking skills, and similarly, the items for factor 2 which measures the participants' perception of the improvement of critical thinking skills were interspersed with item 15, 18, 20 which are supposed to measure the perception of the guided instruction. In particular, item 15, 20 have lower factor loadings of 0.19 and 0.30, respectively, less than 0.40. Therefore, these two items were dropped. Under the scrutiny of wordings of item 1, 6, 8, 18, it was found that their statements were not clearly. As a result, their wordings were refined. In addition, with respect to the Chinese translation of the entire questionnaire, about 71% of 35 valid responses answered "No".

Reliability analysis indicates that the questionnaire had a high coefficient  $\alpha$  of .83, more than .70, which means that the questionnaire is reliable. The correlations between item 15, 20 and the total score from the questionnaire were .16 and .28, respectively, less than .30, which endorsed lower factor loadings of these two items. Two subscale of the questionnaire, one for the perception of the development of critical thinking skills and the other for the perception of the guided instruction, were found to have acceptable reliability with the same  $\alpha$  of .76.

### 3.9.3.4 Learner Journals and Interviews

Participants were required to write their journals with two entries. Results show that in the first entry, 91% of 45 valid journals recorded only what had been learned and what had not been learned, rather than what was difficult or easy and why it was difficult or easy. After the researcher-teacher gave the feedbacks for the first entry, in the second entry, 33% of 45 valid journals did not record why it was difficult. During the main study, for each entry, before the participants wrote their journals, the researcher-teacher reminded them what were supposed to be recorded.

There were four semi-structured interviews in the main study. Before the interviews, the questions which had been proposed were found to be general and complex and difficult for students to answer, and thus needed to be specified. Take identification of arguments as an example, there were three proposed questions for it in the interview: 1. "Could you tell me what you have learned about critical thinking skills?" 2. "How do you find the author's arguments in a reading text?" 3. "What can constitute an argument?". However, in the main study, these questions became more specific: 1. "Have you heard argument?" 2. "Have you heard critical thinking?" 3. "Can you find an argument in a reading text?", and "If you can, how do you find it?" or "if you cannot, why?" 4. "How many constituents of an argument are there? And what are they?" 5. "Can you find an explanation, or a description, or a summary?" 6. "Which one do you think is difficult? Why? And which one do you think is easy? Why?". For the other interviews, the questions were similarly specified.

In summary, in the CTSTP, the handouts were refined and the relations between the handouts and the corresponding critical thinking skills and sub-skills were presented clearly. For the teaching strategies, illustration and practice was added. In the

RCTST, '*Directions*' for each section, and new words and expressions in the passages were translated into Chinese; the questions for the last item were reduced, and then refined clearly. Two items were deleted in the PPQ and the wordings of some other items were refined. For learner's journal, before the main study, participants were trained to how to write journals. The questions used in each semi-structured interview were specified.

### **3.10 Summary**

In the present study, two potential factors—participants' English proficiency and initial level of critical thinking skills, could impose possible effects on the development of critical thinking skills. The relation among them was described in the conceptual framework. English proficiency could indirectly affect the development through reading comprehension. The initial level of participants' critical thinking skills could affect the growths and trajectories of critical thinking skills. Participants with different level of critical thinking skills could present different growth rates and trajectories.

In order to develop critical thinking skills with EFL learners in a reading class, the mixed research design was employed, because mixed research of quantitative and qualitative methods can inform us what development of critical thinking skills can be obtained as well as how the development can be achieved. In total, two natural classes were selected with one for the pilot study, one for the main study. The instruments include 'reading-embedded critical thinking skill test', 'learner's journal', 'semi-structured interview', 'higher education entrance examination' and 'perception questionnaire'. 'Critical thinking skills training package' was implemented as the

research treatment. The instruments and the Package were piloted and refined. The quantitative data were analyzed by descriptive statistical analysis, t-test, ANOVA, and multilevel modeling. Thematic analysis and content analysis were used to analyze qualitative data.



## **CHAPTER 4**

### **RESULTS**

The chapter aims to present the results generating from the quantitative and qualitative data, which tend to answer the six research questions formulated in the first chapter. The results are organized by the research questions and thus, there are six sections, each for each question. In each section, the question would be answered by the quantitative data or the qualitative data or both (see Table 3.1).

#### **4.1 Answer to the First Research Question**

The first research question explores whether guided instruction in an English reading class can develop EFL learners' critical thinking skills and the influence of the guided instruction on the developmental pattern of critical thinking skills. The quantitative data collected through the instrument—Reading-embedded Critical Thinking Skill Test, was analyzed to answer the question.

##### **4.1.1 Data from RCTST**

The RCTST examined the four critical thinking skills: interpretation, analysis, synthesis and evaluation. Its three forms—Form A, B and C were administered before, in the middle of and after the guided instruction, respectively. In order to reduce the biases produced by only one rater in subjective scoring and examine whether the data were collected in a consistent way, the RCTST was scored by two raters: the researcher and another English teacher from one university in China, who is a Ph.D. professor.

Her research focuses on EFL reading. Intraclass reliability analysis was employed to examine inter-rater reliability. Intraclass correlation coefficients (ICCs) for Form A, B, and C were 0.93, 0.88, 0.89, respectively, which means higher consistence between the two raters' ratings. Paired-samples t-test and repeated-measures ANOVA were employed to analyze the data. Paired-samples t-test was carried out to explore whether there were significant differences between pretest and posttest, which verified whether the guided instruction affected the development of critical thinking skills. Repeated-measures ANOVA was performed to discover the effect of the guided instruction on the developmental pattern of critical thinking skills.

#### 4.1.2 Improvement of Critical Thinking Skills through the Guided Instruction

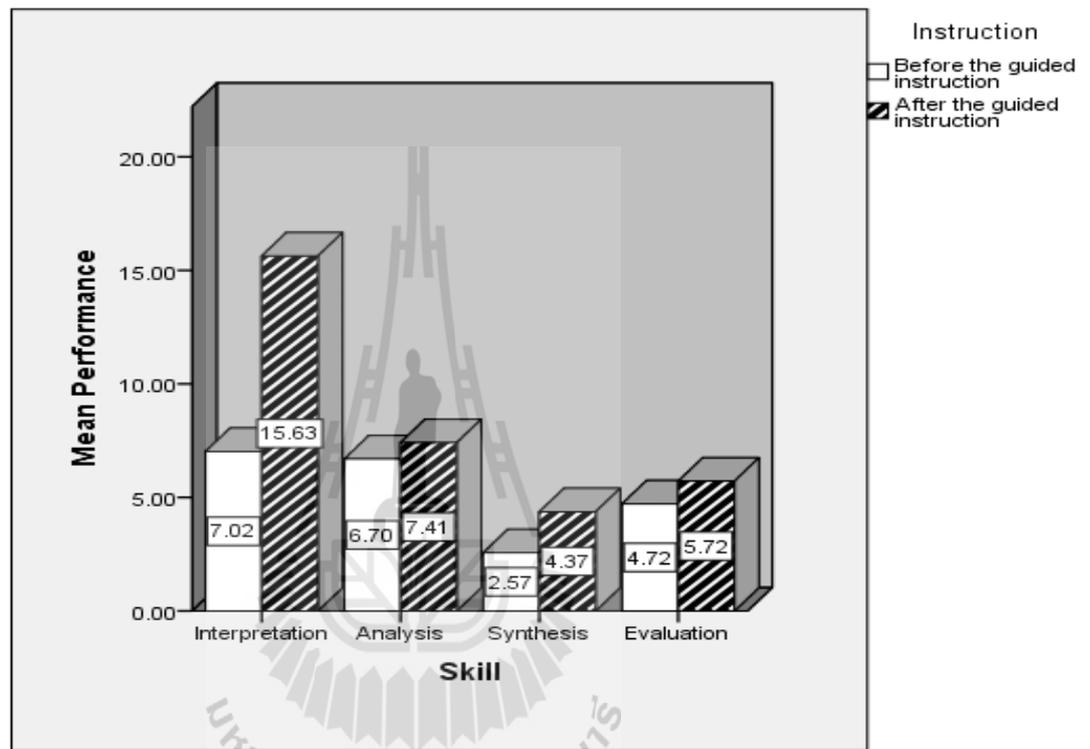
Form A and C of RCTST were taken as pretest and posttest. The section mainly examines whether the difference between pretest and posttest was significant, which provides evidence to prove that the guided instruction could significantly improve critical thinking skills. The results are presented in Table 4.1.

**Table 4.1 Difference between Pretest and Posttest**

Critical Thinking Skill	Pretest		Posttest		<i>t</i>	<i>p</i>	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Interpretation	7.02	4.40	15.63	3.63	-10.76	<.001	2.13
Analysis	6.70	2.87	7.41	3.28	-1.16	.253	0.23
Synthesis	2.57	1.49	4.37	1.53	-6.35	<.001	1.19
Evaluation	4.72	2.07	5.72	2.02	-2.31	.026	0.47

As can be seen in Table 4.1, there were significant differences between pretest and posttest for interpretation,  $t(45) = -10.76, p < .001$ , synthesis,  $t(45) = -6.35, p < .001$ , and evaluation,  $t(45) = -2.31, p < .05$ , but no significant difference for analysis,

$t(45) = -1.16, p > .05$ , indicating there was a significant main effect of the guided instruction in the development of interpretation, synthesis and evaluation. Participants performed in posttest better than in pretest for interpretation ( $M = 15.63 / M = 7.02$ ), synthesis ( $M = 4.37 / M = 2.57$ ), evaluation ( $M = 5.72 / M = 4.72$ ) (see Figure 4.1).



**Figure 4.1 Mean Differences between Pretest and Posttest**

The guided instruction significantly improved interpretation, synthesis and evaluation, except analysis. Among the three skills of interpretation, synthesis and evaluation, although significant improvement was found, effect size indices indicated that the guided instruction imposed different extents of influence. The commonly-used criteria for Cohen's  $d$  are:  $d = 0.2$  (small effect),  $d = 0.5$  (medium effect),  $d = 0.8$  (large effect). It can be interpreted that  $d = 0.2$  means that the average treatment group outperformed 58% of the control group;  $d = 0.5$  means that the average treatment group

outperformed 69% of the control group;  $d = 0.8$  means that the average treatment group outperformed 79% of the control group. According to the criteria, the guided instruction imposed a very large effect on interpretation,  $d = 2.13$ , meaning that on average, the participants in posttest outperformed 98% of themselves in pretest, a large effect on synthesis,  $d = 1.19$ , meaning that on average, the participants in posttest outperformed 88% of themselves in pretest, and a medium effect on evaluation,  $d = 0.47$ , meaning that on average, the participants in posttest outperformed 68% of themselves in pretest.

Another finding is that before the guided instruction, on average, students' four critical thinking skills were all at the weak level: interpretation ( $M = 7.02$ ,  $SD = 4.40$ ), analysis ( $M = 6.70$ ,  $SD = 2.87$ ), synthesis ( $M = 2.57$ ,  $SD = 1.49$ ), and evaluation ( $M = 4.72$ ,  $SD = 2.07$ ), based on the RCTST Scoring Rubric (see Appendix B). After the guided instruction, although significant improvement was found on interpretation, synthesis and evaluation, only interpretation ( $M = 15.63$ ) and synthesis ( $M = 4.37$ ) were improved into the moderate levels, while evaluation ( $M = 5.72$ ) was remained at the weak level. The finding reveals that Chinese EFL learners were really insufficient in critical thinking ability. After the guided instruction, their critical thinking ability were not improved much as expected, which implies that for EFL learners, intensified instruction, which needs more time and practice, might be required for great improvement of critical thinking skills.

In order to examine the influence of the guided instruction on the developmental patterns of critical thinking skills, the data from the RCTST Form B administered in the middle of the guided instruction was included. Three measurements divided the development of critical thinking skills into two stages: from Form A to Form B as the first stage and from Form B to Form C as the second stage.

### 4.1.3 Developmental Patterns of Critical Thinking Skills

This section reported the results of repeated-measures ANOVA which examined whether there were significant differences in the development of critical thinking skills across three forms of the RCTST, i.e. in the two stages. Different developments in the two stages forms different developmental patterns. The results could offer some insights into the effects of the guided instruction on the developmental patterns of critical thinking skills: interpretation, analysis, synthesis, and evaluation. The results are presented in Table 4.2.

**Table 4.2 The Effect of the Guided Instruction on the Developmental Patterns of Critical Thinking Skills**

Critical Thinking Skill	Mauchly's test		<i>F</i>	<i>p</i>	$\eta_p^2$
	$\chi^2(2)$	<i>p</i>			
Interpretation	2.92	.23	66.85	<.001	0.60
Analysis	0.02	.99	47.16	<.001	0.51
Synthesis	0.32	.85	23.53	<.001	0.34
Evaluation	0.56	.76	3.04	.053	0.06

As seen in Table 4.2, Mauchly's test indicated that the assumption of sphericity had been met for four critical thinking skills: interpretation,  $\chi^2(2) = 2.92, p > .05$ , analysis,  $\chi^2(2) = 0.2, p > .05$ , synthesis,  $\chi^2(2) = 0.32, p > .05$ , and evaluation,  $\chi^2(2) = 0.56, p > .05$ . It means that it is appropriate to perform repeated-measures ANOVA. The results show that, in general, there were significant differences across the RCTST Form A, B, and C for interpretation,  $F(2, 90) = 66.85, p < .001$ , analysis,  $F(2, 90) = 47.16, p < .001$ , and synthesis,  $F(2, 90) = 23.53, p < .001$ , but, except evaluation,  $F(2, 90) = 3.04, p > .05$ . It indicates that in general, the guided instruction significantly influenced the developmental patterns of interpretation, analysis, and synthesis across the two stages. It had no significant effect on the developmental pattern of evaluation. However, effect size

estimates show that, even though significantly, the guided instruction had different extents of influence. The commonly-used criteria for partial eta squared which is often used to measure effect size for repeat-measures ANOVA are: 0.01 (small effect), 0.06 (medium effect) and 0.14 (large effect). It can be interpreted that for small effect, 1% of variance in dependent variable is accounted for by one factor when other factors are controlled for; for medium effect, 6% of variance is accounted for; for large effect, 14% of variance is explained. According to criteria, the guided instruction had a very large influence on interpretation,  $\eta_p^2 = 0.60$ , i.e., 60% of variance in the development of interpretation was accounted for by the guided instruction when other factors were controlled for, and analysis,  $\eta_p^2 = 0.51$ , i.e., 51% of variance was accounted for, and a large one on synthesis,  $\eta_p^2 = 0.34$ , i.e., 34% of variance was accounted for.

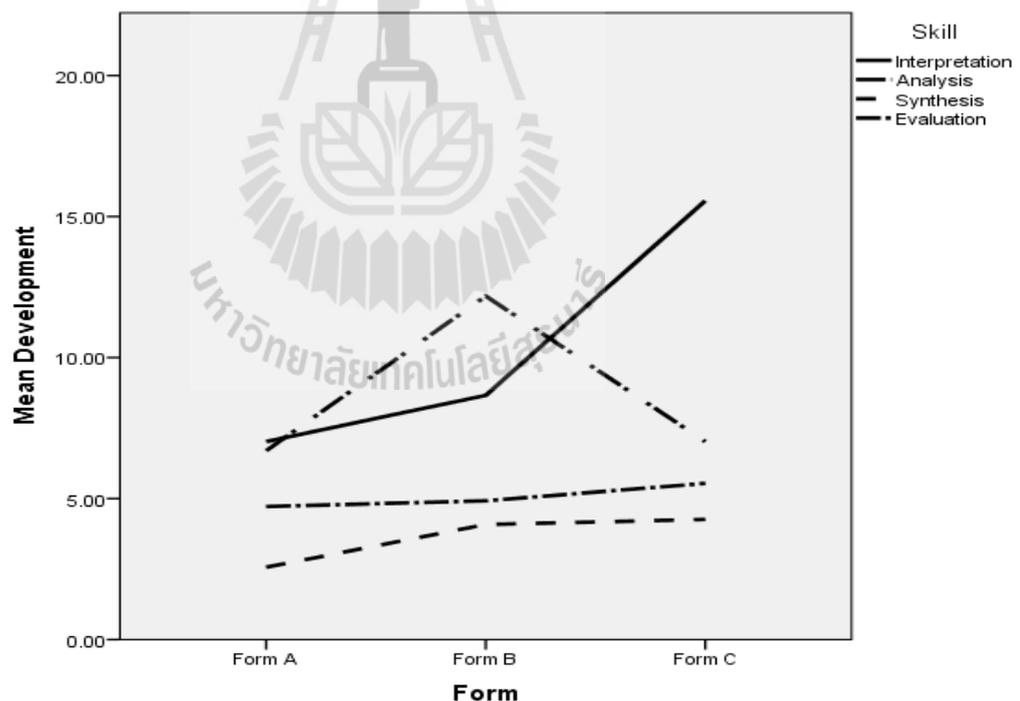
In order to examine on which stage the guided instruction had influence significantly, the tests of contrasts were performed. The result of tests of contrasts is presented in Table 4.3.

**Table 4.3 Differences of Students' Performance across Three Forms of the RCTST**

<b>Critical Thinking Skill</b>	<b>RCTST Form Contrast</b>	<i>Mean Difference</i>	<i>F</i>	<i>p</i>	$\eta_p^2$
Interpretation	A vs B	1.81	4.41	.041	0.09
	B vs C	6.80	98.27	<.001	0.69
Analysis	A vs B	5.58	79.27	<.001	0.64
	B vs C	-4.87	59.63	<.001	0.57
Synthesis	A vs B	1.60	28.65	<.001	0.39
	B vs C	0.20	0.49	.490	0.01
Evaluation	A vs B	0.35	0.78	.381	0.02
	B vs C	0.65	2.56	.117	0.05

As found in Table 4.3, for interpretation, students performed in Form B significantly better than in Form A,  $F(1, 45) = 4.41$ ,  $p < .05$ , and then, in Form C

significantly better than in Form B,  $F(1, 45) = 98.27, p < .001$ , indicating that interpretation was improved significantly in both stages and the guided instruction had significant effects on the development in both stages. Mean difference and effect size indices indicate that the effects had different degrees in different stages. In the first stage, the guided instruction had a moderate influence and interpretation developed significantly slowly,  $Mean\ Difference = 1.81, \eta_p^2 = .09$  and then in the second stage, the guided instruction had a very large influence and the development became significantly rapid,  $Mean\ Difference = 6.80, \eta_p^2 = .69$ . It presented a slow-rapid developmental pattern caused by different degrees of influence of the guided instruction in different stages (see Figure 4.2).



**Figure 4.2 Developmental Patterns of Critical Thinking Skills**

For analysis, students performed in Form B significantly better than in Form A,  $F(1, 45) = 79.27, p < .001$ , however, in Form C significantly worse than in Form B,  $F(1,$

45) = 59.63,  $p < .001$ , which was indicated by positive and negative mean differences. It reveals that in the first stage, analysis was improved significantly and the guided instruction had a significant effect on the development, and in contrast, in the second stage, the analysis was exacerbated rather than improved significantly and the guided instruction had a significant effect on the exacerbation. This distinctive finding was justified by the mean difference and effect size. Mean differences and effect size indices indicate that the guided instruction had a very large effect on the development in the first stage and a very large effect on the exacerbation in the second stage. Analysis developed very rapidly in the first stage and then deteriorated very rapidly in the second stage. It presented a consistently-rapid-improvement-deterioration developmental pattern (see Figure 4.2).

For synthesis, students performed in Form B significantly better than in Form A,  $F(1, 45) = 28.65.72$ ,  $p < .001$ , but not significantly, in Form C better than in Form B, indicating that only in the first stage, synthesis was improved significantly and the guided instruction significantly influenced the development in the first stage, not in the second stage. The finding was also supported by the mean difference and effect size. Mean difference and effect size indices show that in the first stage, the guided instruction had a large influence and it was developed significantly quickly, *Mean Difference* = 1.60,  $\eta_p^2 = .39$  and then in the second stage, the guided instruction had a very small effect and the development became very slow, *Mean Difference* = 0.20,  $\eta_p^2 = .01$ . It presented a rapid-tardy developmental pattern (see Figure 4.2).

For evaluation, though students performed in Form B better than in Form A, and then, in Form C better than in Form B, both were not significant, indicating that the guided instruction had no significant effects on the development in both stages. This

finding was strengthened by the mean difference and effect size. Mean differences and effect size indices show that the guided instruction had small effects on the development in both stages and the development was consistently slow across the two stages, *Mean Difference* = 0.35,  $\eta_p^2 = .02$ , and *Mean Difference* = 0.65,  $\eta_p^2 = .05$ . The finding suggests that evaluation developed very slowly and stably during the two stages. It presented a consistently-tardy developmental pattern (see Figure 4.2).

The finding reveals that the guided instruction had different degrees of influence on the development of critical thinking skills in the two stages, which leads to different developmental patterns. Firstly, it is a slow-rapid pattern which means the significantly slow improvement in the first stage and then significantly rapid improvement in the second stage, such as the development of interpretation; secondly, consistently-rapid-improvement-deterioration pattern which means the significantly rapid improvement in the first stage and then significantly rapid exacerbation in the second stage, such as the development of analysis; thirdly, a rapid-tardy pattern in which the improvement is significantly rapid in the first stage, and then non-significantly slow in the second stage, such as the development of synthesis; fourthly, a consistently-tardy pattern which involves a non-significantly slow improvement in the duration, such as the development of evaluation. The reason for the different effects of the guided instruction on the development of critical thinking skills in the two stages, which results in the different developmental patterns for different skills, is the interaction of skill complexity, skill proficiency interval, overlearning and skill decay. The detailed discussion would be conducted in the next chapter.

## 4.2 Answer to the Second Research Question

In answering the first research question, we found that critical thinking skills presented different developmental patterns. This section answered the second research question which aims to further explore the process of development of critical thinking skills in details by using qualitative data. It focuses on the training stages of each skill: presentation stage, application stage and habit formation stage. In presentation stage, students built the relevant knowledge of a skill; in application stage, the knowledge acquired at presentation stage was applied into practice; in formation stage, the skill was developed into the speedy and automatic level.

The qualitative data were collected from journals and interviews. Content and thematic analyses were employed to analyze the data. Each entry of journals was required after the lessons for a sub-skill, while interviews were conducted after a skill was completely instructed. Therefore, there was a temporal interval between journal writing and interviewing for each skill. Interviews could provide some information about the development over time. This section is organized by the developmental process of each critical thinking skill through presentation stage, application stage and formation stage. In general, there are six themes which reveal the developmental processes of critical thinking skills. One is that the knowledge built at presentation stage was consolidated and increased; one is the improvement of discovery at application stage; one is the decrease of mistakes made in application stage; one is that knowledge acquired at presentation stage affects the practice of a skill at application stage; one is that it became easier or remained difficult for the application of a skill. It notes that each skill is presented with some of these themes, not all of them.

### **4.2.1 Developmental Process of Interpretation**

There are four themes revealing the developmental process of interpretation. The first one is the consolidation and increase of the relevant knowledge; the second one is the reduction of mistakes; the third one is that it became easier for the discovery than before; the last one is that the effect of the relevant knowledge acquired at presentation stage on the discovery of arguments at application stage.

#### **4.2.1.1 Knowledge Consolidation and Increase**

At presentation stage, participants acquired the relevant knowledge of argument. There were different extents of knowledge acquisition. Some acquired clear knowledge and some acquired unclear knowledge. There were different amounts of knowledge acquired. Some acquired more and some acquired less. Through training, unclear knowledge became clear and acquired knowledge was consolidated. At the same time, participants acquired some new knowledge. The following is the description of qualitative evidence from learners' journals and interviews.

In the journals, two (13%) reported that they had clear ideas about argument definition, argument attribute, argument constituent, logical relation between conclusion and reasons, using words indicators to discover constituents of one argument, and the way to discover argument. Most of relevant knowledge was acquired. Both reported again in the interviews that they had clear ideas about argument definition, attribute and constituent, and described the steps to discover arguments in a text. Through the training, their knowledge of argument definition, attribute and constituent, and the way to discover argument acquired at presentation stage was consolidated. However, they mistakenly acquired some knowledge, as they reported in the journals that they falsely used argument to denote conclusion. But, in the interviews, they

reported that argument has the component of conclusion. Through training, unclear ideas became clear.

Eight (53%) reported that at presentation stage, they acquired argument attribute, argument constituent, word indicator use and the way to discover argument. Many of relevant knowledge was acquired. Subsequently, they described the detailed steps to discover arguments in the interviews. Through training, their knowledge of steps to discover arguments was consolidated. Three (20%) reported in the journals that they had clear ideas only about argument constituent and the way to discover argument. Later on still in the journals, one of them reported clear ideas about logical relations among the constituents, and afterwards, in the interviews, reported the argument constituent and logical relations among the constituents. Through training, the new knowledge of logical relations among the constituents was acquired and consolidated. The knowledge of argument constituent acquired at presentation stage was also consolidated. One (7%) reported the way to discover arguments in the journal and described the steps to discover arguments again in the interview. Through training, the knowledge was consolidated. One (7%) reported argument constituents and attributes in the journal and reported it again in the interview. Through training, the knowledge was also consolidated.

The following excerpts, respectively, were from the journal describing the steps to discover an argument in a reading text, and the interview reporting the constituents of an argument (pseudonym of interviewer and interviewee used for privacy, the same as hereinafter):

... ..  
*I have learned how to discover the author's argument today. Normally, there are two steps: 1. Point of view/conclusion (statement)—support—2. reason/evidence (statement). Through the teacher's explanation of Text A (a reading text) and discussion with classmates, generally, I know how to discover the argument. (JQ/J).*

... ..

... ..  
*WS: How many constituents do you know an argument consists of?  
 SLC: There are two. One is the author's viewpoint (conclusion), and the other is, which persuades other people, is exactly reasons (SLC/I).*

... ..

#### **4.2.1.2 Reduction of Mistakes**

In application stage, when participants were required to use knowledge they acquired at presentation stage to discover arguments in a reading text, they appeared unskillful at the discovery, because when applying the knowledge acquired, they had to judge whether what one sentence contains is conclusion or reason. Sometimes, sentences presenting conclusion or reason are not put together in one paragraph, even separated from each other in several paragraphs, which makes the discovery and judgment more difficult. In addition, before participants began to use what they had acquired at presentation stage to discover arguments in a reading text, they had to go over the knowledge in their mind, which makes the discovery time-consuming. Therefore, participants initially could make mistakes in the discovery. Through training, they could reduce mistakes and discover arguments better and more correctly. They thought that it became easier to make the discovery than before. The qualitative evidence from learners' journals and interviews is provided as follows.

Five participants (33%) reported in the journals that they made three types of mistakes in applying the knowledge into discovering arguments in a reading text. The first mistake is that when they discovered arguments and their constituents,

they mistook argument as conclusion, i.e. they used ‘argument’ rather than ‘conclusion’ itself to denote conclusion. The second mistake is that they could not discover all the reasons for an argument. The third one is that they could find only conclusion, rather than reasons. In the ensuing journals and interviews, they said that they could discover arguments, but sometimes they still made one mistake, e.g., not discovering all the reasons for an argument. Through training, the three mistakes made at the beginning decreased into one at the end.

The other ten participants (67%) reported in the journals that they made four mistakes when discovering arguments in a text: argument was used to denote conclusion; not all the reasons were discovered; only conclusion was discovered; conclusion and reasons were not distinguished. Then, in the interviews all the participants stated that they could discover arguments better and more correctly, and did not make any mistakes. Through training, mistakes diminished. The excerpt from the journal is as follows, which indicates how to discover an argument in a reading text and one mistake was made:

... ..

*There is a big argument in the text, which is ‘it is one of the outstanding peculiarities of the French that their vices are all on the surface, and their extra-ordinary virtues concealed’. After showing this argument to us, the author raised many examples to us to make us convinced of the idea put up by him (LMT/J).*

... ..

In the description of how to discover an argument in the excerpt, the participant discovered conclusion and reasons (examples), but mistakenly used argument to name conclusion by saying “showing this argument to us”.

#### 4.2.1.3 Easiness of Argument Discovery

Through training, participants thought that it became easier to discover arguments in a reading text than before. Thirteen participants (87%) reported in the interviews that at the beginning, it was difficult to discover an argument and now, it became easier. They could discover an argument better and more correctly than before. However, only one (7%) reported that nothing had changed and it was as difficult to discover an argument as before. The following excerpt from the interview shows that it became easier to discover an argument:

... ..

*WS: Do you think it is now easier to discover an argument?*

*ZT: For a long time, you have been teaching us. Absolutely, yes.*

*WS: What about it when you began to learn it?*

*ZT: At the beginning...(being silent). At the beginning, when I wanted to discover an argument, I had to understand what argument is and try to recall it in my mind, and then, understand the paragraph in a text. Afterwards, I can discover it (ZT/I).*

... ..

#### 4.2.1.4 The Effect of Knowledge Acquired on Discovery of Argument

There is a close relation between the relevant knowledge acquired at presentation stage and applying the knowledge into the practice of argument discovery at application stage. The knowledge imposed effects on the discovery of arguments in a reading text. Clear knowledge could facilitate the discovery and unclear knowledge could cause confusion leading to difficulty discovery and mistakes. The following is the description of qualitative evidence from the interviews.

Ten participants (67%) reported in the interviews that the knowledge acquired at presentation stage influenced the discovery of arguments. They said that they needed to have the concept of argument in mind and then they could discover it in a reading text. Argument, explanation, summary and description could be discovered

according to what they had learned about the differences among them. Sometimes, they confused argument with explanation, summary and description in the discovery because they did not have clear ideas about the differences among them, for instance, they confused argument with explanation. They could not distinguish deductive argument from inductive argument. The following excerpt from the interview shows that unclear ideas about the differences between argument and explanation lead to the difficult distinction of argument and explanation in the discovery:

... ..

*WS: So, among the discovery of argument, explanation, summary and description, which one do you think is difficult?*

*LJJ: Argument and explanation.*

*WS: Why?*

*LJJ: they are similar. It is easy to confuse them (LJJ/I).*

... ..

To conclude, at presentation stage, participants acquired different amounts of knowledge. Through training, the knowledge was consolidated and sometimes, could increase. At application stage, participants could make some mistakes when they initially used the knowledge to discover arguments in a reading text. Through training, the mistakes reduced and participants thought that it became easier to discovery arguments. The knowledge acquired at presentation stage affected participants' performance in the discovery. It could facilitate or hinder the discovery. However, although progress had been achieved in the discovery, participants thought that they were still not so skillful to discover arguments. Their skill of interpretation has not reach the automatic level, i.e., habit formation stage, which implies that more time and practice could be required.

## **4.2.2 Developmental Process of Analysis**

The skill of analysis involves the discovery of assumptions and faults of an argument in a reading text. There are three themes revealing the developmental process of analysis: knowledge consolidation and increase, the improvement of the discovery, and easiness or difficulty in the discovery.

### **4.2.2.1 Knowledge Consolidation and Increase of Assumption**

For assumption, which involves the knowledge of assumption attributes and the way to discover assumption in a reading text, participants acquired the relevant knowledge at presentation stage, but in different amounts. Some even mistakenly acquired the knowledge. Through training, they consolidated the knowledge acquired and at the same time, acquired the new knowledge. The following is the reporting of qualitative evidence from the journals and interviews.

Four participants (27%) reported in the journals that they acquired the knowledge of assumption attributes and the way to discover assumption in a reading text and reported it again in the interviews. Through training, the knowledge of assumption attributes and the way to discover assumption was consolidated. Three participants (20%) reported in the journals that they acquired only assumption attributes and reported it again in the interviews. Through training, the knowledge of assumption attributes was consolidated. Five participants (33%) reported in the journals that they acquired assumption attributes. In the interviews, they reported it again and described the steps to discover assumptions in a reading text. Through training, the knowledge of assumption attributes was consolidated and at the same time, the new knowledge of the steps to discover assumption was acquired. The knowledge increased.

One (7%) reported in the journal that she mistook assumption as conclusion of an argument and reported it again in the interview. Through training, the knowledge falsely acquired did not make right. One (7%) reported in the journal that she falsely acquired the knowledge of assumption attributes and reported again in the interview that the knowledge of assumption attributes became clear. Through training, the knowledge was improved. The following excerpts from the journals show the acquisition of knowledge of assumption attributes and the way to discover assumption:

... ..

*Assumptions, which the author does not express explicitly in a text, may be used as reason or as conclusion (WCL/J).*

... ..

... ..

*In an argument, the author's reasons are not sufficient to support conclusion. In that case, implicit assumptions are needed to bridge the gap between reasons and conclusion, so that the reasons can support conclusion sufficiently (WCL/J).*

... ..

#### **4.2.2.2 Improvement of Assumption Discovery**

In application stage, initially, participants performed differently in the discovery of assumptions in a reading text. Some of them could discover most of assumptions; some of them could discover some of assumptions; some could not discover them because assumption is complicated and the inference for assumption is difficult; some could discover assumption only with assistance from the teacher and classmates. Through training, some made little progress in the discovery; some made some progress; some made great progress. The qualitative evidence from the journals and interviews is reported as follows.

Four participants (27%), who acquired the knowledge of assumption attributes and the way to discover assumption, reported in the journals that there were some

difficulties in the discovery of assumption and they could not discover assumptions correctly; if with the assistance from the teacher and peers, they could discover them. In the interviews, one of them reported that they could discover most of assumptions; one reported some discovery of assumption; the other two reported that they still made incorrect discovery. Through training, some progress in the discovery was made.

Three participants (20%), who acquired the knowledge of only assumption attributes, reported in the journals that they could discover assumptions with the assistance from the teacher and peers. In the interviews, they said that they could not independently discover assumption in a reading text due to difficult inferences. Through training, they made little progress. Five participants (33%), who acquired the knowledge of assumption attributes and through training, acquired the new knowledge, reported in the journals that they could not discover assumption correctly or they could discover it with the assistance from the teacher and peers. In the interviews, they reported that they could discover most of assumptions. Through training, they made great progress.

Two participants, who mistakenly acquired the knowledge, reported in the journal that she could not discover assumption correctly. However, one of them, who made the knowledge right, reported in the interview that she could discover assumption, while the other, who did not make right the wrongly acquired knowledge, still could not discover it correctly. Through training, if the knowledge mistakenly acquired could be corrected, subsequently, the progress in the discovery could be achieved. The following excerpts, respectively, were from the journals, showing the reason for incorrect discovery of assumptions, and the interviews, showing the steps to discover an assumption:

... ..

*When discovering an argument in last paragraph in a text in Unit6, the sentence which is the conclusion of an argument is mistaken as reasons. I can't discover assumptions, either (WCL/J).*

... ..

... ..

*WS: Now, do you know what assumption is?*

*WCL: Assumption is..., sometimes, no direct relation between the author's conclusion and reasons is found. That is, the author thought you should know it and didn't express it in a text explicitly.*

*WS: Can you infer it (assumption)?*

*WCL: Generally, when I infer assumption, based on reasons and their relation with conclusion, I set up a kind of relation between reasons and conclusion, and then, infer the gap of relation.*

*WS: Mostly, you can infer it.*

*WCL: Yeah, I think I can (WCL/I).*

... ..

To conclude, with the knowledge of only assumption attribute, little progress at application stage was made; with a little more knowledge of assumption attribute and the way to discover assumption, some progress was made; with the knowledge increase, great progress was made. In particular, only if the knowledge mistakenly acquired was corrected, could the progress be achieved.

#### **4.2.2.3 Knowledge Consolidation and Discovery Improvement of Argument Faults**

Faults of an argument involves the knowledge of false premise, false correlation, false causal link, the satisfaction of necessary and sufficient conditions, appropriateness of analogy, and going around in circle in an argument. In presentation stage, participants knew that an argument has defects, and acquired some of the knowledge, not all of them. As found in the qualitative evidence from journals and interviews, nine participants (60%) in the journals reported that they acquired one or two pieces of the following knowledge: necessary and sufficient conditions, appropriateness of analogy, and going around in circle in an argument. In the interviews,

four of them (27%) reported that they had clear ideas about most of the faults of an argument. Through training, a small number of participants consolidated and increased the knowledge.

In application stage, initially, participants could discover one or two faults of an argument. Fault discovery was a hard task for them, due to complicated concepts of faults and difficult judgments on them. Through training, most of them could discover some of faults, while some of them most of faults, and thus, different extents of progress were made. As can be seen in the qualitative evidence from journals and interviews, five participants (33%) reported in the journals that they could discover analogy and evaluate it or going around in circle in an argument. They found it hard to discover faults. In the interviews, one of them (7%) reported that they could discover most of the faults of an argument. Through training, great progress was achieved. Two of them (13%) reported that they could discover some of faults, some progress achieved. Two of them (13%) still found it hard to discover faults, little progress made. Among the other ten participants, only in the interviews, nine of them reported that they could discover some of the faults. Through training, a little progress was made.

The following excerpts, respectively, were from the journals, reporting the faults an argument could have, and the interviews, showing some discovery of faults:

... ..

*I've learnt some faults in arguments today. Some writers may not give enough reasons to support arguments. Some may even not have reasons. Their arguments are as well as reasons. The paragraph may look like in circles. And you can't find apparently the reasons. Some may want to prove the arguments wrong only by attacking the author, which it is certainly wrong (LJJ/J).*

... ..

... ..

*WS: Since we have learnt to judge whether an argument is good or bad, can you now judge it?*

*LJJ: For some, I can.*

- WS: *For some, you can't.*
- LJJ: *Yeah.*
- WS: *Why you can't, for some?*
- LJJ: *For example, the text is profound. Sometimes, the author's argument is difficult. That is, it seems to be clear, but actually, it is difficult to get deep insights into it.*
- WS: *So, sometimes, can you judge an argument by sufficient and necessary conditions?*
- LJJ: *I can discover some of the conditions. But, sometimes, it is easy to confuse them when judging.*
- WS: *You can judge whether an argument satisfying sufficient conditions, can't you?*
- LJJ: *Sometimes, I can.*
- WS: *For some arguments, their conclusion is based on a false causal link. Can you discover the false causal link?*
- LJJ: *Yes.*
- WS: *For some arguments, their reasons are not reasons, but a kind repetition of conclusion. Can you judge it?*
- LJJ: *For some, I can.*
- WS: *So, for some, you can't. That means, you find it difficult to judge it. So, why do you think it is difficult?*
- LJJ: *Some texts may involves some, culture, or religion, which is difficult to understand. Then, I can't judge it (LJJ/I).*
- ... ..

#### **4.2.2.4 Easiness or Difficulty in the Discovery**

Through training, most participants thought that it was still difficult to discover assumptions and faults. They found it hard to make inferences about assumptions on the basis of conclusion and reasons of an argument and judge the faults of an argument. As found in the qualitative evidence from interviews, seven participants (47%) reported in the interviews that there were difficulties in discovering assumption, while two participants (13%) reported in the interviews that it became easier to discover assumption. Six participants (40%) reported in the interviews that it remained difficult to discover the faults of an argument, and that if faults were simple, they could discover them.

It was found that it remained difficult for participants to discover assumptions and faults after the training, which suggests that they had to spend a long time on the discovery. The skill of analysis was far from the automatic level at formation stage.

#### **4.2.3 Developmental Process of Synthesis**

The skill of synthesis involves the logical relations among a complex argument and diagramming them. There are three themes for the developmental process of synthesis: knowledge consolidation and increase, the improvement of argument diagramming, and easiness or difficulty in diagramming.

In presentation stage, participants acquired the relevant knowledge of synthesis, but in different amounts. Most of them acquired one piece of the knowledge. Through training, participants still had unclear ideas about logical relations among components of a complex argument. As found in the qualitative evidence from journals and interviews, six participants (40%) reported in the journals that they acquired only one piece of the following knowledge: attributes of a complex argument, or procedure of argumentation, or the way to diagram a complex argument. Only one participant (7%) reported in the journal that she acquired two pieces of knowledge: procedure of argumentation and the way to diagram a complex argument. Four of them (27%), in the interviews, reported that they had no clear ideas about logical relations among the components. No direct evidence was found about the consolidation and increase of knowledge acquired. It was found that after training, some participants did not have clear knowledge of logical relations among the components of a complex argument.

In application stage, initially, some participants could analyze and discover the relations among the sentences in one paragraph which contains a complex argument,

and diagram the relations. Through training, participants could diagram a complex argument and argument diagramming was strengthened and improved, but a few of them made some mistakes. As can be seen in the qualitative evidence from journals and interviews, seven participants (47%) reported in the journals that they could diagram a complex argument and one (7%) reported that under scaffolding, she could diagram a complex argument. In the interviews, five of them (33%), who acquired the relevant knowledge at presentation stage, reported that they could diagram a complex argument and three of them (20%) reported that they sometimes made some mistakes in diagramming because the relations among sentences could not be discovered correctly. Through training, the argument diagramming was strengthened for those who acquired the knowledge and at the same time, for a few participants, some mistakes occurred due to incorrect analysis of logical relations among sentences in one paragraph. Among the other seven participants, who did not mention diagramming a complex argument in the journals, six (40%) reported in the interviews that they could diagram a complex argument and only one (7%) reported some mistakes in diagramming because she was not skillful at it. After training, argument diagramming was improved.

To conclude, after training of synthesis, most of participants could diagram a complex argument, while some of them sometimes made some mistakes in diagramming due to incorrect or unskillful analysis of logical relations. Those, who acquired the knowledge, strengthened argument diagramming, while those, who did not mention the acquisition of the knowledge, improved argument diagramming.

The following excerpts, respectively, were from the journals, showing the knowledge acquired, and the interviews, showing that if the logical relations of a complex argument were simple, the argument could be diagrammed:

... ..  
*learnt the chain argument today. It has an intermediate conclusion in the middle, which can be used as conclusion of a small argument, and at the same time, as a reason of a big argument (ZCY/J).*

... ..  
 WS: *Then, the second, we have learnt to diagram the relations among arguments. Can you diagram them?*

ZCY: *Well, if the relations among sentences were clear, I can diagram them.*

... ..

As for easiness or difficulty in diagramming, after training, participants thought that if the logical relations among the components were simple, they could discover and diagram them. Some thought that it became easier to discover and diagram the logical relations. Four participants (27%) in the interviews reported that if the logical relations of a complex argument were not complicated, they could discover and diagram a chain argument. One participant (7%) reported in the interview that it became easier to discover and diagram a complex argument than before. Only one (7%) reported in the interview that it remained difficult to discover the logical relations of a complex argument and therefore, diagram them.

To conclude, at presentation, participants acquired some knowledge of synthesis. Through training, no direct consolidation and increase of knowledge was found and some participants did not have clear ideas about the logical relations of a chain argument. At application stage, nearly half of participants could diagram a complex argument at the beginning. After the training, a great majority of participants could diagram a complex argument. Diagramming was improved a lot. However, some of them made some mistakes due to incorrect or unskillful analysis of the logical relations among the components of a complex argument. Through training, most participants thought that it was still difficult to discover the logical relations of a complex argument and diagram them, which implies that they had to spend a long time

on diagramming. Their skill of synthesis had not achieved the automatic level at formation stage.

#### **4.2.4 Developmental Process of Evaluation**

There are eight thought standards used to assess arguments and six reasoning elements required to be found in a reading text. There are three themes revealing the developmental process of evaluation: knowledge consolidation and increase, the improvement of applying knowledge into practice, and easiness or difficulty in the application of knowledge.

In presentation stage, participants acquired the concepts of thought standards and reasoning elements. After training, some consolidated the knowledge; some forgot some of the knowledge; some forgot all of the knowledge. Some of knowledge was consolidated and some of knowledge decayed. For thought standards, in the journals, all the participants reported that they knew the standards. In the interviews, three of them (20%) said that they could remember the standards. The knowledge was consolidated after training. Five of them (33%) said that they could remember some of the standards and seven of them (47%) said that they could not remember the standards. After training, the knowledge decayed more or less.

For reasoning elements, 11 participants (73%) reported in the journals that they acquired the concepts of reasoning elements. In the interviews, five of them (33%) reported that they still could remember the reasoning elements. After training, the knowledge was consolidated. Five of them (33%) could not remember the reasoning elements and one of them (7%) could remember some of reasoning elements. After training, the knowledge decayed more or less. The other four (27%), who did not

mentioned knowledge acquisition in the journals, reported in the interviews that they could not remember any reasoning elements. After training, the knowledge decayed.

In application stage, no participants provided any information about their performance in the journals. They reported their performance only in the interviews, which provided information about their use of thought standards and discovery of reasoning elements after the training. For the standards, after training, participants who acquired more knowledge performed better in the application of the standards; participants who acquired less knowledge improved their performance in the application. With decayed knowledge, the skill did not decay consequently. Three participants (20%), who mentioned that they could remember the standards, said in the interviews that they could apply the standards into the assessment of arguments. Five participants (33%), who related that they could remember some of the standards, stated in the interviews that they could apply some of the standards into the assessment. Among seven participants, who reported that they could not remember any standards, five of them (33%) said in the interviews that they could apply some of the standards into the assessment of arguments; one of them (7%) could apply some of standards into the assessment with some mistakes; one of them (7%) could not apply the standards into the assessment.

For reasoning elements, after training, whether participants remembered all the reasoning elements or some of them or none of them, most of them discovered some of reasoning elements in a reading text. To a certain degree, most of them improved the discovery of reasoning elements. Five participants (33%), who stated that they could remember reasoning elements, and one participant (7%), who stated that she could remember some of reasoning elements, reported in the interviews that they could

discover some of the elements. Among five, who stated that they could not remember reasoning elements, three of them (20%) reported in the interviews that they could discover some elements, and two of them (13%) could discover none of the elements. The other four, who did not mention reasoning elements in the journals and in the interviews, reported in the interviews that they could discover some of reasoning elements.

The following excerpts, respectively, were from the journals, showing the knowledge acquired at presentation stage, and the interviews, showing that after training, the knowledge was forgotten and could not be applied:

... ..

*The standards used to assess arguments.*

1. clarity (whether the author's viewpoint is clear.)

2. accuracy Reasons must be accurate.

3. precision ----more details

4. relevance

5. depth (The depth of argument, which should not be superficial.)

6. breadth 7. logicalness 8. significance (WWY/J)

*Elements of Reasoning*

1. point of view, thought (文章整体从什么角度写。In what perspective a text was written generally)

2. information

3. conclusion (It can be found at the end of a text normally.)

4. basic ideas (concepts) Normally, they are words or phrases.

5. assumptions

6. implication (Implied significance) (WWY/J)

... ..

Excerpt from the interview:

... ..

WS: In the last several lessons, we learnt to use eight standards to assess an argument. Do you remember these standards?

WWY: I can't remember them clearly.

... ..

WS: They are breadth, accuracy, precision, significance, relevance, etc. If you know the eight standards, can you use them to assess an argument?

WWY: I can't

... ..

... ..

WS: And then, we also learnt to discover six reasoning elements. Do you remember the elements?

*WWY: I can't remember them clearly.*

*WS: I give you some hints. They are point of view, conclusion, information, basic ideas, assumptions, and implication.*

*WWY: I can't distinguish them clearly.*

*WS: So, it's difficult for you to discover them.*

*WWY: That is, the last text (referring to the RCTST Form C) you asked us to take, the last item, asking us to discover the elements, information, basic ideas, ..., these, I think I can't distinguish (WWY/I).*

... ..

As for easiness and difficulty in the discovery, through training, participants thought that if they had clear ideas about the standards and knew the differences among them, they could use them to assess arguments. They thought that it was still difficult to use the standards for the assessment of arguments due to difficult distinction of them. In particular, it was difficult to assess the logicalness of argument due to harsh inference. In the discovery of reasoning elements in a reading text, participants thought that it was difficult to distinguish them. In particular, it was difficult to discover implication due to difficult inference and generalization, and assumption due to complicated discovery steps.

To conclude, in the development of the evaluation skill, the relevant knowledge played a positive role and more relevant knowledge implies the better development for the standards, but not for reasoning elements, which more knowledge did not mean better discovery. The relevant knowledge of evaluation was decayed as time passed, but the skill did not subsequently decay. After training, participants thought that it was still difficult to use the standards and discover reasoning elements, which suggests that the skill of evaluation did not achieve automatic level at formation stage.

### **4.3 Answer to the Third Research Question**

This section answered the third research question which examined the effects of students' initial level of critical thinking skills on the development of these skills. On the basis of the overall scores of the RCTST Form A, by norm-reference scoring, students were statistically classified into three groups with low, intermediate and high levels of critical thinking skills, respectively. Multilevel modeling was employed to explore growth rates of critical thinking skills and the effect of initial levels on the growth rates and trajectories, more detailed than the developmental patterns of critical thinking skills found in answering the first question. Statistically, there are three models: unconditional means model examining whether further analysis was needed, unconditional growth model exploring, in what growth rate and trajectory, students developed their critical thinking skills due to their different initial levels of critical thinking skills, and conditional growth model, into which three different levels were entered, estimating the effects of these levels on the growth rates and trajectories of critical thinking skills.

#### **4.3.1 Growth Rate and Trajectory of Critical Thinking Skills development**

The results of unconditional means model and unconditional growth model are presented in Table 4.4. Unconditional means model examined whether there was significant within-individual residual variance and unconditional growth model explored the growth rates and trajectories of critical thinking skills.

**Table 4.4 Results of Unconditional Means and Growth Model for Critical Thinking****Skills**

<b>Unconditional Means Model</b>						
<b>Parameter</b>		<b>Interpretation</b>	<b>Analysis</b>	<b>Synthesis</b>	<b>Evaluation</b>	
Intercept	Initial status	10.51***	8.68***	3.66**	5.07**	
Variance	Level1	28.36***	16.96***	2.96**	4.11**	
Components	Level2	Initial status	0.00	0.00	0.48	0.13
Deviance		902.70	827.60	592.11	625.18	
AIC		908.70	833.60	598.11	631.18	
BIC		917.65	842.55	607.06	640.13	
<b>Unconditional Growth Model</b>						
Intercept	Initial status	7.00***	6.65***	2.52**	4.71**	
Growth rate	Time	-0.96	10.88***	2.25**	0.42*	
	Time x Time	2.62***	-5.35***	-0.69**	0.21	
Variance	Level1	13.35***	7.96***	1.91**	3.39**	
Components	Level2	Initial status	2.61	0.49	0.65	0.81
		Growth rate	0.51	0.37	0.01	0.52
Pseudo-R <sup>2</sup>		0.53	0.53	0.34	0.18	
Deviance		805.18	755.38	557.65	620.06	
AIC		819.18	769.38	571.65	632.06	
BIC		840.06	790.26	592.53	649.96	

Notes. \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$

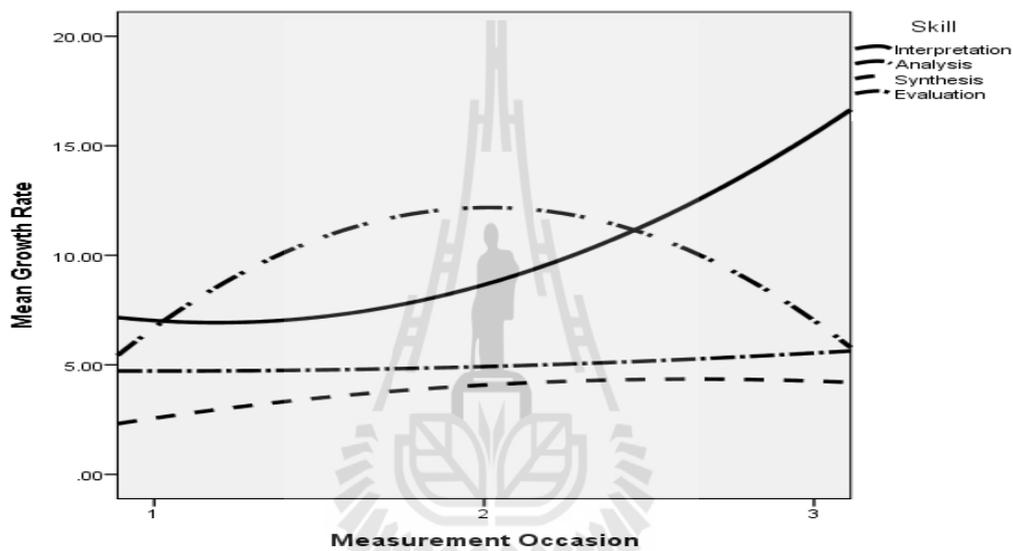
As the table shows, in unconditional means model, the variance component of level-one was significant for all the skills: interpretation,  $\sigma^2 = 28.36$ ,  $p < .001$ , analysis,  $\sigma^2 = 16.96$ ,  $p < .001$ , synthesis,  $\sigma^2 = 2.96$ ,  $p < .01$ , and evaluation,  $\sigma^2 = 4.11$ ,  $p < .01$ , indicating that there was significantly unexplained within-individual residual variance across different measurement occasions. There were little level-two variance components for all the skills, indicating that there was little unexplained inter-individual variance across individual students on different measurement occasions. The variation of the development of critical thinking skills mainly existed within individual student across different measurement occasions (i.e., Form A, B and C). It suggested

that there were latent level-one predictors which could mainly explain the variation of the development. That is the repeated measurements over time for each individual student (i.e., within individual), which needed to be included into the model. As a result, two level-one predictors—Time and Time x Time were included into the unconditional growth model, which examine whether the growth rates of critical thinking skills were linear or curvilinear (i.e., quadratic). Linear growth means that the growth rate is constant, while curvilinear means that the growth rate is ever changed. The inclusion of the level-one predictors can inform the growth rates and trajectories of students' critical thinking skills, determined by initial levels of critical thinking skills.

Comparison of unconditional means model and unconditional growth model indicates that, deviance significantly reduced for interpretation, from 902.70 to 805.18,  $\chi^2(4) = 902.70 - 805.18 = 97.52$ ,  $p < .01$ , for analysis, from 827.60 to 755.38,  $\chi^2(4) = 827.60 - 755.38 = 72.22$ ,  $p < .01$ , for synthesis, from 592.11 to 577.65,  $\chi^2(4) = 592.11 - 577.65 = 14.46$ ,  $p < .01$ , but non-significantly for evaluation, from 625.18 to 620.06,  $\chi^2(4) = 625.18 - 620.06 = 5.12$ ,  $p > .05$ . This reveals that unconditional growth model significantly improved model fit over unconditional means model for interpretation, analysis, and synthesis, but non-significantly for evaluation. It corroborated by the decline of level-one within-student variance for interpretation from 28.36 to 13.35,  $Pseudo-R^2 = 0.53$ , for analysis, from 16.96 to 7.96,  $Pseudo-R^2 = 0.53$ , for synthesis, from 2.96 to 1.91,  $Pseudo-R^2 = 0.34$ , for evaluation, from 4.11 to 3.39,  $Pseudo-R^2 = 0.18$ . It means that, for interpretation, analysis, synthesis, and evaluation, 53%, 53%, 34% and 18% of within-student residual variance could be explained by growth with time.

As Table 4.4 shows, for interpretation, the linear effect was negative, but non-significant,  $\beta = -0.96$ ,  $p > .05$ , and quadratic growth was positive and significant,  $\beta = 2.62$ ,

$p < .001$ , showing that, on average, the growth of interpretation was mostly accelerated over time at the rate of 2.62 after instantaneous small decrease of rate of 0.96 at initial status. The acceleration of the growth started instantly after instantaneous decrease ( $0.96/2 * 2.62 = 0.18$ ), i.e. about a week. It reveals that the initial slight decrease of the growth diminished quickly and then the growth headed up drastically at the accelerating growth rate. The growth trajectory presented the features of U-shaped growth (see Figure 4.3).



**Figure 4.3 Growth Rates and Trajectories of Critical Thinking Skills**

Analysis started with a significantly positive linear effect,  $\beta = 10.88$ ,  $p < .01$ , and then, a significantly negative quadratic effect,  $\beta = -5.35$ ,  $p < .001$ , indicating that, on average, the instantaneous growth rate of 10.88 was slowed down by deceleration rate of 5.35 and finally, diminished at the time of  $10.88/2 * 5.35 = 1.02$ , i.e., immediately after the second measure occasion in the eighth week. Afterwards, the growth turned around to decelerate drastically at the rate of 5.35 over time. The growth rate was greatly changed and heterogeneous and the growth trajectory appeared the features of  $\cap$ -shaped growth (see Figure 4.3).

Synthesis started with a significantly positive linear growth rate,  $\beta = 2.25$ ,  $p < .01$ , and then, a significantly negative the quadratic one,  $\beta = -0.69$ ,  $p < .01$ , revealing that, on average, the instantaneous growth rate of 2.25 at the initial status was gradually slowed down by the deceleration rate of 0.69. Finally, the increase diminished near to the last measurement ( $2.25/2*0.69 = 1.63$ ) and growth turn around to decelerate at the rate of 0.69. The growth rate was changed slowly and heterogeneous and the growth trajectory appeared the features of  $\cap$ -shaped growth (see Figure 4.3).

The linear growth for evaluation was significantly positive,  $\beta = 0.42$ ,  $p < .05$ , while the quadratic growth was also positive but non-significantly,  $\beta = 0.21$ ,  $p > .05$ , indicating that, on average, evaluation increased quite slowly at the instantaneous growth rate of 0.42 initially and then gradually accelerated at the rate of 0.21. To a certain degree, the growth rate mostly remained constant over time and homogeneous. The growth trajectory presented the features of linear growth (see Figure 4.3).

The finding mentioned above reveals that the four critical thinking skills grew at different rates in different growth trajectories. It suggests that, except evaluation whose growth was mostly homogeneous in a linear trend, the growth rates in the other critical thinking skills were heterogeneous, due to different initial levels of initial critical thinking skills among individual students. However, the detailed effects of specified initial levels of critical thinking skills on the growth rates and trajectories require the further analysis of conditional growth model with the addition of three initial levels of critical thinking skills as the level-two fixed predictor.

### 4.3.2 Effects of Initial Levels of Critical Thinking Skills on Growth Rates and Trajectories

The results of conditional growth model are presented in Table 4.5, which examined the effects of initial levels of critical thinking skills on growth rates and trajectories of the skills.

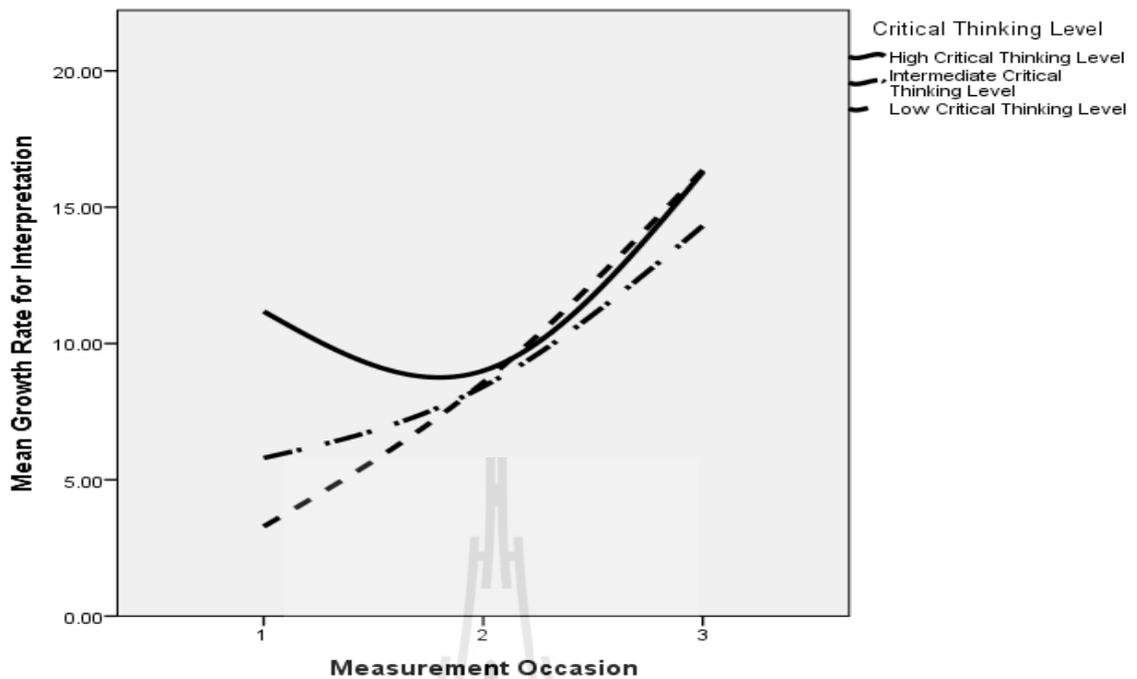
**Table 4.5 Results of Conditional Growth Model for Critical Thinking Skills**

Parameter		Interpretation	Analysis	Synthesis	Evaluation
Intercept (initial status)	Low level	3.29***	4.29	1.00**	3.73***
	Intermediate level	2.51*	2.71	1.90***	1.03
	High level	7.89***	4.13	2.47***	1.55*
Growth rate	Time	4.04*	13.11**	4.00***	0.96*
	Time * Time	1.25	-6.04***	-1.21**	
	Intermediate level x Time	-3.05	-1.50	-2.72*	-0.54
	High level x Time	-10.95***	-5.20	-2.29*	-1.02
	Intermediate level x Time x Time	0.39	0.22	0.93	
	High level x Time x Time	3.49**	1.89	0.57	
Variance Components	Level1	8.99***	7.54***	1.25***	3.40***
	Level2 Initial status	0.00	0.00	0.30	0.39
		Growth rate	0.29	0.75	0.17
Deviance		761.48	737.82	537.67	614.26
AIC		787.48	763.82	563.67	634.26
BIC		826.27	802.61	602.45	664.10

Notes. \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$

As found in the table, between low and high levels, there was significant difference in the initial decrease,  $p < .001$ , and the following acceleration,  $p < .01$ , in the growth of interpretation. On average, the estimated difference in weekly growth rate between low and high levels was -10.95 and 3.49 for the initial decrease and the

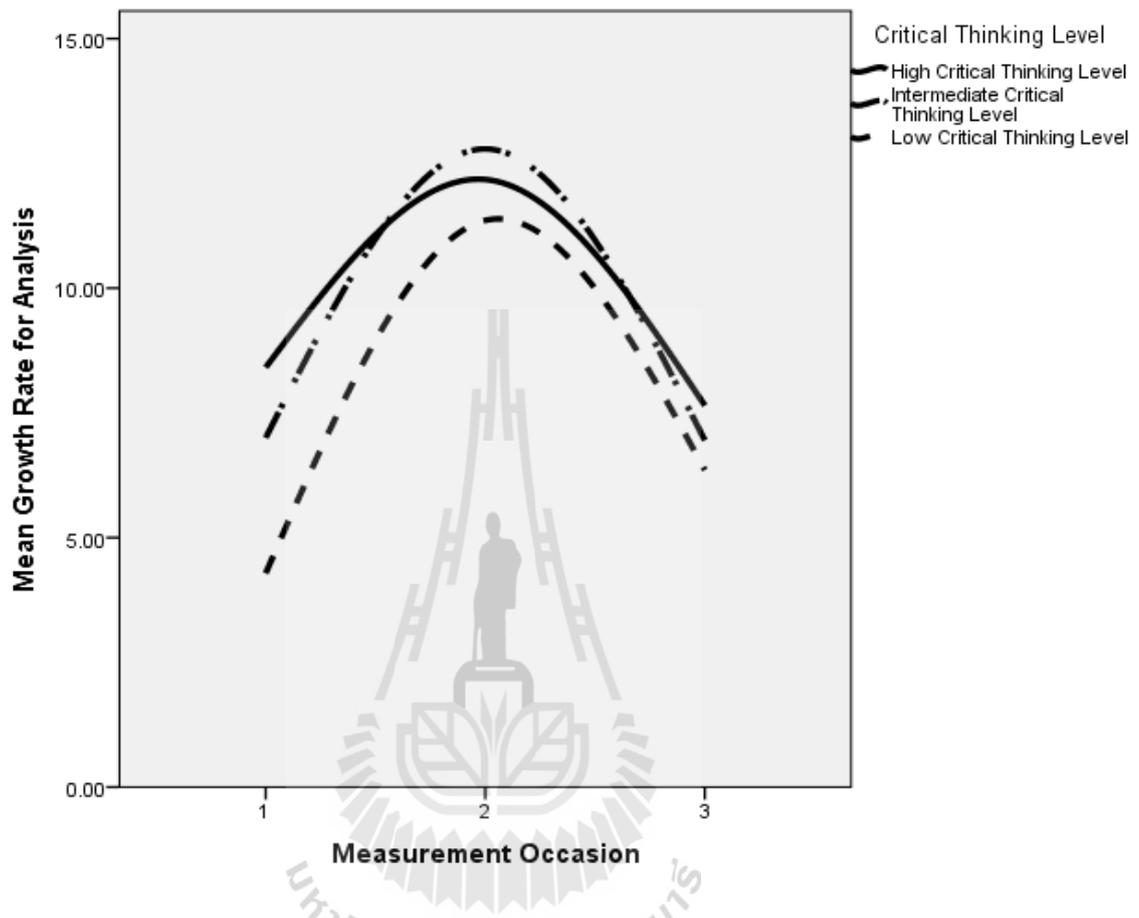
subsequent acceleration, respectively. During the initial decrease, low level increased at the rate of 4.04, while high level had a growth rate of  $\beta = 4.04 - 10.95 = -6.91$ , i.e., decreased at the rate of 6.91. Low level showed a higher growth rate than high level. Low level also showed a higher growth rate than intermediate level, which increased at the rate of 0.99 ( $\beta = 4.04 - 3.05 = 0.99$ ). During the initial momentary deceleration, low level increased at the rate of 4.04, faster than intermediate level at the rate of 0.99 and significantly faster than high level which, in contrast, decreased at the rate of 6.91. The initial decrease in the growth of interpretation mainly resulted from high level. However, during the subsequent acceleration, low level had growth rate,  $\beta = 1.25$ , significantly lower than high level,  $\beta = 1.25 + 3.49 = 4.74$ ,  $p < .01$ , and also lower than intermediate level ( $\beta = 1.25 + 0.39 = 1.63$ ). High level grew at the rate of 4.74, faster than intermediate level at the rate of 1.63 and in turn, significantly than low level at the rate of 1.25. In a word, initially, low level significantly performed the best and subsequently, the worst; in contrast, initially, high level significantly performed the worst and subsequently, the best (see Figure 4.4).



**Figure 4.4 Effects of Initial Levels on the Growth Rate and Trajectory of Interpretation**

In regard to analysis, during both acceleration and deceleration, there were no significant differences in the growth rate among three levels. It indicates that participants with different initial levels of critical thinking skills had similar growth rate over time. Although non-significant, some differences were found among three levels in the growth rate. During initial acceleration, low level ( $\beta = 13.11$ ) had faster growth rate than intermediate level ( $\beta = 13.11 - 1.50 = 11.61$ ) and in turn, than high level ( $\beta = 13.11 - 5.20 = 7.91$ ). During deceleration, high level ( $\beta = -6.04 + 1.89 = -4.15$ ) showed smaller decrease rate than intermediate level ( $\beta = -6.04 + 0.22 = -5.82$ ) and in turn, than low level ( $\beta = -6.04$ ), indicating that high level decreased slower at the rate of 4.15 than intermediate level at the rate of 5.82 and in turn, than low level at the rate of 6.04. Similar to interpretation, initially, low level performed the best and subsequently, the

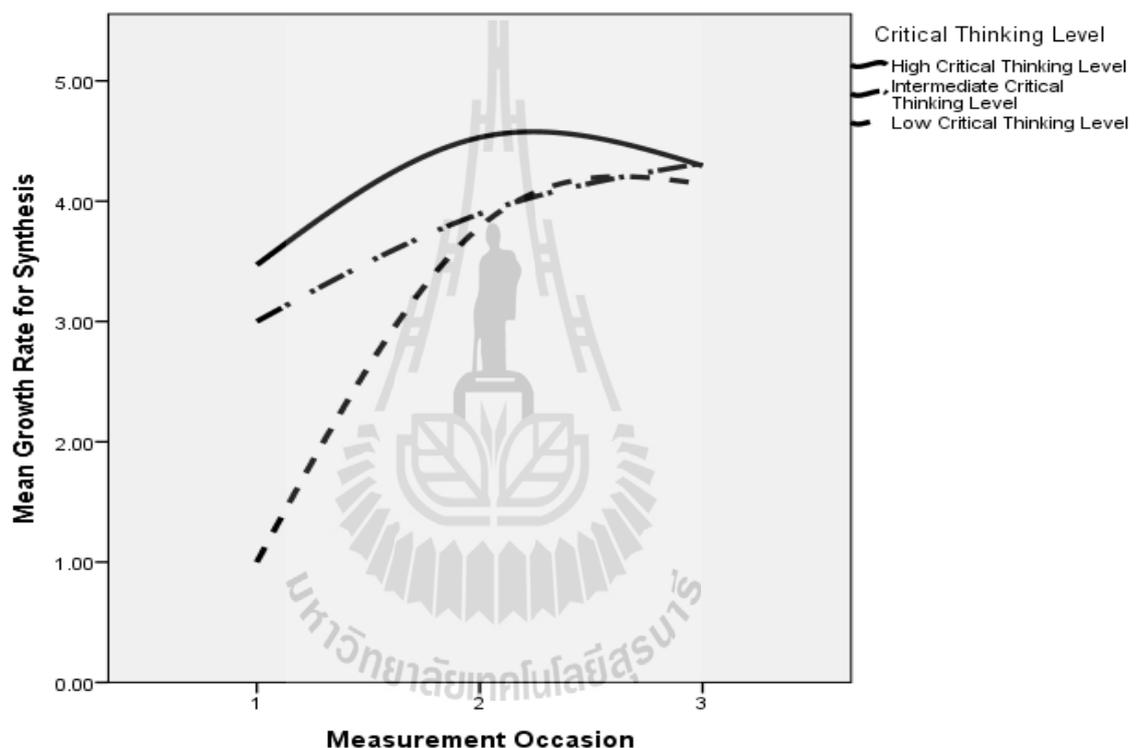
worst, while high level, initially, preformed the worst and subsequently, the best, though the difference was not significant (see Figure 4.5).



**Figure 4.5 Effects of Initial Levels on the Growth Rate and Trajectory of Analysis**

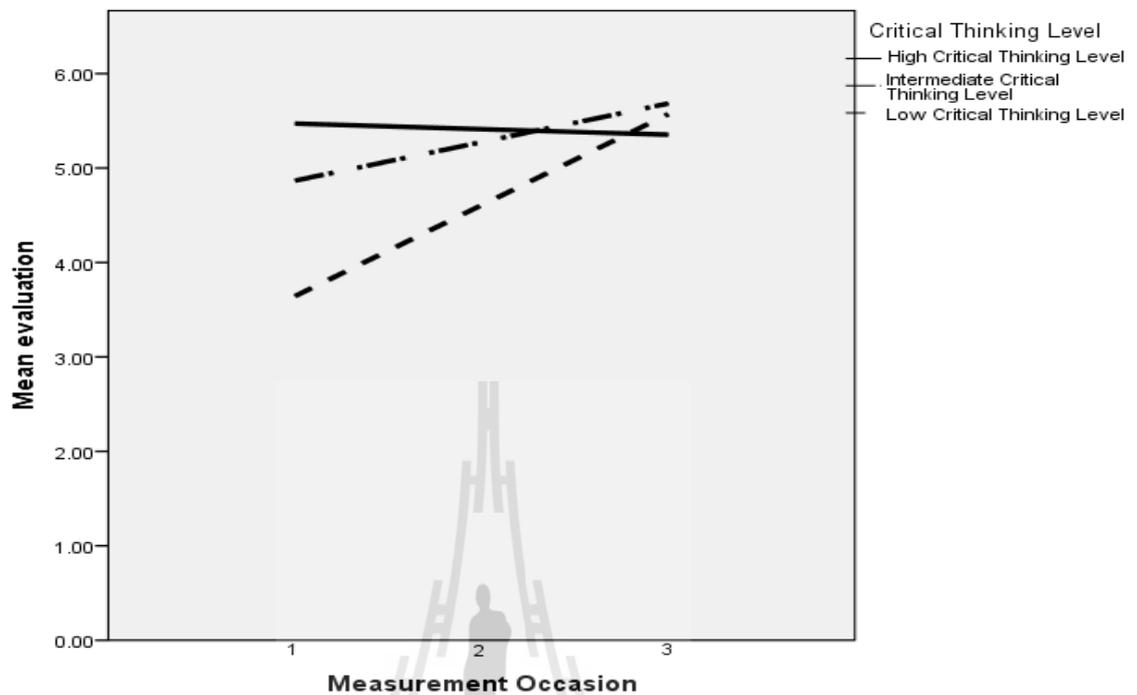
For synthesis, there were significant differences in weekly growth rate among the three levels only during the initial acceleration. Low level ( $\beta = 4.00$ ) showed a significantly higher growth rate than intermediate level ( $\beta = 4.00 - 2.72 = 1.28$ ),  $p < .05$ , and high level ( $\beta = 4.00 - 2.29 = 1.71$ ),  $p < .05$ , indicating that low level grew significantly fastest and intermediate level grew significantly slowest. During the subsequent deceleration, the difference in weekly growth rate among three levels was found, but non-significantly. Low level ( $\beta = -1.21$ ) decreased faster than intermediate

level ( $\beta = -1.21 + 0.93 = -0.28$ ) and high level ( $\beta = -1.21 + 0.57 = -0.64$ ), indicating that intermediate level decreased at the rate of 0.28, slower than high level at the rate of 0.64 and than low level at the rate of 1.21. Intermediate level decreased slowest and low level decreased fastest. The finding indicates that initially, low level significantly performed best and subsequently, the worst, while the high and intermediate levels initially performed significantly worse, and subsequently, the better (see Figure 4.6).



**Figure 4.6 Effects of Initial Levels on the Growth Rate and Trajectory of Synthesis**

For evaluation, no significant difference was found among three levels in the growth rate. Its trajectory was approximately linear. However, low level ( $\beta = 0.96$ ) presented a higher growth rate than intermediate level ( $\beta = 0.96 - 0.54 = 0.42$ ) and in turn, than high level ( $\beta = 0.96 - 1.02 = -0.06$ ), though non-significantly, indicating that low level grew faster than intermediate level and in turn, than high level. Low level performed the best (see Figure 4.7).



**Figure 4.7 Effects of Initial Levels on the Growth Rate and Trajectory of Evaluation**

In conclusion, students' initial levels of critical thinking skills imposed effects on the development of critical thinking skills. It significantly influenced the growth rates and trajectories of interpretation and synthesis. However, whether significant or non-significant influence, in the initial growth of interpretation and analysis, low level performed the best and high level the worst, and later on, low level became the worst and high level became the best. But for synthesis, low level initially grew the best and intermediate level worst, and later on, intermediate became the best and low level the worst. For evaluation, the difference between the three levels of critical thinking skills in the development remained unchanged and consistent, low level performed the best and high level the worst, but non-significantly.

#### 4.4 Answer to the Fourth Research Question

This section used the quantitative data from the RCTST and the National Higher Education Entrance Examination to examine the effect of students' English proficiency on the development of critical thinking skills: interpretation, analysis, synthesis and evaluation. The data from the National Higher Education Entrance Examination were used to determine students' English proficiency and those from three forms of the RCTST to examine the development of critical thinking skills. Mixed ANOVA and repeated-measures ANOVA were employed to analyze the data. Generally, mixed ANOVA was used to explore the effect of the English proficiency on the development of critical thinking skills measured by the three forms of the RCTST. Repeated-measures ANOVA explored the unique developmental patterns of critical thinking skills for each level of English proficiency.

##### 4.4.1 Effects of English Proficiency on Development of Critical Thinking

###### Skills

The results of mixed ANOVA are presented in Table 4.6, which aim to examine whether there were significant differences in the development of critical thinking skills among students with low, intermediate and high levels of English proficiency. As found in Table 4.6, there were no significant differences among students with low, intermediate and high levels of English proficiency for all the critical thinking skills: interpretation,  $F(2, 43) = 1.17, p > .05$ , analysis,  $F(2, 43) = 0.99, p > .05$ , synthesis,  $F(2, 43) = 0.06, p > .05$ , and evaluation,  $F(2, 43) = 0.19, p > .05$ . It indicates that there was no significant main effect of English proficiency on participants' performance, averaged across the three measurements. On average, the participants with high English proficiency did not perform better than those with intermediate proficiency, and in turn, better than those

with low proficiency. Effect size indices, which corroborated no significant main effect of English proficiency, showed that English proficiency had small effects on the development of critical thinking skills: interpretation,  $\eta_p^2 = 0.05$ , analysis,  $\eta_p^2 = 0.04$ , and evaluation,  $\eta_p^2 = 0.01$ , and almost no effect on synthesis,  $\eta_p^2 = 0.00$ .

**Table 4.6 Effects of English Proficiency on the Development of Critical Thinking**

Skills				
Critical Thinking	Effect	<i>F</i>	<i>p</i>	$\eta_p^2$
Interpretation	Proficiency	1.17	.320	0.05
	Form x Proficiency	1.47	.220	0.06
Analysis	Proficiency	0.99	.380	0.04
	Form x Proficiency	1.48	.215	0.06
Synthesis	Proficiency	0.06	.941	0.00
	Form x Proficiency	0.92	.459	0.04
Evaluation	Proficiency	0.19	.827	0.01
	Form x Proficiency	0.88	.478	0.04

For interaction of English proficiency and the forms of the RCTST, as can be seen in Table 4.6, there was no significant interaction of the forms of the RCTST and English proficiency for all the skills: interpretation,  $F(4, 86) = 1.47, p > .05$ , analysis,  $F(4, 86) = 1.48, p > .05$ , synthesis,  $F(4, 86) = 0.92, p > .05$ , and evaluation,  $F(4, 86) = 0.88, p > .05$ . It indicates that the differences in students' performance across the three measurements were similar for low, intermediate and high levels of English proficiency. Students with high English proficiency did not necessarily significantly develop their critical thinking skills more quickly than those with intermediate level and in turn, than those with low level. However, although non-significantly, effect size estimates showed that English proficiency had some different extents of effects: a medium effect on interpretation,  $\eta_p^2 = 0.06$ , and analysis,  $\eta_p^2 = 0.06$ , and a small effect on synthesis,  $\eta_p^2 = 0.04$ , and evaluation,  $\eta_p^2 = 0.04$ .

#### 4.4.2 Developmental Patterns of Critical Thinking Skills for Each Level of English Proficiency

As reported above, there were no significant differences among participants with different levels of English proficiency in their performance across the three forms of the RCTST. It means that for three levels of English proficiency, participants developed critical thinking skills at the similar rate. However, growing at the similar rate does not imply the similar developmental patterns for all the three levels of English proficiency. It is necessary to explore the specific developmental patterns of critical thinking skills for each level. This section mainly reported the results about developmental patterns of critical thinking skills across the three forms of the RCTST for participants with low, intermediate and high English proficiency, respectively. The main test and within-subjects contrasts of repeated-measure are presented in Table 4.7 and 4.8, respectively.

**Table 4.7 Development of Critical Thinking Skills for Different Levels of English**

Proficiency		<i>F</i>	<i>p</i>	$\eta_p^2$
Critical Thinking	Proficiency			
Interpretation	Low level	14.83	<.001	0.55
	Intermediate level	29.93	<.001	0.67
	High level	27.70	<.001	0.63
Analysis	Low level	10.11	.001	0.46
	Intermediate level	12.90	<.001	0.46
	High level	27.89	<.001	0.63
Synthesis	Low level	9.90	.001	0.45
	Intermediate level	5.32	.011	0.26
	High level	9.97	<.001	0.38
Evaluation	Low level	3.66	.041	0.23
	Intermediate level	0.25	.780	0.02
	High level	0.74	.484	0.04

#### **4.4.2.1 Developmental Patterns of Critical Thinking Skills with Low English Proficiency**

From the results (see Table 4.7), we found that, in general, for the students with low English proficiency, there were significant differences in participants' performance across the three measurements for all the critical thinking skills, interpretation,  $F(2, 24) = 14.83, p < .001$ , analysis,  $F(2, 24) = 10.11, p < .01$ , synthesis,  $F(2, 24) = 9.90, p < .01$ , and evaluation,  $F(2, 24) = 3.66, p < .05$ . It indicates that participants with low English proficiency improved critical thinking skills significantly across the three measurements. Low English proficiency did not constitute barriers to the development of critical thinking skills as normally expected. Effect size indexes show different extents of improvement: greatly large improvement for interpretation,  $\eta_p^2 = 0.55$ , analysis,  $\eta_p^2 = 0.46$ , and synthesis,  $\eta_p^2 = 0.45$ , and large improvement for evaluation,  $\eta_p^2 = 0.23$ . However, the main test cannot tell us which measurement differed from each other in terms of students' performance. Analysis of within-subjects contrasts among the three measurements was conducted.

**Table 4.8 Within-subjects Contrasts for Students with Different English Proficiencies**

Critical Thinking	Proficiency	Form Contrast	Mean Difference	F	p	$\eta_p^2$
Interpretation	Low level	A vs B	0.77	0.18	.681	0.02
		B vs C	7.00	33.53	<.001	0.74
	Intermediate level	A vs B	0.18	0.02	.892	0.00
		B vs C	8.32	115.61	<.001	0.89
	High level	A vs B	4.12	11.09	<.001	0.41
		B vs C	5.23	14.20	.002	0.47
Analysis	Low level	A vs B	4.16	14.65	.002	0.55
		B vs C	-4.62	12.83	.004	0.52
	Intermediate level	A vs B	5.31	23.57	<.001	0.61
		B vs C	-3.56	11.90	.004	0.44
	High level	A vs B	6.94	45.99	<.001	0.74
		B vs C	-6.30	43.89	<.001	0.73
Synthesis	Low level	A vs B	1.77	11.54	.005	0.49
		B vs C	0.69	1.47	.248	0.11
	Intermediate level	A vs B	1.18	4.81	.045	0.24
		B vs C	0.38	0.63	.440	0.04
	High level	A vs B	1.88	13.82	.002	0.46
		B vs C	-0.35	0.68	.422	0.04
Evaluation	Low level	A vs B	0.61	0.64	.441	0.05
		B vs C	1.46	5.27	.041	0.31
	Intermediate level	A vs B	0.44	1.10	.312	0.07
		B vs C	-0.06	0.01	.927	0.00
	High level	A vs B	0.06	0.01	.944	0.00
		B vs C	0.70	0.86	.367	0.05

As Table 4.8 shows, there were significant differences in students' performance only between Form C and Form B for interpretation,  $F(1, 12) = 33.53$ ,  $p < .001$ ,  $\eta_p^2 = 0.74$ , mean difference = 7.00, and evaluation,  $F(1, 12) = 5.27$ ,  $p < .05$ ,  $\eta_p^2 = 0.31$ , mean difference = 1.46, indicating that students developed the two skills better and more rapidly in the second stage than in the first stage. The two skills presented a tardy-rapid developmental pattern (see Table 4.9). In contrast, for synthesis, they performed significantly better only in Form B than in Form A,  $F(1, 12) = 11.54$ ,  $p < .01$ ,  $\eta_p^2 = 0.49$ , mean difference = 1.77, indicating that students developed synthesis better and more rapidly in the first stage than in the second stage. The development presented a rapid-tardy pattern (see Table 4.9).

**Table 4.9 Developmental Patterns of Critical thinking Skills by English Proficiency**

<b>Critical Thinking</b>	<b>Proficiency</b>	<b>Pattern of Development</b>
Interpretation	Low level	Tardy-rapid
	Intermediate level	Tardy-rapid
	High level	consistently-rapid
Analysis	Low level	consistently-rapid-improvement-deterioration
	Intermediate level	consistently-rapid-improvement-deterioration
	High level	consistently-rapid-improvement-deterioration
Synthesis	Low level	Rapid-tardy
	Intermediate level	Rapid-tardy
	High level	Rapid-tardy
Evaluation	Low level	Tardy-rapid
	Intermediate level	Consistently-tardy
	High level	Consistently-tardy

For analysis, they performed significantly better in Form B than in Form A,  $F(1, 12) = 14.65, p < .01, \eta_p^2 = 0.55, \text{mean difference} = 4.16$ , and in contrast, they performed significantly worse in Form C than in Form B,  $F(1, 12) = 12.83, p < .01, \eta_p^2 = 0.52, \text{mean difference} = -4.62$ , indicating that students developed the analysis better in the first stage and then became worse in the second stage. The development showed a rapid improvement in the first stage and then a rapid deterioration in the second stage, i.e., a consistently-rapid-improvement-deterioration pattern. For students with low English proficiency, the development of their critical thinking skills presented different patterns (see Table 4.9).

#### **4.4.2.2 Developmental Patterns of Critical Thinking Skills with Intermediate English Proficiency**

For participants with intermediate English proficiency, generally, there were significant differences in their performance across the three measurements for

interpretation,  $F(2, 30) = 29.93, p < .001$ , analysis,  $F(2, 30) = 12.90, p < .001$ , and synthesis,  $F(2, 30) = 5.32, p < .05$ , but not for evaluation (see Table 4.7), indicating that across the two stages, students developed interpretation, analysis and synthesis significantly, but non-significantly for evaluation. Evaluation developed slowly in both stages, which presented a consistently-tardy developmental pattern.

For specific development of critical thinking skills in each stage, within-subjects contrasts analysis was performed. As Table 4.8 shows, participants with intermediate English proficiency performed significantly better only in Form C than in Form B for interpretation,  $F(1, 15) = 115.61, p < .001, \eta_p^2 = 0.89, \text{mean difference} = 8.32$ , showing that participants developed the skill better and more rapidly in the second stage than in the first stage. The development showed a tardy-rapid pattern. In contrast, for synthesis, students performed better only in Form B than in Form A,  $F(1, 15) = 4.81, p < .05, \eta_p^2 = 0.24, \text{mean difference} = 1.18$ , revealing that the skill was developed more rapidly in the first stage than in the second stage. The development displayed a rapid-tardy pattern. For analysis, as those with low proficiency, students performed significantly better in Form B than in Form A,  $F(1, 15) = 23.57, p < .001, \eta_p^2 = 0.61, \text{mean difference} = 5.31$ , but significantly worse in Form C than in Form B,  $F(1, 15) = 11.90, p < .01, \eta_p^2 = 0.44, \text{mean difference} = -3.56$ , indicating that participants increased the skill rapidly in the first stage and decreased it quickly in the second stage. The development exhibited a consistently-rapid-improvement-deterioration pattern. For students with intermediate level of English proficiency, their critical thinking skills presented different developmental patterns (see Table 4.9)

#### 4.4.2.3 Developmental Patterns of Critical Thinking Skills with High English Proficiency

Comparable to those with intermediate English proficiency, for participants with high proficiency, generally, there were significant differences in their performance across the three measurements for interpretation,  $F(2, 32) = 27.70$ ,  $p < .001$ , analysis,  $F(2, 32) = 27.89$ ,  $p < .001$ , and synthesis,  $F(2, 32) = 9.97$ ,  $p < .001$ , except evaluation (see Table 4.7). It indicates that, during the two stages, participants with high level developed interpretation, analysis, and synthesis significantly, except evaluation. Evaluation presented a consistently-tardy developmental pattern.

For specific performance in each stage, Table 4.8 shows that, for interpretation, participants performed significantly better in Form B than in Form A,  $F(1, 16) = 11.09$ ,  $p < .001$ ,  $\eta_p^2 = 0.41$ , *mean difference* = 4.12, and in Form C than in Form B,  $F(1, 16) = 14.20$ ,  $p < .01$ ,  $\eta_p^2 = 0.47$ , *mean difference* = 5.23, indicating that participants developed the skill rapidly in both stages. The development showed a consistently-rapid pattern. For analysis, they performed significantly better in Form B than in Form A,  $F(1, 16) = 45.99$ ,  $p < .001$ ,  $\eta_p^2 = 0.74$ , *mean difference* = 6.94, but significantly worse in Form C than in Form B,  $F(1, 16) = 43.89$ ,  $p < .001$ ,  $\eta_p^2 = 0.73$ , *mean difference* = -6.30, indicating that the skill was developed rapidly in the first stage and deteriorated rapidly in the second stage. The development exhibited a consistently-rapid-improvement-deterioration pattern. For synthesis, participants performed significantly better only in Form B than in Form A,  $F(1, 16) = 13.82$ ,  $p < .01$ ,  $\eta_p^2 = 0.46$ , *mean difference* = 1.88, indicating that they developed the skill more rapidly in the first stage than in the second stage. The development displayed a rapid-tardy pattern.

In conclusion, generally, students with high English proficiency did not develop critical thinking skills better than those with intermediate level, and in turn, better than those with low level. There were no significant differences among students with different English proficiencies in the development of critical thinking skills across the three measurements. On the other hand, students with different levels of English proficiency had their own specific developmental patterns. Students with low, intermediate and high levels of English proficiency had the same developmental pattern for analysis, consistently-rapid-improvement-deterioration pattern, and for synthesis, rapid-tardy pattern. With respect to interpretation and evaluation, there were some differences in the patterns. Students with low and intermediate levels had the same tardy-rapid pattern, while those with high level had a different consistently-rapid pattern. That is, in the first stage, students with high level developed the skill better than those with low and intermediate levels. As for evaluation, students with intermediate and high levels presented the same consistently-tardy pattern, different from those with low level who presented tardy-rapid pattern. That is, in the second stage, students with low level developed evaluation better than those with intermediate and high levels.

#### **4.5 Answer to the Fifth Question**

The fifth question explored students' perception of the guided instruction of critical thinking skills, which can provide some insights into the effectiveness of teaching strategies used in the guided instruction, and therefore, to a certain extent, further corroborate the effectiveness of the guided instruction found in answering the first research question. The data used to answer the question were elicited from the second section and the open-ended questions of Participant Perception Questionnaire

(PPQ) (see Appendix E) and students' interviews. Therefore, there are two kinds of data: quantitative data from the second section of the PPQ (see Appendix E) and qualitative data from the open-ended questions and students' interviews. The PPQ was administered with fifty subjects, while the interviews were conducted with fifteen subjects with high, intermediate and low levels of critical thinking skills. Descriptive analysis and frequency analysis were employed for quantitative data, and content and thematic analyses for qualitative data.

#### **4.5.1 Results of Quantitative Data for Guided Instruction**

Description statistic analysis was performed to examine whether participants agreed on the items which elicited participants' perception of the roles of teaching strategies in the development of critical thinking skills using the following statistics: mean and percentage. The results are presented in Table 4.10. For frequency analysis, the options 'strong agreement' and 'agreement' were combined into 'agreement' and similarly, 'strong disagreement' and 'disagreement' were combined into 'disagreement'. Due to four-point Likert-like scale, the criteria for mean value are: 1 – 1.75 as strong disagreement, 1.76 – 2.50 as disagreement, 2.51 – 3.25 as agreement, and 3.26 – 4.00 as strong agreement.

**Table 4.10** Statistic Results of Students' Perception of the Guided Instruction

Item	Disagree Frequency (percent)	Agree Frequency (percent)	<i>M</i>
12. I enjoyed learning critical thinking skills in the reading class.	7(14%)	43(86%)	3.02
13. I enjoyed discussion on questions asked by the teacher in the reading class.	14(28%)	36(72%)	2.84
14. I think that questioning in class can help me much with my critical thinking skills.	0(0%)	50(100%)	3.32
15. I think that explicit explanations of arguments can assist in learning critical thinking skills.	5(10%)	45(90%)	3.10
16. I think that discussion can help me develop critical thinking skills.	3(6%)	47(94%)	3.36
17. I enjoyed drawing a diagram to show relations among components of arguments.	21(42%)	29(58%)	2.62
18. I think that practice of recognizing arguments and analyzing them can help me improve my critical thinking skills.	3(6%)	47(94%)	3.28

As Table 4.10 shows, generally, mean values for item 16, 14 and 18 were within 3.26 – 4.00, meaning students strongly agreed that the strategies of discussion, questioning and practice were effective in the development of critical thinking skills. The finding was corroborated by frequency. They had a higher percent of agreement for item 14 (100%), that is, all the students thought that one of teaching method—questioning, helped them much with the development of critical thinking skills. A large number of students agreed on item 16 (94%) and item 18 (94%), that is, nearly all of students thought that practice of discovering and discussion were effective in the development of critical thinking skills.

For item 12, 13 and 15, mean values indicate that students agreed that they liked learning critical thinking skills and participated in discussion in class. They thought that explicit explanations (i.e., illustration) assisted in learning critical thinking skills.

Although the mean value for item 17 indicates agreement on the effectiveness of diagramming arguments in the development of critical thinking skills, the percentage of agreement reduced to nearly a half in comparison with the other items, more than half of students (58%) said that they liked diagramming arguments to show the relations among components, while close to a half did not. The possible reason is that argument diagramming was mainly used for presenting logical relations in a complex argument, and thus mainly useful for synthesis, i.e. its effectiveness might mainly limit to the skill of synthesis.

The results mentioned above indicate that among teaching strategies, questioning, practice, discussion, and illustration were among the most helpful. For stages of the guided instruction, presentation stage, in which the explanation of arguments was conducted, and application stage, in which questioning, practice and discussion were used, both provided much assistance in development of critical thinking skills. However, the finding concerns students' general perception of the teaching strategies used in the guided instruction. In order to understand how teaching strategies contributed to the development of critical thinking skills, qualitative data was analyzed.

#### **4.5.2 Results of Qualitative Data for Guided Instruction**

The section explored the specific roles played by teaching strategies used in the guided instruction in the development of critical thinking skills through the analysis of the qualitative data. Open coding, axial coding and selective coding were used to form categories and themes from the qualitative data. It includes three aspects: students' participation in activities in class, optimal teaching method, and contributions of each teaching method.

#### 4.5.2.1 Students' Engagement in Activities in Class

The results from the open-ended questions of the PPQ shows that half of students were often engaged in activities in a reading class (50%). About one third of students reported that they were not engaged in activities in class (34%); some not often (10%); some sometimes (6%). These activities include those in the stages of the guided instruction and in the teaching strategies used in class. The reasons for those who often participated in activities in class are as follows:

- a) participation could improve their understandings of a text (17%);
- b) participation could help the development of critical thinking skills (13%);
- c) participation could improve their English speaking level (13%);
- d) participation could assist in their English learning (13%);
- e) they had to finish the exercises assigned and to answer questions asked by the teacher (13%);
- f) they enjoyed the activities (13%).

The reasons for those who were not or not often engaged in the activities are:

- a) it was difficult for them to understand a reading text and what the teacher said (25%);
- b) they worried about their wrong answer (25%);
- c) they were reserved and not willing to participate in the activities (15%);
- d) they had formed learning habits in the past and were reluctant to change them (10%);
- e) their English speaking was poor and therefore, they were not or not often engaged in the activities (10%).

The findings mentioned above were supported by the data from interviews which were concerned with students' participation in the activities in questioning and discussion. Students actively participated in the discussion in class and thought over the questions asked by the teacher, but seldom answered the questions or spoke out results of their discussion. They were worried that their answers were possibly wrong. They were too reserved to answer the questions or spoke out their discussion. As can be seen in qualitative evidence from interviews, 13 interviewees said that they did not or seldom answer the questions asked by the teacher in class, though they all thought over the questions. They reported that they were worried about wrong answers and not willing to answer the questions in front of others. 12 interviewees reported that they actively participated in discussion, but not or seldom spoke out the results of their discussion. The excerpt from interviews, showing the participants' behaviors in class, is as follows:

- ... ..
- WS: Do you often answer the questions asked by the teacher?*
- JX: No.*
- WS: Often think over the questions?*
- JX: Yes.*
- WS: You actively think over the questions. Why do you not actively answer the questions?*
- JX: Learning habit (laughing).*
- WS: What are you worried about?*
- JX: I'm afraid my answer is wrong.*
- WS: So, do you often actively join in discussion in class?*
- JX: Yes.*
- WS: And, you are not willing to speak out the results of discussion to the teacher, are you?*
- JX: Yes.*
- WS: You are worried...*
- JX: Wrong answer (JX/I).*
- ... ..

In summary, the finding from open-ended questions of the PPQ indicates that half of students were often active in the teaching and learning activities in class because the guided instruction could improve the development of critical thinking skills, and at the same time, promote reading comprehension, English speaking and learning, even though some students had to join in the activities by the teacher's assignments and questions. Nearly half of students were not or not often engaged in the activities because they found it difficult to understand a reading text and worried about their possible wrong answers. They also explained that they had reserved personality and were reluctant to participate in the activities, and that their learning habits forged in the past resisted changes. The finding was corroborated by the interviews in which students reported that they actively thought over the questions and participated in discussion, however, they seldom spoke out the answers or the results of discussion, because they were reserved and worried about their wrong answers.

#### **4.5.2.2 Optimal Teaching Strategies in Development of Critical Thinking Skills**

The results from open-ended questions of the PPQ and interviews reveal some optimal teaching strategies in the development of critical thinking skills. Students also offered some reasons why these strategies were optimal.

As the results of open-ended questions of the PPQ indicate, the best teaching strategies were, respectively, discussion, diagram-drawing, questioning and combination of various teaching strategies. These teaching strategies were used in application stage. Each teaching method played a significant role in the development of critical thinking skills in their unique ways. The first best teaching method was discussion (60%). Students thought that discussion could help them learn others' ideas

and thinking through idea exchange, improve their own thinking and obtain deep insights into the issues discussed. The second best teaching method was diagram-drawing (36%). They explained that drawing diagrams could help them understand the text and clear logical relations among sentences and paragraphs in the text, and therefore, they could discover arguments, explanation, description and description, and analyze and assess them. The third best one, students thought, was combination of different teaching strategies of questioning, discussion, and diagram-drawing (8%), because the combination could assist them in deep understandings of a text, in particular, of the main ideas in a text, and in independent thinking. The last best one was questioning (6%), because it could improve independent thinking.

The finding was supported by interviews which would provide more detailed information about the roles of these teaching strategies play in the development of critical thinking skills, and at the same time, some insights into the teaching strategy used in the presentation stage.

A little more than half of the interviewees (53%) thought that in the introduction of concepts of critical thinking skills, examples used to illustrate how to use these concepts in application were the best. They explained that the major advantage of illustration was to clarify and consolidate the concepts. With respect to the teaching strategies used in the application stage, most of students thought that discussion (73%), and practice and after-class practice (60%) were the best, and a minority of students thought questioning (33%) and combination (27%) of these strategies were the best.

They explained that discussion could promote mutual ideas exchange and independent thinking. Practice and after-class practice could assist in discovering arguments and inferring assumptions in the text. Questioning could promote

independent thinking and the combination could assist in discovering arguments and assumptions in a text. The following were some typical excerpts from the interviews, showing the best teaching strategy.

- ... ..
- WS: Can you say something about teaching methods?*
- JQ: Teaching methods, quite good.*
- WS: Then, specifically, among discussion, questioning, assignments, etc. which one do you think is the best?*
- JQ: Together, mutual Complement.*
- WS: Combining is the best.*
- JQ: Right.*
- WS: Can Combination of these teaching methods help you discover argument and assumption?*
- JQ: Yes (JO/I).*
- ... ..
- WCL: As for teaching methods, I think, usually, assigning some practice is the best. Well, I like assignments.*
- ... ..
- WCL: Because assignments can make you think about them independently, you can take every aspects into consideration, deep into issues (WCL/I).*
- ... ..
- WS: Then, among discussion, illustration, practice and questioning, which one do you thinking the best?*
- ZT: Questioning.*
- WS: Why?*
- ZT: By questioning, we can think about it independently. And then, we can talk about it and exchange ideas. It's quite good (ZT/I).*
- ...

In conclusion, the findings from the open-ended section of the PPQ and the interviews present a picture of the best teaching strategies employed in presentation and application stages. In the presentation stage, illustration was the best in clarifying and consolidating concepts of critical thinking skills and used as a model for students to put concepts into practice in the application stage. In the application stage, discussion, practice, diagram-drawing, and questioning were the best.

### 4.5.3 Major Contributions of the Teaching Strategies

The teaching strategies in presentation and application stages made contributions to the development of critical thinking skills. Generally, interviewees reported that the training, as a whole, was effective for the development of critical thinking skills. During the three stages of the training, the first stage—presentation stage for establishment of knowledge of critical thinking and the second stage—application stage for use of knowledge in practice are both greatly important for the development of critical thinking skills. The training could help students clarify the abstract concepts, and assist them in the discovery of arguments, explanations, assumptions, reasoning elements, etc. The discovery in the application stage was on the basis of the concepts established in presentation stage. The excerpt, which shows the contribution of teaching methods in clarifying the abstract ideas, is as follows:

... ..  
*WS: Do those teaching methods used by the teacher in class help you discover arguments and assumptions?*  
*DQQ: For some aspects, in particular, something abstract, some ideas, viewpoints, possibly, it can help us with deep understandings (DOO/I).*  
 ... ..

Among the teaching strategies used in presentation and application stages, each had their unique contributions to the development of critical thinking skills. In presentation stage, knowledge of critical thinking was firstly introduced and explained, and then students were provided with examples, to illustrate how to use the knowledge in application stage until they became habitual of critical thinking skills in the third stage. The instruction and explanation of concepts could boost students' clear ideas of these concepts and build up relevant knowledge for the later application. Illustration could further consolidate the concepts besides clarifying them. Interviewees mentioned that the teaching strategy in presentation stage could also improve the discovery. The

excerpt, showing the contributions of the teaching strategy at presentation stage, is as follows:

... ..  
*WS : Do you think the teaching methods used by the teacher in the presentation are helpful for discovering arguments and inferring assumptions?*  
*WCL: Yes.*  
*WS: What help?*  
*WCL: What you have taught, sometimes, some of them, some you showed in examples, anyway, some details you explained and illustrated, I find it helpful for me to understand them, and then, bases on it, to discover them (WCL/I).*  
 ... ..

In application stage, practice, discussion and questioning were the main teaching strategies, though sometimes, diagram-drawing was used. Discovery of arguments in a text is a starting point to analyze, synthesize and evaluate them. Even analysis, synthesis and evaluation of arguments are mainly concerned with discovery of faults of arguments, logical relations among sentences for diagram-drawing, appropriateness of thought standards and reasoning elements. The major contribution of practice was to improve the discovery. In addition, it could consolidate concepts of critical thinking students learned at presentation stage and promote their independent thinking and understandings of rhetoric relations in a text. On the other hand, interviewees reported that, if there was lack of practice, they could not discover necessary and sufficient conditions, not have clear ideas on deductive and inductive arguments and therefore discover them, and not use thought standards to evaluate arguments, etc. The excerpt, showing the contributions of discovery practice, is as follows:

... ..  
*WS: Is it now easier for you to discover arguments?*  
*ZCY: Yes, easier.*  
*WS: Easier than before.*

ZCY: *Yeah.*

WS: *Why easier?*

ZCY: *In class, you ask us to discover arguments.*

WS: *More practice of discovering arguments.*

ZCY: *Well, after class, you ask us to discover arguments again.*

WS: *That is, you practice a lot.*

ZCY: *Yes (ZCY/I).*

... ..

For discussion, interviewees stated that they exchanged their ideas freely if the teacher did not stand by, through which they could find some strengths of others' ideas and the defects of their own. Therefore they could notice weakness of their own ideas and improve it, which guarantee the appropriate answers to the questions asked by the teacher and thus promote their confidence in answering. By discussion, students could obtain insights into the issues discussed and the concepts used. For questioning, interviewees mentioned that, when the teacher asked them questions, they needed to think about these questions and prepare for the answers. As a result, questioning improved their independent thinking. In addition, these questions were mostly related to the discovery. Therefore, to a certain extent, it could assist in the discovery. The excerpt, showing the contributions of discussion, is as follows:

... ..

WS: *Do you think discussion is better than questioning?*

WQQ: *I don't mean that. It is mainly because we can exchange ideas when in discussion. And then, we can notice, we have different ideas from others. Then, we have more confidence in answering (WOO/I).*

... ..

In summary, generally, the training was effective for students' development of critical thinking skills. The presentation stage assisted students in establishment of the knowledge. Practice could help them with the discovery on the basis of the knowledge and make it easier until it became habitual; discussion promoted idea exchange and confidence in answering; questioning improved students' independent thinking.

## 4.6 Answer to the Sixth Question

The sixth question is about students' perception of the development of critical thinking skills, which further, provides deep insights into the development found in answering the first question. Data used to answer the question includes quantitative data from the first section of the PPQ (see Appendix E) and qualitative data from the open-ended questions of the PPQ (see Appendix E) and interviews. The quantitative data were analyzed with descriptive analysis and frequency analysis which examines whether students agreed or disagreed on the items. The qualitative data was analyzed with content and thematic analyses.

### 4.6.1 Results of Quantitative Data for the Improvement

As shown in Table 4.11, generally, mean values were all between 2.50 and 3.00, revealing agreement on all the items. This finding indicates that generally, students thought that their critical thinking skills were improved after training. Frequency analysis shows that different items had different extents of agreement on the improvement of critical thinking skills. There were higher degrees of agreement on item 4 (68%), item 6 (68%), item 3 (70%), item 7 (76%), item 2 (78%), item 5 (80%), item 1 (84%), and item 8 (86%). Students mostly agreed that they could discover arguments and its components of conclusion and reasons, and implicit conclusion, reasons and assumptions. They could diagram the logical relations among components of a complex argument. In addition, they could discover reasoning elements in a text and offer reasons to support their views.

**Table 4.11** Statistic Results of Students' Perception of the Improvement

Item	Disagree Frequency (Percent)	Agree Frequency (Percent)	<i>M</i>
1. I can identify an argument in an essay.	8(16%)	42(84%)	2.88
2. I can make inferences about implicit conclusions.	11(22%)	39(78%)	2.82
3. I can make inferences about implicit reasons.	15(30%)	35(70%)	2.74
4. I can make inferences about assumptions.	16(32%)	34(68%)	2.74
5. I can recognize the components of an argument.	10(20%)	40(80%)	2.92
6. I can draw a diagram of the relationship among components of arguments.	16(32%)	34(68%)	2.66
7. I can find out the elements of thought in an essay.	12(24%)	38(76%)	2.82
8. I can give reasons to support my viewpoint or conclusion.	7(14%)	43(86%)	2.98
9. I can find the weakness of an argument.	23(46%)	27(54%)	2.60
10. I can find the strength of an argument.	21(42%)	29(58%)	2.64
11. I can use thought standards to find the weakness and strength of an essay.	23(46%)	27(54%)	2.54

In contrast, for item 9 (54%), item 10 (58%), and item 11 (54%), percentage of disagreement rose to nearly a half, which means that, in comparison with other skills, there were moderate agreement among students for these items. That is, the ease decreased for them to use thought standards to find weaknesses and strengths of arguments. They made less improvement of application of thought standards than that of the other skills.

In conclusion, it was found that students had some different extents of agreement on the improvement of critical thinking skills. Most students thought that they achieved improvement of arguments and implicit arguments, logicity of components of arguments and reasoning elements. In comparison, nearly half of students thought that they did not achieve the improvement of the standards.

#### 4.6.2 Result of Qualitative Data for the Improvement

Argument discovery in interpretation is the initial step for analysis, synthesis and evaluation. Therefore the improvement of argument, i.e., identifying arguments and distinguishing them from explanation, description and summary, is significant for the development of other skills. There are four themes showing the improvement of critical thinking skills. The first one is that it becomes easier to make the discovery; the second one is the detailed description of discovery process; the third one is that if it is simple, participants can make the discovery. The fourth one is how much of discovery participants could make. It notes that critical thinking skills were not reported with all the themes, but some of them.

For interpretation, three interviewees with low level of critical thinking skills, five interviewees with intermediate level and four interviewees with high level thought it easier to identify arguments in a text than before. It indicates that the discovery of arguments was improved over time. But it does not mean that those with intermediate level performed better than those with high level and in turn, than those with low level, because a difference of one or two in the number does not make a difference.

The finding was corroborated by the results from the open-ended questions of the PPQ. Among 50 students, 34% of them stated that they were good at argument discovery, and 18% of them were good at the discovery of constituents: conclusion/viewpoint or reasons. In addition, all the interviewees said that it was easy to discover description, because it had a simple constituent, indicating that all the interviewees had formed the habits of description discovery and reached the automatic level. However, although interviewees thought that it became easier to discover arguments, it does not mean that they could actually discover arguments in a text

skillfully. This finding was also supported by the results from the PPQ. Twenty-six percent of students reported that they were not good at argument discovery. The excerpt, showing the improvement of interpretation, is presented as follows:

... ..  
 WS: *Can you now discover argument?*  
 WWY: *Sometimes, I can, sometimes, I can't.*  
 WS: *Why sometimes you can't?*  
 WWY: *Well, I find those sentences, most of them, I can't understand, and then, I can't get clear ideas about the logical structure among these sentences (WWY/I).*  
 ... ..

The easier discovery of arguments was also strengthened by the detailed description of the discovery process. One interviewee with low level, five interviewees with intermediate level, and two interviewees with high level reported the detailed description of discovering arguments in a text. The excerpt, showing the steps to discover arguments in a reading text, is presented as follows:

... ..  
 WS: *How did you find arguments in a text?*  
 WWY: *Firstly, I understood the text, and then found them.*  
 WS: *Then, how to find them, do you have any ideas?*  
 WWY: *In this way [laughing], first, writers' viewpoints, and then, its....*  
 WS: *Writers' viewpoints. And then...?*  
 WWY: *Then, there are reasons to support the viewpoints.*  
 WS: *You discovered arguments based on these.*  
 WWY: *Yeah. Then I can find arguments (WWY/I).*  
 ... ..

Two with low level, four with intermediate level and one with high level, stated that if it is simple, they could discover arguments. One with low level and three with high level said that they could discover some of arguments in a text. It indicates that, although participants could discover arguments, there were still some difficulties they have to confront with, revealing that their discovery of arguments was under the development and did not reach the automatic level.

The findings in the above indicate that generally, most of interviewees found it easier to identify arguments in a text than before. However, in practice, they did not appear to be skillful. That is, their habits of discovery of argument were under the process of formation. Only one interview reported the skillful discovery of arguments due to easier judgment of constituents, which means that her habit of the discovery had been formed.

For analysis, the results from interviews show that only two interviewees with intermediate level reported that it became easier to discover assumptions. Only one interviewee with low level reported that it was difficult to discover assumptions. It indicates that in comparison with argument, assumptions were improved a little due to fewer interviewees reported the easier discovery. This finding was also justified by the results of the PPQ, in which 6% of students stated that they were good at assumption discovery. Three interviewees with intermediate level and four with high level described the discovery processes. Three interviewees with intermediate level and two with high level reported that they could discover them; in contrast, one with intermediate level and one with high level reported some discovery. The findings above indicate that the analysis were under the process of habit formation and did not reach automatic level. The excerpt, showing the easiness or difficulty in the discovery, is as follows:

... ..  
*WS: But, the assumptions, also need inference, right.*  
*SLC: Yeah.*  
*WS: Is it difficult?*  
*SLC: I think, they are easier for me (SLC/I).*  
 ... ..

As for synthesis, only one interviewee with low level said that it became easier to discover logical relations among the sentences in a paragraph, showing the small

improvement of synthesis. This finding was strengthened by the results of the PPQ. It shows that 2% of students said that they were good at argument-diagramming, which indicates that such improvement was small. Four interviewees with low level, two interviewees with intermediate level and one interviewee with high level reported argument diagramming. It indicates that, to a certain degree, argument-diagramming was improved. The excerpt, showing the improvement of synthesis, is presented below:

... ..  
*WS: Then, we have learned to diagram the relations among components of arguments or arguments in one paragraph. Can you now diagram them?*  
*CSY: Yes, I can diagram components of arguments or arguments in a text (CSY/I).*  
 ... ..

With respect to evaluation, in comparison, a very small improvement was found from interviews. Two with low level, five with intermediate level and two with high level reported that they could use some of thought standards to evaluate arguments. One with low level, three with intermediate level and two with high level, respectively reported that they could find some of reasoning elements. Two with high level stated that they could not use the standards and not discover reasoning elements. This finding indicates that most interviewees could use some of the standards and discover some of reasoning elements. The excerpt, showing the improvement of evaluation, is presented in the following:

... ..  
*WS: Now, can you use assessment standards to evaluate an argument?*  
*SLC: Almost.*  
*WS: Not all?*  
*SLC: Yes (SLC/I) .*  
 ... ..

In conclusion, interpretation was improved, but still under the process of habitual formation. Discovery of description was improved much and became habitual.

Interviewees with different levels of critical thinking skills made a little different improvement. In comparison, analysis was improved, but less than that of interpretation, and still under the process of habitual formation. The improvement of synthesis was small. In addition, there was very small improvement of thought standards and reasoning elements. The development of synthesis and evaluation were also under the process of habitual formation, less than that of interpretation.

In summary, the finding from the quantitative data for the first research question proved the effects of the guided instruction not only on the improvement of four critical thinking skills and but also on the developmental patterns. The development of critical thinking skills presented various patterns. The finding from the qualitative data for the second research question offered deep insight into the process of the development of critical thinking skills, which corroborated the finding for the first research question. It shows that the establishment of knowledge for a skill is a determinant to the application of the skill, and therefore, to the development of a skill. More knowledge implies the more application of a skill in the application stage. Over time, the knowledge increased and consolidated and the application of a skill became easier. However, all the skills had not formed habits and were under the development in the second stage, not the third stage of automaticity.

The finding from the quantitative data for the third research question provided some information about the effects of the initial levels of critical thinking skills on the growth rates and trajectories of critical thinking skills. It reveals that students' initial levels of critical thinking skills exerted significant effects on the growth rates of critical thinking skills except analysis and the growth presented various trajectories. The finding from the quantitative data for the fourth question offered some understandings

of the effects of English proficiency on the development. It proves that there were no significant differences among the students with different levels of English proficiency in the development of critical thinking skills. Students with high English proficiency did not necessarily develop critical thinking skills better than those with intermediate, and in turn, better than low levels, as expected. For each level of English proficiency, they presented their own various developmental patterns of the skills.

The finding for the fifth question using qualitative and quantitative data shows that the training was beneficial to the development of critical thinking skills. The presentation stage established the relevant knowledge. In the application stage, different teaching strategies, such as practice, discussion, questioning and illustration promoted the development of the skills and made their own contributions to the development. The finding for the sixth question shows that students perceived improvement of four critical thinking skills. Interpretation was improved much and in comparison, analysis was improved less than interpretation. The improvement of synthesis was small. There was little improvement of evaluation. All the skills were under the process of habitual formation. The findings for the fifth and sixth questions, in another aspect, support the effects of the guided instruction on the development of critical thinking skills found in answering the first question.

## **CHAPTER 5**

### **DISCUSSION**

This chapter mainly discusses the major findings reported in Chapter Four. There are four significant findings. The first finding is about the effects of the guided instruction on the development of critical thinking skills. It includes the findings from the results for answering the first and fifth research questions. The second finding is about the process of development of critical thinking skills. It subsumes the findings from the results for answering the second and sixth research questions. The third finding concerns the effect of initial level of critical thinking skills on the development of the skills, which stems from the results for answering the third research question. The fourth finding involves the effect of English proficiency on the development of critical thinking skills, which generates from the results for answering the fourth research question. The chapter is organized by the findings.

#### **5.1 Effect of the Guided Instruction on Development of Critical Thinking Skills.**

The finding about the effect of the guided instruction on the development of critical thinking skills includes four parts. The first part is concerned with the general effect of the guided instruction, that is, whether the guided instruction had the effect on the development of the skills; the second part is about the specific effect of the guided instruction, that is, how the guided instruction affected the development in the two

stages. The third part discusses the teaching strategies used in the guided instruction and their roles in the development of the skills. The fourth part talks about the participants' activities in class during the guided instruction.

### **5.1.1 Effects of the Guided Instruction on Improvement of Critical**

#### **Thinking Skills**

The results indicate that the guided instruction significantly developed the skills of interpretation, synthesis and evaluation except analysis, which was supported by the results from the interviews that there was the general effectiveness of guided instruction in the development of the skills. However, the effects were different: a very large effect on interpretation and then, synthesis, a medium effect on evaluation, and a small effect on analysis.

There are three possible reasons for the different effects of the guided instruction on different critical thinking skills. One is overlearning which refers to the deliberate continuous practice of a skill beyond successful performance defined by a set of criterion (Dougherty & Johnston, 1996; Driskell, Willis, & Copper, 1992). The criterion was set at "one errorless trial" (Driskell et al., 1992, p.615). One is 'skill proficiency interval', which was proposed in the study. It refers to the length of the training of a skill from the beginning to successful performance of the skill. One errorless trial is taken as the indication of the successful performance. One is skill complexity, defined by the knowledge which a skill involves. The more knowledge it involves, the more complex it is, because more knowledge demands more cognitive resources to process (Nembhard & Osothsilp, 2002; Sweller, 2011; Van Merriënboer & Sweller, 2005).

In practice, the order of the training of the skills leads to the different allocations of time. Four critical thinking skills were trained in the order of interpretation, analysis, synthesis and evaluation and the similar periods of time were allocated for each skill. The training of each skill proceeded through the presentation stage in which the relevant knowledge was presented, the application stage in which the knowledge was applied, and the habit formation stage in which the application of skill became automatic. For analysis, synthesis, and evaluation, the skill of interpretation is prerequisite for their training because, in order to analyze, synthesize and evaluate arguments, arguments need to be found and distinguished from explanation, summary, and explanation initially. As a result, interpretation has more time for continuous practice than the other skills. That is, it obtained more overlearning, which leads to its better development (Dougherty & Johnston, 1996; Rohrer, Taylor, Pashler, Wixted, & Cepeda, 2005).

In addition, different skills involve different relevant knowledge. Interpretation involves argument attributes and constituents, and differences between argument and explanation, summary and description. Analysis contains the knowledge of assumption and faults of arguments, i.e., assumption attributes and the way to discover it, appropriateness of analogy, false causal link, false correlation, and satisfaction of necessary and sufficient conditions. Synthesis covers logical relations among components of a chain argument and the way to diagram them. Evaluation subsumes eight assessment standards and differences among them, and six reasoning elements and differences among them. Analysis has more relevant knowledge than evaluation, and evaluation than interpretation and interpretation than synthesis. In other words, analysis has higher skill complexity than evaluation, and evaluation than interpretation, and interpretation than synthesis. Higher skill complexity requires longer skill

proficiency interval and more overlearning for its application and consolidation. However, actually, interpretation makes use of more time and practice than the other skills and each of the other skills gains similar periods of time and amount of practice. That is, relative to skill proficiency interval, different amounts of time and practice allocated to four critical thinking skills lead to different levels of overlearning. Interpretation has more overlearning than synthesis, and in turn, than evaluation, and in turn, than analysis. Correspondingly, interpretation developed better than synthesis, and in turn, than evaluation, and in turn, than analysis.

The finding also provides supportive evidence for the view that critical thinking skills can be developed subject-independently (Beyer, 2008; Ennis, 1989; Paul, 1985b; Quinn, 1994). In this study, critical thinking skills were trained in an English extensive reading course in which reading texts involve various topics irrelevant to any specific disciplinary subject. In addition, it offers support for the argument that the skills of interpretation, analysis, synthesis and evaluation are general and transferable across disciplinary subjects, and do not require any specific domain content (Ennis, 1989; Halpern, 1998; Johnson et al., 2010). The finding verifies the effectiveness of the CTSTP on the development of critical thinking skills, of which the instructional procedure was based on presentation-practice-production (P-P-P) sequence. It provides empirical evidence for the justification of P-P-P sequence in development of skills, in particular, general skills (Carless, 2009; Ranta & Lyster, 2007).

In conclusion, because of collaborative effects of skill complexity, skill proficiency interval and overlearning for the skills of interpretation, analysis, synthesis and evaluation, the guided instruction exerted different effects on the skills. It had a large and significant effect on interpretation and then, synthesis, a medium and

significant effect on evaluation, and a small and non-significant effect on analysis. Such finding verifies the effectiveness of the CTSTP in the development of critical thinking skills. It also echoes the argument that the skills of interpretation, analysis, synthesis and evaluation are general and transferable and can be taught subject-independently, and therefore, these skills can be applied to diverse disciplinary subjects.

### **5.1.2 Effects of the Guided Instruction on Developmental Patterns of Critical Thinking Skills**

The finding shows that the guide instruction imposed different influence on the developmental patterns of four critical thinking skills. Interpretation presented a slow-rapid pattern; analysis presented a consistently-rapid-improvement-deterioration pattern; synthesis had a rapid-tardy pattern; evaluation took a consistently-tardy pattern. In literature of the instruction of critical thinking skills, few similar findings have been reported.

The possible reasons for different patterns of the development include not only skill complexity, skill proficiency interval and overlearning, but also skill decay. The level of overlearning is negatively related to the amount of skill decay (Arthur, Bennett, Stanush, & McNelly, 1998; Rohrer et al., 2005). As discussed before, analysis has higher skill complexity than evaluation, and evaluation than interpretation, and interpretation than synthesis. Therefore, correspondingly, for the development, analysis requires longer skill proficiency interval than evaluation, and evaluation than interpretation, and interpretation than synthesis. Practically, interpretation was offered with more overlearning than the other skills. More overlearning means less skill decay. Therefore, at the beginning, interpretation developed slowly, and then, with more time and practice, during which skill decay did not happen, the development became rapid.

For synthesis which has lower skill complexity than the other skills, it demands shorter skill proficiency interval correspondingly. However, practically, similar amount of time and practice to that of analysis and evaluation means higher overlearning than them, but the overlearning might be equal to or a little more than skill proficiency interval requirements relative to its skill complexity, i.e., zero overlearning, which means more skill decay than interpretation. This might lead to its initial rapid development, and then, with focus of the training changing into evaluation, skill decay occurs during periods of nonuse, which drove down the rapid development. Therefore, the development became tardy.

For evaluation, more relevant knowledge than interpretation and synthesis means higher skill complexity than them. However, less time and practice, which might mean a minus overlearning, than requirements of skill proficiency interval relative to its skill complexity lead to its tardy development over the duration. Given the fact that Form C of the RCTST was administered immediately after finishing the instruction of evaluation, its skill decay did not occur. For analysis with the highest skill complexity among the four skills, it requires longest skill proficiency interval. However, practically, the similar time and amount of practice to that of synthesis and evaluation, i.e., much less time and practice than its skill proficiency interval requires, led to great minus overlearning. In addition, more skill decay occurred due to longer periods of nonuse than synthesis and evaluation. These lead to its initial rapid development and then skill decayed drastically.

In conclusion, the guided instruction has different magnitudes of influence on the development of critical thinking skills in the two stages, which leads to different

developmental patterns. The different patterns are mainly caused by collaborative effects of skill complexity, skill proficiency interval, overlearning and skill decay.

### **5.1.3 Effectiveness of Teaching Strategies in Development of Critical Thinking Skills**

The guided instruction consists of three stages: presentation stage, application stage, and habit formation stage. When participants can produce individual work independently, it means that the transformation of application stage into habit formation stage would be achieved. In presentation stage, the main teaching strategy is illustration and in application stage, discussion, practice, and questioning are the main teaching strategies. The finding from the questionnaire and the interviews shows that illustration, discussion, practice, and questioning facilitated the development of critical thinking skills.

Illustration in the presentation stage refers to examples used to illustrate how to put the knowledge of critical thinking skills into application. It could clarify the concepts, principles and procedures of the skills and consolidate them, and further, enhance the discovery in application stage. The finding lends support to effectiveness of examples in cognitive skill acquisition in previous studies (Atkinson, Derry, Renkl, & Wortham, 2000; Atkinson & Renkl, 2007; Van Gog & Rummel, 2010). The reason why examples were used in presentation stage in this study is that examples are more effective for novice learners of cognitive skills than other methods, which can reduce cognitive load and effectively support initial skill acquisition (Renkl, 2014; Van Gog & Rummel, 2010). That is, examples are more important for the initial stage of cognitive skill acquisition than others. The finding supports the claim stated by Atkinson and Renkl (2007) that, by illustrating how to perform a task or solve a problem,

which refers to the discovery in this study, in a step-by-step fashion, examples are made as a model which learners can use to guide their own task-performing or problem-solving (p.376). The finding proves that examples are also effective for non-structured domains such as critical thinking skills, not only for well-structured domains such as mathematics and physics, found by Renkl (2002).

The effectiveness of discussion in the study echoes the finding of previous studies that discussion can improve critical thinking skills (Hayes & Devitt, 2008; Pena & Almaguer, 2012; Yang, 2008). Through discussion, students, in particular, non-native English college students who have grown up intellectually and cognitively, can discern the weakness and strengths of their own thinking and others', and obtain deep insights into the issue discussed. Discussion can promote reflection and the exchange of ideas, and therefore, increases students' critical thinking skills. However, due to the limited amount and length of discussion in class, discussion was not effective as expected in the development of critical thinking skills in this study. Most students suggested more discussion needed.

Practice in class and after-class could improve the discovery of argument, deductive and inductive arguments, faults of arguments, logical relations among sentences for diagram-drawing, appropriateness of assessment standards and reasoning elements. In addition, the discovery practice could reinforce the knowledge of concepts, principles and procedures of critical thinking skills that participants had learnt in presentation stage because they had to use the knowledge in the discovery. The finding proves the effectiveness of practice in the acquisition of the skills (Ericsson, 2004; Ericsson, Krampe, & Tesch-Römer, 1993; Newell & Rosenbloom, 1981). Practice can convert declarative knowledge in a slow format into procedural knowledge in a fast

format and speed up the performance in skill acquisition until it becomes automatic (Anderson, 1982; Ericsson, 2004; Ericsson et al., 1993). That is, it enhances the discovery which helps the conversion of declarative knowledge into procedural knowledge. In this study, the practice is not a cue-response drill described by Harmer (2007), which focuses on form and does not involve the application of the knowledge of the skills. It is a task-supported practice in which tasks are used as opportunities for practice of the discovery and the communication of meaning on the basis of the knowledge is emphasized (Carless, 2009). Therefore, to a certain degree, the practice benefits the consolidation of the knowledge while boosting the discovery.

Questioning could boost participants' independent thinking and improve the development of the skills through the enhancement of the discovery, because the questions were mostly related to the discovery. The finding echoed the statement that questioning can stimulate critical thinking and direct its development (Browne & Keeley, 2007). Although incompletely, the finding is consistent with the findings in the previous studies that questioning enhances the development of critical thinking (Alexander et al., 2010; Barnett & Francis, 2011; Elder & Paul, 1998). The reason for limited roles played by questioning and partial support of the previous studies might be that questions in this study were closely related to specific discovery, such as discovery argument or assumption, etc., with the aim to push participants to perform the task of the discovery, and therefore, were not higher-level ones which elicit higher order thinking processes (Savage, 1998).

In conclusion, the function of illustration in the development of critical thinking skills verifies the findings of previous studies in that it clarifies and consolidates concepts, principles and procedures of critical thinking and improves the development

of the skills. The effectiveness of discussion in the development of critical thinking skills echoes the findings in previous studies. However, its effectiveness is limited due to limited length of discussion in the study. Task-supported practice enhanced the development of critical thinking skills and at the same time reinforced the knowledge. It played a significant role in conversion of declarative knowledge into procedural knowledge. Questioning played a role in enhancement of critical thinking skills. However, the role is limited, which is partially consistent with previous studies. The reason is because the questions are not higher level and therefore, elicit higher order thinking.

#### **5.1.4 Participants' Activities in the Guided Instruction**

The finding reveals that near half of participants participated in activities in class. In addition, among another half who did not or seldom engage in classroom activities, although they did not actively answer the teacher's questions or speak out the results of their discussion, they actively thought over the questions and discussed with their classmates. The finding, to a certain extent, does not lend support to the argument that Chinese students who are educated in the Confucian culture are reluctant to engage in classroom activities, such as discussion and debate (Atkinson, 1997; Lun et al., 2010; Turner, 2006). The argument that Chinese students' participation in class is inactive and passive does not obtain strong support in this study. In one word, different from some researchers' expectation, Chinese students actively participated in classroom activities.

For those who did not engage in the activities, they explained that they found it difficult to understand a reading text and their spoken English was poor. That is, insufficient English proficiency prevents them from active participation. This finding

is consistent with some findings of previous studies (Huang, 2008; Lun et al., 2010). Imperfect English causes difficulties in expressing and applying critical thinking. The other reasons were that they worried about their possible wrong answers and that their reserved personality prevented them from active expression of their answers to the teacher's questions and of the results of their discussion. This finding supports the claim that Chinese students' modesty which have developed in the Confucian culture makes it difficult to express their own thinking and evaluate others' views (Day, 2003; Yang et al., 2006).

In conclusion, partially different from previous studies and some researchers' arguments, Chinese students who are educated in the Confucian culture actively participated in classroom activities, although many of them were not willing to express their own answers to the teacher's questions and the results of discussion due to their modesty and reserved personality. That is, to a certain extent, the Confucian culture influences Chinese students' learning behaviors and further, their engagement in classroom activities, and reluctant participation might impose some negative influence on the development of critical thinking skills.

## **5.2 Process of Development of Critical Thinking Skills**

There are three significant findings concerning the process of development of critical thinking skills. The first finding is that as the training proceeded, the relevant knowledge of the skills could be increased and consolidated, and on the other hand, it could be decayed. The second finding is that relevant knowledge plays a positive role in the development of the skills. The third finding is that the development of all the skills underwent knowledge compilation and did not reach the automatic level.

### **5.2.1 Consolidation and Decay of the Knowledge of Critical Thinking Skills**

Two converse findings concerning evolution of the relevant knowledge of critical thinking skills were found. One is that as training proceeded, the some relevant knowledge which participants acquired in presentation stage was correspondingly consolidated. The other is that as training proceeded, reversely, the some relevant knowledge decayed rather than consolidated. That is, as time passed, participants could not hold in retention all the concepts, principles and procedures of critical thinking skills that they acquired in presentation stage.

The first finding justifies critical thinking skills development model which was proposed on the basis of ACT theory (Anderson, 1982). It stated that with the reasoning procedures in declarative knowledge converting into procedural knowledge, remaining concepts and principles in declarative knowledge was consolidated. ACT theory claims that with practice, declarative knowledge can be converted into procedural knowledge eventually and at the same time, declarative knowledge can be strengthened (Anderson, 1982, 1992; Anderson, Bothell, Byrne, Douglass, Lebiere, & Qin, 2004; Corbett & Anderson, 1994). The establishment of some procedural knowledge had the indication of reduced mistakes in the discovery of arguments reported by most participants. With the formation of procedural knowledge, the relevant information is not retrieved from declarative knowledge into working memory when applying the skill, and therefore, working memory load decreases and mistakes reduce until they disappear (Anderson, 1982).

In contrast, the decay of knowledge of evaluation skill was found because the reasoning procedures in declarative knowledge had not been converted into correspondent procedural knowledge, which was indicated by the discovery of some

but not all of reasoning elements and application of some but not all of assessment standards, that is, some mistakes were always made. Knowledge compilation for evaluation skill has just begun. Therefore, when applying evaluation skill, the relevant knowledge has to be retrieved from declarative knowledge into working memory, which overloads working memory capacity and results in some mistakes. Given the fact that, as discussed before, Form C of the RCTST was administered after the instruction of evaluation was completed, i.e., skill decay did not occur due to non-existence of nonuse. However, interviews were conducted one week later after the instruction was completed, which means existence of nonuse, due to which retention of the concepts, principles and procedures in declarative knowledge would decrease and then decay as time passes because of much minus overlearning than what skill proficiency interval requires relative to its skill complexity as discussed before. However, with the decay of knowledge, the skill was not subsequently deteriorated, which suggests that the decay of procedural knowledge appears slower than that of declarative knowledge. As a result, those participants whose acquired knowledge decayed could still make some discovery of reasoning elements.

In conclusion, two converse findings, which are concerned with the consolidation and decay of relevant knowledge of the skills, in different ways, verify critical thinking skills development model which was developed on the basis of ACT theory in this study. The build of procedural knowledge reduces working memory load and consolidate relevant knowledge; in contrast, little procedural knowledge overloads working memory capacity and deteriorates relevant knowledge.

## **5.2.2 Role of Relevant Knowledge in Development of Critical Thinking**

### **Skills**

The finding reveals that the participants who had acquired relevant knowledge of the skills performed better in the discovery and over time, made more progress than those who had acquired little relevant knowledge. Those with relevant knowledge, at the beginning, could have some discovery. Over time, they could have more discovery. In contrast, those with little relevant knowledge could not have any discovery initially, and over time, they could have some discovery. In addition, whether with relevant knowledge or little relevant knowledge, all the participants made some mistakes in the discovery at the beginning. Over time, those with relevant knowledge could not make any mistake in the discovery, while those with little relevant knowledge still made some mistakes. The relevant knowledge had positive effects on the development of critical thinking skills.

The finding supports the argument that skill acquisition begins with the establishment of declarative knowledge and then through practice, declarative knowledge is interpreted and compiled into procedural knowledge (Anderson, 1990; Anderson, 2013a, 2013b; Anderson & Lebiere, 2014). When learners begin to acquire critical thinking skills, they need to acquire the relevant knowledge of the skills and store the knowledge in long-term memory in propositional networks, i.e., the establishment of declarative knowledge. When performing a task for the practice of a skill, such as discovery of arguments in a reading text, learners retrieve the relevant knowledge in long-term memory into working memory and interpret and apply the knowledge in the discovery. If learners acquire little knowledge, they cannot retrieve sufficient and necessary knowledge and interpretively apply it into the discovery. As a

result, learners with little relevant knowledge can have less discovery than those with relevant knowledge.

On the other hand, all the learners, whether they acquire relevant knowledge or little, they have to retrieve the knowledge into working memory when applying it into the discovery, which overloads working memory capacity. Overload of working memory leads to mistakes given limited cognitive resources (Paas, Renkl, & Sweller, 2003, 2004; Sweller, 2011). Therefore, it is unavoidable that initially, they all make some mistakes in the discovery. Later on, through practice, those with sufficient relevant knowledge can easily compile declarative knowledge into procedural knowledge, while those with little insufficient knowledge cannot easily convert declarative knowledge into procedural knowledge. For instance, in order to convert declarative knowledge of an argument into corresponding procedural knowledge, learners need to have the relevant knowledge of argument definition, constituents and procedure to discover an argument in a text. If learners' knowledge of an argument is insufficient, they cannot retrieve sufficient and necessary knowledge of an argument in applying and therefore, easily convert it into procedural knowledge. With the conversion of declarative knowledge into procedural knowledge, retrieval decreases and consequently, working memory load reduces. Therefore, mistakes reduce until they disappear when procedural knowledge is eventually formed. As a result, for learners with relevant knowledge, later on, they could not make any mistakes, while for those with little knowledge, they continue making some mistakes.

In conclusion, the relevant knowledge exerted positive effects on the development of critical thinking skills. It could increase the discovery and reduce mistakes in the discovery, and therefore, improve the development of the skills. The

reason for the roles of relevant knowledge in the development involves the distinction of declarative knowledge and procedural knowledge in ACT theory, and working memory and limited cognitive resources in cognitive load theory.

### **5.2.3 The Development Proceeding of Critical Thinking Skill**

The finding indicates that participants found it easier to make the discovery after the training and made some progress in the development of critical thinking skills. They also perceived the improvement of all the skills. However, participants thought that it was still difficult for the discovery after the training. They still made some mistakes in the discovery or some discovery. The development of critical thinking skills is under knowledge compilation and far from the speed-up and automatic level in large margin, which was also supported by the finding for the first question, i.e. after the training, interpretation and synthesis developed into the moderate level, while analysis and evaluation were still at the weak level. As ACT theory claims, productions in procedural knowledge have not been built completely.

The finding proves the significant functions of declarative and procedural knowledge in the process of development of critical thinking skill. According to critical thinking skills development model proposed in this study on the basis of ACT theory, the development of critical thinking skills goes through declarative knowledge, knowledge compilation, and procedural knowledge until the acquisition of the skills is achieved (Anderson, 1982, 2013b). Anderson (1982) thought that composition of multiple steps used for the discovery into unitary one can promote the speedup. However, the finding that it was still difficult for the discovery after a period time of the training reveals that the speedup of the discovery has not been promoted greatly. The conversion of declarative knowledge into procedural knowledge is under the

process of composition of knowledge compilation. If proceduralization is achieved and productions are built in procedural knowledge, no relevant knowledge needs to be retrieved from declarative knowledge into working memory. Therefore, no mistakes occur and some discovery cannot happen. However, some mistakes and discovery indicate that proceduralization has not yet finished and the relevant knowledge has to be retrieved from long-term memory into working memory. Therefore, the development of critical thinking skills was under the process of knowledge compilation and need more overlearning to accomplish.

In conclusion, the development of critical thinking skills is still under the process of knowledge compilation, far from the accomplishment of procedural knowledge. The speedup of discovery has not been improved and some mistakes are still made. More overlearning for continued composition and proceduralization are required to accomplish productions and therefore to achieve the eventual acquisition of critical thinking skills.

### **5.3 Effects of Initial Levels on Development of Critical Thinking Skills**

The finding indicates that, due to participants' different initial levels of critical thinking skills, the development of the skills presents different growth rates and trajectories. This finding provides supportive evidence to those in the previous studies that the initial levels of critical thinking skills impose effects on the development of the skills (Fischer, Yan, & Stewart, 2003; McMullen & McMullen, 2009). Different patterns of change in students' critical thinking skills are brought about by their different initial levels of critical thinking skills.

This finding is not consistent with those in the previous studies which used conventional pretest-posttest design that all the participants develop critical thinking skills at the same growth rate in the same direction at the same time during a specific period of the instruction. In this study, the development of four critical thinking skills presents various patterns of change by participants with different initial levels of critical thinking skills. For interpretation, at the beginning, participants with low level developed the skill faster than intermediate level, and intermediate level faster than high level. However, later on, the trend turned converse. High level exhibited a faster growth than intermediate level, and intermediate level faster than low level. For analysis, its development increased greatly at the beginning, but, after the second measurement, the increase changed into great decrease. During the development with time, no effects of initial level of critical thinking skills were found, and all the participants with different initial levels developed analysis at the similar growth rate. As regards to synthesis, at the beginning, it increased greatly with time and then, close to the last measurement, the increase was slowed down and changed into decrease. During the initial increase, participants with low level grew faster than those with intermediate level and high level. Later on, during the last decrease, such significantly different growth rates among participants with different levels disappeared. For evaluation, it grew in a linear trend with time, during which participants with low level showed a faster growth than those with intermediate level, and then, than those with high level.

The finding proves that with the initial levels of critical thinking skills as a determinant, the development of critical thinking skills is heterogeneous rather than homogeneous, because, as Fischer, Yan, and Stewart (2003) pointed out, adults' varying amount of experience and contextual support leads to a wide range of variation

in the development of cognitive skills (p.494). Therefore, an adult presents various levels of cognition development, not one fixed level. For the same task, under different levels contextual support, adults show multiple levels of competence. Mostly, the participants with low initial level benefit more from contextual support than those with intermediate and high levels in the initial development of critical thinking skills, which have been found in previous study (Cherry & Park, 1993; Vandergrift, 2004). However, in the development, the facilitation of contextual support is confounded by overlearning.

In the development of interpretation, synthesis, and evaluation, different levels of performance by different levels of critical thinking skills are due to interaction of different levels of contextual support and different extents of overlearning. At the beginning, participants with low level of critical thinking skills seemed to benefit most, which indicates that contextual support seems higher for them than for the others with the intermediate and high levels. For participants with low level, they have less declarative and procedural knowledge than those with the intermediate and high levels. Therefore, contextual support seems higher for those with low level than those with the intermediate and high levels.

Later on, for interpretation and synthesis, they seemed to benefit less, indicating the decline in contextual support. In the development with time, participants with low level acquired more declarative and procedural knowledge, and therefore, the contextual support seems to be decreasing for them relatively. For interpretation, with more overlearning, conversely, those with high initial level benefited more from contextual support than the others, while for synthesis, with zero overlearning, the difference between the participants with different initial levels in benefiting from contextual support disappeared. In contrast, for evaluation, the level of contextual

support keeps unchanged. Minus overlearning leads to almost unchanged declarative and procedural knowledge for participants with low level during the development with time. As a result, they could benefit more from contextual support as before.

For analysis, it has higher skill complexity than the other skills, relative to which longest skill proficiency interval was demanded. However, great minus overlearning was offered actually, and thus, contextual support seems to be similarly insufficient for all the participants during the development. All the participants, whether with low, or intermediate, or high initial levels, benefited from contextual support in invariable way. Therefore, there is no difference among the participants with different initial levels in the development of critical thinking skills.

In conclusion, participants with different levels of critical thinking skills show different patterns of change in the development due to different levels of contextual support. For participants with low level of critical thinking skills, they could benefit from contextual support much for their high performance in the initial development of interpretation, synthesis, and evaluation. However, later on, they benefited from contextual support in different extents due to the confounding effects of overlearning. For analysis, in particular, all the participants benefited similarly from contextual support due to great minus overlearning.

## **5.4 Effects of English Proficiency on Development of Critical Thinking**

### **Skills**

The finding shows that in the development of critical thinking skills. Participants with high English proficiency did not necessarily perform better than those with intermediate English proficiency, and in turn, better than those with low English

proficiency. This finding supports previous studies which found that participants' English proficiency imposes no significant effects on the development of critical thinking skills (Fahim et al., 2012; Mansoor et al., 2010; Tung & Chang, 2009). The researcher believes that there might be two reasons for non-significant effects of English proficiency on the development of critical thinking skills: low level of participants' overall English proficiency and scaffolding in understanding.

#### **5.4.1 Low Level of Overall English Proficiency**

Although the participants could be classified into three levels of English proficiency on the basis of their performance in Higher Education Entrance Examination, they might entirely acquire much lower level of English proficiency than native English speakers or at least, requirements for using English to perform tasks involving critical thinking skills. As a result, according to cognitive load theory, they had to spend more cognitive resources on solving unfamiliar English words, expressions and sentences in understanding and therefore, less cognitive resources for performing tasks of critical thinking skills, given the limited cognitive resources (Paas et al., 2003, 2004; Sweller, 2011; Van Merriënboer & Sweller, 2005). As a result, the participants develop critical thinking skills at the similar rate and non-significant differences among participants with three levels of English proficiency were found, because overall low English proficiency exerted similar effects on the development of critical thinking skills for all the participants, whether they had low, or intermediate or high levels of English proficiency. This can be verified by some results from participants' interviews.

There is inconsistency between English proficiency level and initial level of critical thinking skills among 15 interviewees. Among five interviewees with low initial

level of critical thinking skills, two have high English proficiency; two have intermediate English proficiency; and one has low English proficiency. For those with intermediate initial level of critical thinking skills, three have high English proficiency and two have low English proficiency. For those with high initial level of critical thinking skills, one has high English proficiency; one has intermediate English proficiency; and three have low English proficiency. It indicates that participants with high English proficiency do not necessarily have high initial level of critical thinking skills, and those with low English proficiency do not necessarily have low initial level of critical thinking skills. In addition, although they have different initial levels of critical thinking skills, participants' initial critical thinking skills were all at weak level. Inconsistence between initial level of critical thinking and English proficiency and weak initial levels of all the critical thinking skills justify that the participants' overall English proficiency might be at low level. English proficiency imposes effects on the development of critical thinking skills through reading comprehension, which was proposed in the conceptual framework in the study (see Figure 3.1), and such effect was similar for all the participants due to their similar level of English proficiency. As a result, there are no significant differences among them in the development of critical thinking skills.

Indirect effects of participants' low English proficiency on critical thinking skills through understanding were further supported by the interviews. Among 15 interviewees, they reported that understanding of paragraphs in a reading text was the initial step to do the discovery. If it was difficult to understanding a text, the discovery consequently became tough. They also reported that they could understand only words and sentences, not relations among sentences or paragraphs. They further reported that it was difficult to understand the rhetoric structure of a text. They explained that not

deep understanding of a test was the main barrier to the discovery. This finding verifies that for all the participants, whether their English proficiency are low, or intermediate or high, their initial understanding is literal and deep understanding can cost them most of limited cognitive resources, which leads to less cognitive resources available for the discovery. As a result, all of them develop critical thinking skills at the similar speed and there are no significant differences among them.

In conclusion, the possible reason for non-significant differences among the participants with different levels of English proficiency might be that their English proficiency is at low level and therefore, they had to consume most of limited cognitive resources, of which less cognitive resource is available for the development of critical thinking. As a result, they can not develop critical thinking skills as well as expected due to limited cognitive resource available and their performance is mostly similar in the development and there are no significant differences among them.

#### **5.4.2 Scaffolding in Understanding**

As discussed above, in the interviews, the participants said that understanding was the first step for the application of the relevant knowledge of critical thinking skills into the application, i.e. the discovery. For the participants with overall low English proficiency, all of them had to consume most of limited cognitive resources to achieve reading comprehension before they could make the discovery. Therefore, in order to relieve the participants from overloads on their limited cognitive resource posed by reading comprehension, scaffolding was offered, because scaffolding can efficiently improve reading comprehension (Duffy, 2002; Fitzgerald & Graves, 2005).

In class, scaffolding was instantiated through five techniques: modeling, questioning, contingency management, feedback and ask for participation (McLoughlin,

1999; Rafik-Galea & Nair, 2007). In terms of modeling, before the participants performed a task, the teacher demonstrated how to perform the task by using examples. Through questioning, the participants were asked for the meanings of words, expressions and complex sentences, for the main idea of one paragraph, and for the relations among sentences and paragraphs. Contingency management refers to the recognition of the participants' actions and adjusted scaffolding activities promptly. By feedback, the answers were provided heuristically, and some correctness was checked through enabling participants to compare themselves to others. Ask for participation aims to engage the participants in class activities. It could be accomplished by asking them to express their own ideas about the content of a reading text or others' task performance. These scaffolding techniques are flexibly incorporated into teaching activities and work collaboratively to assist the participants in reading comprehension.

For the three forms of the RCTST, the direct translation of some words and expressions and if necessary, direct explanations for some complicated sentences were offered. Direct explanation and use of learners' native language in direct translation have been used in some studies and proved effective (Fitzgerald & Graves, 2005; Silliman, Bahr, Beasman, & Wilkinson, 2000). For EFL readers, they tend to employ their native language to facilitate their reading process in a foreign language (Koda, 2005). Therefore, direct translation can facilitate their reading process and reduce burdensome on their limited cognitive resources. As discussed before, long and complicated sentences constitute the main barrier to reading comprehension, and therefore, direct explanation of these sentences can provide explicit information to assist the participants to understand them.

Because scaffolding has improved reading comprehension and removed one major barrier of understanding to the development of critical thinking skills for all the participants, all of them could invest their limited cognitive resources on the development of critical thinking skills. As a result, their English proficiency could not cause significant differences among them in the development, and all the participants could develop critical thinking skills at the similar rate through scaffolding.

In conclusion, there might be two reasons for no effects of English proficiency on development of critical thinking skills. One is that all the participants might have low English proficiency and therefore, all of them have to invest more of their limited cognitive resources on reading comprehension and leave less of cognitive resources on the development of critical thinking skills. As a result, their English proficiency did not play a significant role in the development of critical thinking skills. Other is that scaffolding was provided to remove reading comprehension as the main barrier to the development of critical thinking skills, so that all the participants could use all of their limited cognitive resources to develop critical thinking skills. Therefore, the effects of their English proficiency on the development were consequently removed.

In summary, there are four main findings involving the guided instruction, the process of development of critical thinking skills, the initial level of critical thinking skills, and the participants' English proficiency. The guided instruction imposed effects on the development of critical thinking skills. The development of critical thinking skills was proceeding through knowledge compilation and far from the maturation and automaticity. The participants' initial level of critical thinking skills influenced the development of the critical thinking, while the English proficiency has no influence on the development of critical thinking skills. These findings were discussed in comparison to previous studies and explained practically and theoretically.

## **CHAPTER 6**

### **CONCLUSION**

This chapter synthesizes the study. It consists of four sections. The first section involves the summary of the study; the second section concerns implications of the study for the instruction of critical thinking skills in EFL learning context; the third section is concerned with limitations of the study; and finally, the fourth section provides recommendations for the future study.

#### **6.1 Summary of the Study**

The study aims to explore how Chinese EFL learners, who are edified in the Confucian culture, develop critical thinking skills in an EFL reading class. It investigated six research questions. Firstly, the study examined whether the guided instruction can improve the development of critical thinking skills. Secondly, it explored the process of the development of critical thinking skills. Thirdly, it probed whether EFL learners' initial level of critical thinking skill imposes influence on the development of critical thinking skills. Fourthly, the study investigated whether EFL learners' level of English proficiency exerts influence on the development of critical thinking skills. Fifthly, it explored the learners' perception of the guided instruction and finally, the study probed the learners' perception of the development of critical thinking skills. In order to inquire answers to these questions, some theoretical and educational models have been proposed on the basis of previous research in the study.

Theoretically, critical thinking was defined and elaborated on the basis of its three traditional conceptualizations: philosophic, psychological, and educational traditions. Adapted from Paul's model and Bloom's model, the model of reading-embedded critical thinking skills was proposed. It consists of four components: critical thinking ability, elements of reasoning, standards of thought, and intellectual resources. Instructionally, the instructional model of critical thinking skills proposed in the study incorporates Vygotsky's Zone of Proximal Development and Wood, Bruner, and Ross's scaffolding. It starts with the assignment of a task to perform or a problem to solve, and then, if necessary, assistance from the teacher and peers is offered. The instruction of critical thinking skills happens in Zone of Proximal Developments. Adapted from Anderson's adaptive control theory, the critical thinking skills development model was proposed. The development of critical thinking skills proceeds through three stages: declarative knowledge, knowledge compilation, and procedural knowledge, which corresponds to three stages in the critical thinking skills training package: presentation, application, and formation, proposed on the basis of the well-established instructional sequence of presentation-practice-production.

Guided and determined by research questions, the mixed design of qualitative and quantitative methods was employed. Confirmative and explorative research questions necessitate the mixed research design. Quantitative method can provide confirmative answers to examine whether the guided instruction, initial level of critical thinking skills, and English proficiency influence the development of critical thinking skills, while qualitative method explores how EFL learners develop critical thinking skills, which can enable us to gain deep insights into the process of the development. The two research methods are complementary and can uncover different aspects of the

development. For qualitative and quantitative data, different instruments were administered with different samples, including learner journal, semi-structured interview, reading-embedded critical thinking skill test, higher education entrance examination, and perception questionnaire. For quantitative data collection instruments, 50 English major freshmen from one natural class were selected purposefully, while for qualitative data collection instruments, 15 English major freshmen from the same natural class were chosen purposefully. Different instruments were employed to collect different types of data, which can provide different reliable answers to different research questions concerning various aspects of critical thinking skills development. From these answers, some main findings were discerned.

There are several main important findings. It was found that the guided instruction facilitated the development of interpretation, synthesis, and evaluation significantly, and of analysis non-significantly. The guided instruction imposed great influence on the development of interpretation and then, synthesis, moderate influence on the development of evaluation, and small influence on the development of analysis. For the effect of the guided instruction on the process of the development of critical thinking skills, it was found that the facilitation of the guided instruction in the process of the development displayed different patterns: the slow-rapid pattern for interpretation, the consistently-rapid-improvement-deterioration pattern for analysis, the rapid-tardy pattern for synthesis, and the consistently-tardy pattern for evaluation.

The knowledge of reasoning played a positive role in the development of critical thinking skills. More knowledge means more discovery and more progress in the development. As the training progressed, acquired knowledge was consolidated and unclear knowledge was clarified for interpretation, analysis and synthesis. For all the

participants, whether they acquired much or little knowledge, at the beginning, they all made mistakes in the discovery at application stage. Later on, as the training proceeded, mistakes reduced and it became easier to conduct the discovery than before. However, they thought it was still difficult to make the discovery. Therefore, their critical thinking skills developed, but were still under the process of the development and did not reach automatic and speedy level.

Due to the participants' different initial levels of critical thinking, the development of each critical thinking skill appears its distinctive growth rate and trajectory. Except evaluation whose development appears homogeneous with the same growth rate in a linear growth trajectory, the other critical thinking skills developed heterogeneously with different growth rates in quadratic trends. It was found that the participants' English proficiency imposed no significant effect on the development of critical thinking skills. There were no significant differences among the participants with low, intermediate and high level of English proficiency. On average, those with high English proficiency did not necessarily perform better than those with intermediate English proficiency and in turn, than those with low English proficiency. Similarly, during the process of the development of critical thinking skills with time, English proficiency did not present significant effects. In the longitudinal training, those with high English proficiency did not necessarily develop critical thinking skills faster and more greatly than those with intermediate English proficiency and in turn, than those with low English proficiency.

## 6.2 Implications for Development of Critical Thinking Skills

The findings and the corresponding discussions delineated in the study can facilitate the deep insights into the development of critical thinking skills in EFL teaching and learning settings, in particular, EFL reading context. They are conducive to unveil the issues of development of critical thinking skills in the Confucianism flavor and can offer some significant implications for the instruction of critical thinking skills with EFL learners who have been nurtured in a different culture from western culture. The implications involve theoretical and practical aspects of the instruction of critical thinking skills.

Firstly, in the study, the MRCTS was justified, except reasoning elements and thought standards adapted from Paul's model (Paul & Elder, 2008a, p.19). The MRCTS is effective in the development of critical thinking skills with EFL learners through EFL reading, and could be especially appropriate for the development of critical thinking skills with EFL learners in a distinctive culture from western culture. However, the study reveals that evaluation developed very slowly, implying that the elements and standards are not appropriate to be directly instructed with EFL learners in an eastern culture, since, as Thayer-Bacon (2001) pointed out, they are western cultural bias in orientation. They are not somewhat suitable for EFL learners who nurture in the Confucian culture. In addition, the elements and standards are concept-based and lack specific procedures and steps to follow, and therefore, may be contributive to curriculum development, not to the instruction (Nosich, 2011). If the instruction of the elements and standards is conducted, they have to be elaborated. The researcher believes that during the instruction, elaboration of procedures and steps to find them need to be offered.

Secondly, the study verified the CTSDM which adapted from Anderson's ACT theory. The study shows that declarative knowledge is not converted into procedural knowledge once and for all. Declarative and procedural knowledge can both decay after a period of nonuse. With more overlearning, the skill could develop correspondingly rapidly and was not susceptible to readily decay with nonuse. At the same time, declarative knowledge could be consolidated. A well-practiced skill is not prone to decay with nonuse (Anderson, 1992). The CTSDM has significant implications for the development of critical thinking skills in that it has a powerful explanation for the development of critical thinking skills and can identify potential factors affecting establishment of declarative and procedural knowledge, knowledge compilation and decay during the development.

Thirdly, the CTSTP was proved to be effective in the development of critical thinking skills, in particular, in an EFL setting. It was developed on the basis of the traditional teaching sequence of presentation-practice-production and divided the instruction of critical thinking skills into three stages: presentation, application and formation. Presentation and application stages play important roles in facilitating the development until critical thinking skills become automatic in formation stage. Teaching strategies of illustration, practice, group discussion and questioning were also proved to be effective in the development of critical thinking skills. Therefore, it is important to realize that the development of critical thinking skills goes through three stages, which can not be achieved once and for all. Various teaching strategies can be used to promote the establishment of declarative and procedural knowledge, and to facilitate knowledge compilation.

Fourthly, the study reveals that the development of critical thinking skills could be achieved with EFL learners who are cultivated in the Confucian culture. The finding defies the claims stated by some researchers that Chinese students passively participate in class activities and are reluctant to actively engage in discussion and evaluate their peers' and the teachers' performance (Atkinson, 1997; Lun et al., 2010; Turner, 2006). The participants reported that they were reluctant only to speak out their thinking and answers to questions in class publicly, not to participate in group discussion with their classmates and thinking over questions in person. It also refutes the claim that critical thinking is a social and cultural practice (Atkinson, 1997). The study shows that general critical thinking skills of interpretation, analysis, synthesis and evaluation are not culture-specific. Their development can be achieved in a different culture from western culture. Therefore, Chinese students' inactive and passive participation in class activities is a kind of gloss. The researcher believes that the development of critical thinking skills with EFL Chinese learners can be accomplished.

Fifthly, the study indicates that EFL learners' initial level of critical thinking skills affected the development of critical thinking skills. Participants with different levels exhibited various growth rates and trajectories of critical thinking skills. Therefore, before cultivation of critical thinking skills is commenced, it is requisite to gain clear ideas about learners' initial level of critical thinking skills, and then, by consideration of the initial levels, attempt to improve corresponding contextual support, because, as Fischer et al. (2003) pointed out, learners can benefit variously from contextual support in the development of critical thinking skills.

Finally, this study verifies that EFL learners' English proficiency did not affect the development of critical thinking skills. However, it was found that reading

comprehension was a precondition for practice in application stage. Therefore, the statement made in the study is justified that English proficiency did not directly impose influence on the development of critical thinking skills, but indirectly through reading comprehension. As a result, we need to help EFL learners to overcome the barrier to comprehension before cultivating their critical thinking skills so that they can direct their cognitive resources only to the development of critical thinking skills, because reading comprehension cost much of their limited cognitive resources (Sweller, 2011; Van Merriënboer & Sweller, 2005).

### **6.3 Limitations of the Study**

The study set out to explore the process of the development of critical thinking skills with EFL learners in the Confucian culture. It offers some deep sights into the process of the development and the effects of some important factors on the development, which has significant implications for the instruction of critical thinking skills with EFL learners in a different culture from western one. However, the study has its inherent limitations.

Firstly, the sample is limited to EFL English major freshmen in a tertiary institution in China, excluding alternative levels and majors which could provide insights into versatile aspects of the development of critical thinking skills. Therefore, the findings generated from the study can not be generalized to all the EFL learners in China and need to be used with cautions.

Secondly, the study lacks control group which provides reliable baseline data to compare the results of the study with. Control group can contribute to the elimination and isolation of confounding variables and bias. Due to exclusion of control group in

the research design, the results of the study could be unavoidably influenced by the participants' biological variation, teaching and learning environmental variation and researcher bias, apart from the direction intervention, and thus, validity of findings could be reduced.

Thirdly, time and practice offered in the study may not be enough for the efficiency of the intervention. Due to insufficient time and practice, the participants' critical thinking skills are under the process of the development and nowhere near achieved the automatic level. Sufficient time and practice provided could provide discerning information about the length of exposure to the intervention required with EFL learners in the development of critical thinking skills in the Confucian culture, and furthermore, deeper insights into the efficiency of the intervention and the process of the development, in particular, the last stage of the development—the formation stage in which critical thinking skills achieve automaticity.

Finally, although some teaching strategies used in presentation and application stages were proved to be effective in the development of critical thinking skills, we have not gained any ideas about which one makes more or less contributions to the development. The study did not disentangle the teaching strategies to examine which one is the most or least effective in the development of critical thinking skills, and which one is more or less suitable for EFL learners in the Confucian context.

#### **6.4 Recommendations for Future Research**

Although the study generated some penetrating insights into the process of the development of critical thinking skills with EFL learners, inevitably, it has built-in limitations which future research needs to overcome, and thus, can provide undimmed

and detailed information about the vague areas in the process of the development of critical thinking skills in a distinctive culture from western culture. Some recommendations are suggested for future research.

Firstly, various samples in different EFL settings need to be chosen in future research to further examine the effectiveness of the MRCTS, the CTSDM, and the CTSTP in EFL settings, even in other culture rather than Confucian and western cultures. Although the effectiveness of the MRCTS, the CTSDM, and the CTSTP has been proved in the study, it is necessary to conduct further research to explore their effectiveness in other contexts with other samples, to discern their strengths and weaknesses, and refine them.

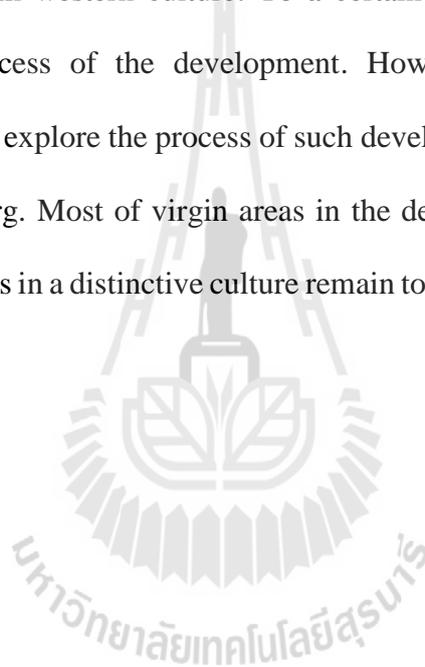
Secondly, future research needs to take into consideration EFL learners' demographic variation, and various EFL teaching and learning environment. The effects of demographic variables and environmental variables on the development of critical thinking skills with EFL learners require more exploration and research which can provide implicative insights into interaction among these variables and their weighted-effects.

Thirdly, control group is needed to be included in future research. The inclusion of control group in research design can statistically increase the validity of findings and control the potential effects of confounding variables. Therefore, efficiency of intervention in the development of critical thinking skills can be solely investigated.

Fourthly, future research needs to provide enough time and practice for the efficacy of intervention, and enables EFL learners to adequately develop their critical thinking skills into the level of speedup and automaticity. Future research may require at least one year, even at most several years to bring into full play the development of critical thinking skills with EFL learners.

Finally, the comparison of different teaching strategies among different groups should be included in future research to examine their effectiveness in the development of critical thinking skills with EFL learners. It is also imperative to discern potential factors affecting the teaching strategies.

In summary, the study has generated some significant findings that critical thinking skills can be developed with EFL learners in the Confucian culture, a distinctive culture from western culture. To a certain extent, it has produced some insights into the process of the development. However, since the study is the preliminary attempt to explore the process of such development, what it has uncovered is the tip of the iceberg. Most of virgin areas in the development of critical thinking skills with EFL learners in a distinctive culture remain to be cultivated in future research.





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## APPENDIX A

### Reading-embedded critical thinking skill test

#### Test of Critical Thinking Skills-Form A

(即可用中文也可用英文作答, 请自行选择)

Name: \_\_\_\_\_

Student ID: \_\_\_\_\_

**Directions:** Identify for each whether the author is presenting an argument a description, an explanation, or a summary. For each answer, please provide reasons.

(请判断下列每个自然段是作者论点的论证, 还是描写或解释或总结, 并只能选择一个, 且给出判断的理由)

1. Bilingualism (能用两种语言的) and multilingualism confer (赋予、带来) many benefits. Speakers of more than one language have a better understanding of how languages are structured because they can compare across two different systems. People who speak only one language lack this essential point of reference (参照). In many cases, a second language can help people to have a better understanding and appreciation of their first language. (4.1)

.....

Reasons:

.....  
.....

2. The solar (太阳的) system is an inhospitable (待人不热情的、冷淡的) place not just for humans but also for machines. Despite this, over 8000 satellites and spacecraft were launched (发射) into space from more than 30 countries between 1957 and 2004. Over 350 people have hurtled (飞驰、驰骋) through space, not all returning to earth. Launch sites based near the equator (赤道), such as that at Kourou (库鲁) in Guyana (英属圭亚那(拉丁美洲)), enable rockets to make best use of the earth's rotation (旋转). (4.7)

.....

Reasons:

.....  
.....

3. The article outlined the difference between individual yawns (打哈欠) and infectious (传染的) yawning. It referred particularly to research by Professor Platek which suggests that only humans and great apes (类人猿) yawn sympathetically. The article went on to say that people who yawn more easily in response to other people's yawns are also more likely to be good at inferring (推测) other people's states of mind. Finally, the article indicates (表明) some social benefits of yawning, suggesting that contagious (传染的) yawning might have helped groups to synchronise (使同步、同时) their behaviour. (4.9)

.....

Reasons:

.....

.....

4. It was not until 2003 that the first Ice Age engravings (雕刻、雕塑) of horses, red deer (马鹿) and bison (野牛) were discovered at Cresswell Crags (克罗斯韦尔峭壁) in Nottinghamshire (诺丁汉郡), England. However, the oversight (忽视) occurred partly because it was assumed that such work was not to be found in Britain. Indeed, in the initial (初次) survey (调查) of the cave, the experts did not notice the art that surrounded them. (4.14)

.....

Reasons:

.....

.....

**Directions:** Identifying for each passage the inclusion and the implicit assumptions used as reasons, and implicit argument. (请从下列每个自然段中找出某一论点的结论、作为理由的假设以及隐含的论点)

5. It has long been the hope of many people that robots would revolutionise (使发生革命性的变化) mundane (平凡的) chores (琐事) and hard labour (繁重劳动) such as construction (建筑) work and housework. The first humanoid (具有人形的) robot was designed by Leonardo da Vinci as long ago as 1495. We have gone for hundreds of years with little progress in gaining humanoid robots to assist around the house and construction site. Labour-saving (节省劳力) robots are just a dream. As there has been so little advance on humanoid robots assisting with housework and construction, it will probably never be achieved. (6.7)

Conclusion: .....

.....

Implicit assumption: .....

.....

6. Employees would do very well to bear in mind (记住) that all forms of trade union (工会) and association (联合会), other than for sports and recreation (娱乐), are not viewed favourably (赞同地). Employees are not to discuss their rates of pay with other workers. (6.21)

Implicit argument: .....

.....

**Directions:** Detecting for each passage false premises or false causal links or valid analogies or other flaws in the argument. Give reasons for your answers. (请从下列每个自然段中找出错误的前提或错误的因果关系或类比是否准确或其他错误之处, 并给出你的理由)

7. Most new restaurants struggle to survive (生存). In order to break even (打破平衡) after the first year of opening, we need to earn £2500 pounds a week. To make this, we need to fill every table every night. Other local restaurants fill about half their tables during the week. We have a good menu so we are likely to get a full restaurant every night. This means we will break even. (6.16)

False premise: .....

.....

Reasons for your answer: .....

.....

8. The entire family was ill last night. They all ate fish at the restaurant yesterday. Therefore, the fish must have been contaminated (污染). (Example2, page106)

False causal link: .....

.....

Reasons for your answer: .....

.....  
 .....

9. The heart works as a pump (水泵、气泵), moving blood through the body by opening and constricting (收缩、压缩). (Example, page112)

Valid analogy or not: .....

Reasons for your answer: .....

.....  
 .....

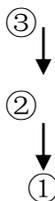
10. Einstein was not very good at maths when he was at school. Many school-children today could solve maths problems that he used to struggle with. The accolade (赞扬) of 'great scientist' shouldn't be ascribed to (归功于、归罪于、归因于) someone who struggled with basic numerical problems. (7.22)

Other flaws: .....

.....  
 .....

**Directions:** Diagramming the argument for the passage. Please use number to represent each premise and conclusion and then diagram relationships among premises and conclusions with the number, using arrow to indicate the direction from premises (or reasons) to conclusions. (请用图标形式表明下列自然段中论点的论证过程。先在自然段中包含有前提和结论的句子前按顺序用数字标号, 然后用图标表示前提和结论之间的关系, 用箭头表明从前提得出结论的论证过程。具体可以参考范例)

Model: ①I don't think we should get Carlos his own car. As a matter of fact, ② he is not responsible because ③he doesn't care for his things.



11. From a letter to the editor: "The idea of a free press (言论自由) in America today is a joke. A small group of people, the nation's advertisers (广告宣传者), control the media more effectively than if they owned it outright (完全、彻底). Through fear of an advertising boycott (抵制), they can dictate (主宰) everything from programming (电视或广播节目) to news report content. Politicians as well as editors shiver in their boots (不寒而栗) at the thought of such a boycott. This situation is intolerable (不可容忍的) and ought to be changed. I suggest we all listen to National Public Radio and public television." (2-14/4, page63)

**Directions:** Evaluating the following passage from the Declaration of Independence by elements of reasoning and standards of thought and answering the questions. (请阅读理解下面短文, 并按要求回答问题)

When in the Course (过程) of human events (人类事业), it becomes necessary for one people (民族) to dissolve (解除) the political bands (政治纽带) which have connected them with another, and to assume (承担、承受...身份) among the powers (强国之林) of the earth, the separate (独立的) and equal station (身份) to which the Laws of Nature (自然法则) and of Nature's God entitle (赋予...的权利) them, a decent (得体的、恰当的) respect to the opinions (舆论) of mankind (人类) requires that they should declare the causes (原因) which impel (迫使) them to the separation (独立).

We hold (认为) these truths to be self-evident (不言而喻的), that all men are created equal, that they are endowed (赋予) by their Creator (造物主) with certain unalienable (不可让与的) Rights, that among these are Life, Liberty and the pursuit of happiness. That to secure (保障) these rights, Governments are instituted (建立) among Men, deriving (获得) their just powers (正当权利) from the consent (同意) of the governed (被统治的人). That whenever any Form of Government becomes destructive (破坏作用的) of these ends (目标), it is the Right of the People to alter (更换) or abolish (废除) it, and to institute new Government, laying its foundation on such principles and organizing its powers (组织权利) in such form, as to (以至) them shall seem most likely to effect (影响) their Safety and Happiness. Prudence (审慎), indeed, will dictate (要求、规定) that Governments long established should not be changed (更换) for light (无关紧要的) and transient (一时的) causes (原因); and accordingly all experience (过去的一切经验) hath shown (已经表明) that mankind are more disposed (更情愿) to suffer (忍受), while evils (苦难) are sufferable (可以忍受的), than (而不是) to right themselves (纠错、申冤) by abolishing the forms (政府形式) to which they are accustomed (习惯的). But when a long train (一系列) of abuses (滥用权利的行为) and usurpations (强取豪夺的行为), pursuing (追求) invariably (始终如一地) the same object (目标) evinces (表明) a design (企图) to reduce (迫使) them under absolute despotism (专制、暴政), it is their right, it is their duty, to throw off (推翻) such government, and to provide new guards (保障)

for their future security.

12. The author's point of view:
13. The most significant information:
14. The most basic conclusions of the author:
15. The most basic ideas used by the author:
16. The most fundamental assumptions of the author:
17. The most significant implications of the text:
18. Do the authors say clearly what they mean?
19. Are the authors accurate in what they claim?
20. Are the authors sufficiently precise in providing details and specifics?
21. Do the authors wander, thereby introducing irrelevant material?
22. Is the writing superficial?
23. Do the authors consider other relevant points of view?
24. Is the text internally consistent?
25. Is what the text says significant?



## Test of Critical Thinking Skills-Form B

(即可用中文也可用英文作答, 请自行选择)

**Name:**

**Student ID:**

**Directions:** Identify for each whether the author is presenting an argument, a description, an explanation, or a summary. For each answer, please provide reasons. (请判断下列每个自然段是作者论点的论证, 还是描写或解释或总结, 并只能选择一个, 且给出判断的理由)

1. Both of the toy mice were the same size and shape so the dog was confused. Although one mouse was red and one was blue, Misty was unable to tell which mouse was his toy simply by looking. Like other dogs, he needed to sniff (闻, 嗅) them both, using his sense of smell to tell them apart (区别开), because he couldn't discriminate (区分) between different colors. (4.11)

Reasons:

2. New-born babies may lack the capacity to monitor (监控) their own breathing and body-temperature during the first three months of life. Babies who sleep alongside their mothers could benefit from learning to regulate (调节, 管理) their breathing and sleeping, following the rhythm (节奏) of the parent. These babies wake more frequently than those who sleep alone. Moreover, mothers who sleep next to their babies are better able to monitor their child for movement during the night. Consequently, it may be safer for new-born babies to sleep with their parents. (4.8)

Reasons:

3. Shakespeare's Romeo and Juliet is set in Verona in Italy. At the beginning of the play, Romeo is pining for (思恋) another young woman, but quickly falls for (爱上) Juliet at a ball (舞会). Although their two families are hostile (仇视) to each

other, Romeo and Juliet enlist the services (请求某人帮忙) of their friends and a friar (修道士) to bring about their marriage. Unfortunately, in a tragic turn of events (悲剧的结局), they each kill themselves, believing the other to be already dead. (4.12)

.....

Reasons:

.....

.....

4. Recently, Ice Age specialists (研究冰期的专家) were excited to find evidence of some cultural links between Ice Age peoples across Europe. On a return visit (回访) to Cresswell Crags in England, they found images of horses, bison (野牛), and red deer similar to those already found in Germany. There is much controversy (争议) about other figures found on cave walls, which some experts believe to be images of dancing women, whereas others remain unconvinced (无法令人信服). (4.16)
- .....

Reasons:

.....

.....

**Directions:** Identifying for each passage the inclusion and the implicit assumptions used as reasons, and implicit argument. (请从下列每个自然段中找出某一论点的结论、作为理由的假设以及隐含的论点)

5. People used plants (植物) as a method of curing illness for centuries before the advent (出现, 问世) of modern medicines. The same plants are often used by the pharmaceutical industry (制药行业) as the basis for the medicines we use even today. Medicines are now expensive to produce and purchase. It would be better if we returned to traditional methods, using leaves and roots of plants rather than mass-produced (大规模生产) pharmaceuticals (药品). (6.9)

Conclusion: .....

.....

Implicit assumption: .....

.....

6. There were three hundred copper pipes loaded (装载) on lorries (大货车) in the parking bay (停车的地方) at the factory on Saturday afternoon when the manager and other staff left. The pipes had disappeared by Sunday morning. Julian and Ian worked late on Saturday. Both can drive the lorries. Neither has given an alibi (不在犯罪现场的证明) for Saturday night. (6.23)

Implicit argument: .....

.....

**Directions:** Detecting for each passage false premises or false causal links or false analogies or other flaws in the argument. Give reasons for your answers.  
(请从下列每个自然段中找出错误的前提或错误的因果关系或类比是否准确或其他错误之处, 并给出你的理由)

7. Five percent of people got married last year, and five percent the year before. This means that ten percent of people get married every two years. Therefore, in twenty years time, everybody will be married. (6.18)

False premise: .....

.....

Reasons for your answer: .....

.....

8. Life expectancy is much higher in Western countries than in the past. Obesity (肥胖症) is also much higher. Therefore, obesity must increase our life expectancy. (7.1)

False causal link: .....

.....

Reasons for your answer: .....

.....

.....

9. The earth's atmosphere is like a blanket of gases around the earth. It is only a thin layer but it helps to maintain the temperature of the earth, keeping us warm. It also offers a layer (一层) of protection from the intensity (炙热) of the sun. (7.10)

Valid analogy (对比) or not: .....

Reasons for your answer: .....

.....  
 .....

10. Juvenile (青少年) crime has risen sharply in cities. Young people are out of control. There are only two options in a situation like this. Either we agree to put up with (忍受) savage (野蛮的) assaults (袭击) on our persons and property, or we place a curfew (宵禁) on all young people after 10 o'clock. (7.21)

Other flaws: .....

.....  
 .....

**Directions:** Diagramming the argument for each passage. Please use number to represent each premise and conclusion and then diagram relationships among premises and conclusions with the number, using arrow to indicate the direction from premises or reasons to conclusions. (请用图标形式表明下列自然段中论点的论证过程。先在自然段中包含有前提和结论的句子前按顺序用数字标号,然后用图标表示前提和结论之间的关系,用箭头表明从前提得出结论的论证过程。具体可以参考范例)

Model: ①I don't think we should get Carlos his own car. As a matter of fact, ② he is not responsible because ③he doesn't care for his things.



11. As we enter a new decade, about 200 million Americans are producing data on the Internet as rapidly as they consume (消费, 使用) it. Each of these users is tracked (追踪) by technologies ever more able to collate (核对) essential facts about them—age, address, credit rating (信用等级), marital status (婚姻状况), etc.—in electronic form for use in commerce (商用). One Web site, for example, promises, for the meager (微不足道的) sum of seven dollars, to scan “over two

billion records to create a single comprehensive (综合性的) report on an individual.” It is not unreasonable, then, to believe that the combination of capitalism and technology poses a looming (令人担忧的) threat to what remains of our privacy. (2-14/12, page65)

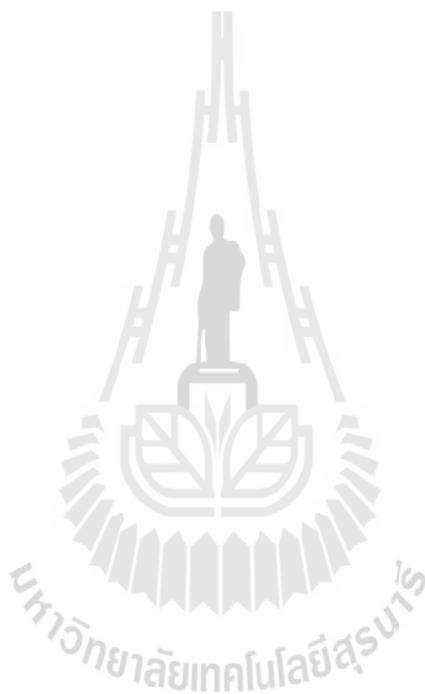
**Directions:** Evaluating the following essay on civil disobedience by elements of reasoning and standards of thought and answering the questions. (请阅读并理解下面短文, 并按要求回答问题)

I heartily accept the motto, “That government is best which governs least (更少的人)””; and I should like to see it acted up to more rapidly and systematically. Carried out, it finally amounts to (达到) this (这样结果), which also I believe, “That government is best which governs not at all”; and when men are prepared for it, that will be the kind of government which they will have. Government is at best but an expedient (权宜之计); but most governments are usually, and all governments are sometimes, inexpedient (不适宜的). The objections which have been brought against (反对) a standing (常设的) army, and they are many and weighty (庞大), and deserve to prevail (流行, 盛行), may also at last be brought against a standing government. The standing army is only an arm of the standing government. The government itself, which is only the mode (形式) which the people have chosen to execute (执行) their will, is equally liable (可能的, 易于) to be abused (滥用) and perverted (堕落, 变坏) before the people can act through it.

Can there not be a government in which majorities do not virtually decide right and wrong, but conscience (良心, 良知)? Must the citizen ever for a moment, or in the least degree, resign (放弃) his conscience, to the legislator? Why has every man a conscience then? I think that we should be men first, and subjects (国民) afterward. It is not desirable to cultivate a respect for the law, so much as for the right. The only obligation which I have a right to assume is to do at any time what I think right....If the injustice is part of the necessary friction (摩擦) of the machine of government, let it go (就不谈了), let it go;...If the injustice has a spring, or a pulley (滑轮), or a rope, or a crank (曲柄), exclusively for itself, then perhaps you can consider whether the remedy (补救) will not be worse than the evil; but if it is of such a nature that it requires you to be the agent (当事人) of injustice to another, then, I say, break the law. Let your life be a counter friction (反摩擦) to stop the machine.

12. The author's point of view:
13. The most significant information:
14. The most basic conclusions of the author:
15. The most basic ideas used by the author:
16. The most fundamental assumptions of the author:
17. The most significant implications of the text:
18. Do the authors say clearly what they mean?
19. Are the authors accurate in what they claim?

20. Are the authors sufficiently precise in providing details and specifics?
21. Do the authors wander, thereby introducing irrelevant material?
22. Is the writing superficial?
23. Do the authors consider other relevant points of view?
24. Is the text internally consistent?
25. Is what the text says significant?



## Test of Critical Thinking Skills-Form C

(即可用中文也可用英文作答, 请自行选择)

Name:

Student ID:

**Directions:** Identify for each whether the author is presenting an argument, a description, an explanation, or a summary. For each answer, please provide reasons. (请判断下列每个自然段是作者论点的论证, 还是描写或解释或总结, 并只能选择一个, 且给出判断的理由)

1. People are less politically aware now than they have been at any time in the past. For hundreds of years, people took great personal risks to fight for causes (事业) that would benefit other people more than themselves. This rarely happens today. As late as the 1980s, there were frequent rallies (集会) with people in one country demonstrating (示威) to show solidarity (团结一致) with people elsewhere. Now, rallies are more likely to be for personal gain such as better salaries or student grants rather than for political issues of wider application. Even low risk activities such as voting in elections attract low turn-outs (参与). (4.4)

Reasons:

2. The village was located near the outer reaches (外围) of the city. The city was starting to encroach (侵占) upon it, swallowing (吞噬) it up, road by road. It would not be long before the village disappeared altogether, to become part of the huge conurbation (城市群) forming on the Eastern seaboard (海岸). To the west, hills enclosed (环绕) the village, trapping it between the city and the mountains beyond. A single road led out from the city, through the village and into the mountains. (4.10)

Reasons:

3. There were many reasons why the student was an hour late for the seminar. First of all, a pan (平底锅) caught fire, causing a minor disaster in his kitchen. It took twenty minutes to restore order (恢复秩序). Then, he couldn't find his house keys. That wasted another ten minutes of his time. Then, just as he closed the door behind him, the postwoman arrived, saying there was a parcel to be signed for. Her pen didn't work which held them up (耽误) further. Finally, of course, he had to find his keys, which had once more slipped (滑进) to the bottom of his bag, in order to re-open the door and place the letter on the table. (4.13)

.....

Reasons:

.....

.....

4. For this cake, you need equal weights of self-raising (含有发酵粉的) flour (面粉), margarine (人造黄油) and sugar. Add one egg for approximately each 50 grams of flour. Place all the ingredients (原料) in a bowl and beat furiously (剧烈) for three minutes. Blend (混合) the ingredients well. Pour into a greased (用油过过) tin and cook in the oven (烤箱) at 190°C for 20 minutes until it is risen, golden brown and coming away from the sides of the tin. Different ovens may require different timings. Leave to cool (凉至冷) before adding decoration such as jam (果酱) and cream (奶油). Therefore, to make the cake, simply buy the ingredients, mix well, cook at 190°C, leave to cool and decorate to taste. (Example, page55)

.....

Reasons:

.....

.....

**Directions:** Identifying for each passage the inclusion and the implicit assumptions used as reasons, and implicit argument. (请从下列每个自然段中找出某一论点的结论、作为理由的假设以及隐含的论点)

5. We should continue to improve sanitation (卫生) and diet in order to further increase our life expectancy (寿命). People in the past had much shorter life expectancies than today. The life expectancy of pre-industrialised societies tended to be an average of 30 years. Today, people in developed (发达) countries can expect to live to over 70 years. Men, in particular, live much longer now. (6.10)

Conclusion: .....

.....

Implicit assumption: .....

.....

.....

6. People in our country believe in honesty and decency (体面). We don't believe in stealing or cheating the state. Now, officials are allowing two thousand people to emigrate here from other countries. (6.24)

Implicit argument: .....

.....

.....

**Directions:** Detecting for each passage false premises or false causal links or false analogies or other flaws in the argument. Give reasons for your answers. (请从下列每个自然段中找出错误的前提或错误的因果关系或类比是否准确或其他错误之处, 并给出你的理由)

7. National identities (民族身份) are strongly entrenched (根深蒂固的). When you are on a beach overseas, you can tell which country people come from just by watching their behaviour. French people, for example, play boules (球) in the sand, whilst Englishmen are noticeable for walking round without any clothing on their upper bodies. So, there must be something in their genetic (基因) make-up (成分) that makes the people of a country behave in a similar way. (6.19)

False premise: .....

.....

Reasons for your answer: .....

.....

7. A prisoner who protested his innocence (清白无辜) by sitting on the prison roof has been released (释放). This is the second time that a prisoner who has protested in this way has been released. Roof-top protests must be a good way of securing release from the prison. (7.2)

8.

False causal link: .....

.....

Reasons for your answer: .....

.....

.....

9. There was no way the defendant (被告) was able to help himself. He had been under excessive (异乎寻常的) strain (压力紧张) for some time and his emotions had been building up like steam (蒸汽) under pressure. The witness had been goading (刺激) the defendant, knowing he was likely to get angry. The defendant was like a pressure cooker (压力锅), just waiting to explode. Eventually, he just reached boiling point and an explosion became inevitable (不可避免). (7.13)

Valid analogy or not: .....

Reasons for your answer: .....

.....

.....

10. The public's knowledge of health is poor and more money is needed for education in this area. Increased sums of money should be spent on courses to make people aware of personal health issues. People don't always know what they can do to take care of their health so further investment is needed in training on health matters. (7.23)

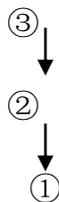
Other flaws: .....

.....

.....

**Directions:** Diagramming the argument for each passage. Please use number to represent each premise and conclusion and then diagram relationships among premises and conclusions with the number, using arrow to indicate the direction from premises or reasons to conclusions. (请用图标形式表明下列自然段中论点的论证过程。先在自然段中包含有前提和结论的句子前按顺序用数字标号,然后用图标表示前提和结论之间的关系,用箭头表明从前提得出结论的论证过程。具体可以参考范例)

Model: ①I don't think we should get Carlos his own car. As a matter of fact, ② he is not responsible because ③he doesn't care for his things.



11. Letter to the editor: “In regard to your editorial (评论), ‘Crime bill (法案) wastes billions,’ let me set you straight (指正你的错误). Your paper opposes mandatory life sentences (终生监禁) for criminals convicted of three violent crimes, and you whine about (警告) how criminals’ rights might be violated. Yet you also want to infringe on (侵犯) a citizen’s right to keep and bear arms. You say you oppose life sentences for three-time losers because judges couldn’t show any leniency (仁慈) toward the criminals no matter how trivial the crime. What is your definition of trivial, busting (敲碎) an innocent child’s skull (头骨) with a hammer?” (2-14/17, page67)

**Directions:** Evaluating the following essay on civil disobedience by elements of reasoning and standards of thought and answering the questions. (请阅读并理解下面短文, 并按要求回答问题)

Is love an art? Then it requires knowledge and effort. Or is love a pleasant sensation (感觉), which to experience is a matter of chance (运气), something one “falls into” if one is lucky? This little book is based on the former premise, while undoubtedly the majority of people today believe in the latter.

Not that (并不是说) people think that love is not important. They are starved for (渴求) it; they watch endless numbers of films about happy and unhappy love stories, they listen to hundreds of trashy (垃圾似的) songs about love—yet hardly anyone thinks (然后几乎没有人认为) that there is anything that needs to be learned about love.

This peculiar attitude is based on several premises (前提) which either singly or combined tend to uphold (支撑) it. Most people see the problem of love primarily as that of being loved, rather than that of loving, of one’s capacity to love. Hence the problem to them is how to be loved, how to be lovable. In pursuit of (追求) this aim they follow several paths. One, which is especially used by men, is to be successful, to be as powerful and rich as the social margin of one’s position permits (一个人社会地位所能允许的). Another, used especially by women, is to make oneself attractive, by cultivating (精心打扮) one’s body, dress, etc. Other ways of making oneself attractive, used both by men and women, are to develop pleasant manners (行为举止), interesting conversation, to be helpful, modest, inoffensive (不招人讨厌). Many of the ways to make oneself lovable are the same as those used to make oneself successful, “to win friends and influence people.” As a matter of fact, what most people in our

culture mean (所谓的) by being lovable is essentially a mixture between being popular and having sex appeal (性感).

The active (积极的) character of love becomes evident in the fact that it always implies certain basic elements, common to all forms of love. These are care, responsibility, respect, and knowledge... Love is the active concern for the life and the growth of that which we love... Respect is the ability to see a person as he is, to be aware of his unique individuality. Respect means the concern that the other person should grow and unfold (展现) as he is (真实的他). Respect, thus, implies the absence of exploitation (利用). I want the loved person to grow and unfold for his own sake (自身缘故), and in his own ways, and not for the purpose of serving me (为了我). If I love the other person, I feel one with him or her, but with him as he is, not as I need him to be as an object for my use. It is clear that respect is possible only if I have achieved independence; if I can stand and walk without needing crutches (拐杖), without having to dominate (控制、支配) and exploit anyone else. Respect exists only on the basis of freedom: "l'amour est l'enfant de la liberté" as an old French song says; love is the child of freedom, never of domination... To love somebody is not just a strong feeling—it is a decision, it is a judgment, it is a promise.

你认为需要整句翻译还是只给出词义? 下面 12 至 19 题有哪几题可以合并为一题?

12. The author's point of view:
13. The most significant information:
14. The most basic conclusions of the author:
15. The most basic ideas used by the author:
16. The most fundamental assumptions of the author:
17. The most significant implications of the text:
18. Do the authors say clearly what they mean?
19. Are the authors accurate in what they claim?
20. Are the authors sufficiently precise in providing details and specifics?
21. Do the authors wander, thereby introducing irrelevant material?
22. Is the writing superficial?
23. Do the authors consider other relevant points of view?
24. Is the text internally consistent?
25. Is what the text says significant?

## APPENDIX B

### Reading-embedded critical thinking skill test Scoring Rubric

In the study, critical thinking is composed of four skills: interpretation, analysis, synthesis and evaluation. Each skill includes several sub-skills. Reading-embedded critical thinking skill test Scoring Rubric is used to assess learners' level of critical thinking. Items 1-4 are used for interpretation skill; items 5-10 for analysis skill; items 11 for synthesis skill; items 12-25 for assess evaluation skill (items 12-17 for elements of reasoning, items 18-25 for standards of thought). The scoring rubric presents criteria to grade test-takers' performance on the Reading-Critical Thinking Skills Test. The total scores are 70 points. Sub-scale scores for interpretation are 20 points; sub-scale scores for analysis are 28 points; sub-scale scores for synthesis are 8 points; sub-scale scores for evaluation are 14 points. The tables below provide the interpretation of the sub-scale scores and the overall score.

Scale	Weak		Moderate		Strong
Interpretation	0---8		9---16		17---20
Analysis	0---11		12---23		24---28
Synthesis	0---3		4---6		7---8
Evaluation	0---5		6---9		10---14
Overall scale	Inferior 0---14	Weak 15---28	Moderate 29---39	Strong 40---59	Superior 60---70

#### Items 1-4 (5 points for each item)

1 point is graded for the correct answer to the question of choices of an argument a description, an explanation, or a summary.

4 points is graded for the reason of the choice:

4 points	Clearly and accurately expresses all the defining features of an argument a description, an explanation, or a summary and use them to support the choice.
3 points	Clearly and accurately expresses most of the defining features of an argument a description, an explanation, or a summary and use them to support the choice.
2 points	Expresses some of the defining features of an argument a description, an explanation, or a summary and use them to support the choice.
1 point	Expresses few of the defining features of an argument a description, an explanation, or a summary and use them to support the choice.

#### Items 5-6 (5 points for item 5 and 4 points for item 6)

For item 5, 1 point is graded for identifying the conclusion and 4 points is graded for implicit assumptions or argument.

For items 6, 4 points is graded for implicit assumptions or argument:

4 points	Clearly and accurately expresses all the implicit assumptions or the argument.
3 points	Clearly and accurately expresses most of all the implicit assumptions or the argument.
2 points	Expresses some of all the implicit assumptions or the argument.
1 point	Expresses some of all the implicit assumptions or the argument.

**Items7-9** (5 points for each item)

1 point is graded for the answer to the first question.

4 points is graded for the reason:

4 points	Clearly and accurately expresses all the reasons.
3 points	Clearly and accurately expresses most of reasons.
2 points	Expresses some of reasons.
1 point	Expresses few of reasons.

**Item10** (4 points)

4 points is graded for identifying flaws:

4 points	Clearly and accurately identifies and expresses all the flaws.
3 points	Clearly and accurately identifies and expresses most of flaws.
2 points	Identifies and expresses some of flaws.
1 point	Identifies and expresses few of flaws.

**Item11** (8 points)

4 points is graded for identifying premises and conclusions:

4 points	Clearly and accurately identifies all the premises and conclusions.
3 points	Clearly and accurately identifies most of premises and conclusions.
2 points	Identifies some of premises and conclusions.
1 point	Identifies few of premises and conclusions.

4 points is graded for diagramming the relations among all the premises and conclusions:

4 points	Clearly and accurately diagrams the relations among all the premises and conclusions.
3 points	Clearly and accurately diagrams most of the relations among all the premises and conclusions.
2 points	Diagrams some of the relations among all the premises and conclusions.
1 point	Diagrams few of the relations among all the premises and conclusions.

**Items12-28**

1 point for each item

## APPENDIX C

### Learner's Journal Entries

Date:.....

Time:.....

In the journal, you are required to write down how you have developed critical thinking skills in the reading class. It should include the following:

1. Your understandings and misunderstandings of critical thinking skills you have learned.
2. Your feelings and thoughts on your understandings and misunderstandings of critical thinking skills you have learned.
3. What can you do by using critical thinking skills you have learned?
4. What can you not do by using critical thinking skills you have learned and the reasons for that?
5. What critical thinking skills you find puzzling, difficult or confusing? And reasons for that.
6. What you expect to learn about critical thinking skills in the next class?
7. Whether what you have learned is useful for you or not? And the reasons for that.
8. Your thoughts on the way in which critical thinking skills are taught.
9. Which teaching way do you think can help your understandings of critical thinking skills or make you confused? And the reasons for that.
10. Your suggestions for the teaching ways of critical thinking skills.

## APPENDIX D

### Semi-structured Interview

#### Introduction

Some information about yourself (interviewer) and this study

#### Purpose of the Study

This study aims to explore the process of development of critical thinking skills and participants' perception of the guided instruction and development of critical thinking skills.

#### Tape Recording, Note Taking and Confidentiality

Ask interviewees if you (interviewer) can tape record the interview. You can tell them that it is very important to capture their words and ideas, and the tape recording can help you to achieve that. Ask interviewees again if you can take notes when the interview is conducting, because it is important for you to keep track of the interview as it progresses.

Tell interviewees that you will keep what they say confidential to the extent law and regulations allow, and that their names and any facts that point to them will not appear when you present or publish the results of this study, and that they will not be identified personally by name.

#### INTERVIEW QUESTIONS

##### (English Version)

#### Questions for Interpretation:

1. Have you heard of argument?
2. Have you heard of critical thinking?
3. Can you now discover arguments in a reading text?
4. What constituents do you think an argument consist of?
5. Can you discover explanation, summary and description?
6. Among the discovery of argument, explanation, summary and description, which one do you think is the most difficult? Why?
7. Which one is the easiest? Why?
8. Do you think the teacher's presentation is helpful for the discovery of argument?
9. Which one is helpful, among illustration, discuss and questioning?
10. Do you often answer the questions asked by the teacher?
11. When the teacher asks questions, do you often think over them?
12. Do you often participate in discussion?
13. Are you willing to tell the teacher the results of your discussion?

14. Do you know how to find the faults of an argument? What are they?
15. For a whole reading text, do you know the elements of reasoning?
16. Do you know the standards used to evaluate the general arguments in a reading text?

#### Questions for Analysis:

1. Does it become easier for you to discover arguments than before? Why?
2. If you can discover an argument, can you judge whether it is a deductive one or inductive one? Why?
3. On the basis of what standards, can you judge?
4. Do you know what assumption is?
5. Can you discover assumptions? Why?
6. How do you infer assumptions? Based on what?
7. In general, what do you think of teaching methods?
8. Among discussion, questioning and practice, which one do you think is the best? Why?

#### Questions for Synthesis:

1. Can you now find and judge the faults of an argument?
2. Is it difficult for you to find the faults of an argument? What difficulty? Why do you think it is difficult?
3. Can you diagram the logical relationships among the components of a chain argument in a paragraph of a reading text?
4. Is it difficult to diagram? Why?
5. Do you think there are some problems with the teacher's teaching methods?
6. Among the teaching methods used by the teacher, such as discussion, illustration, questioning and practice, which one do you think is helpful?

#### Questions for Evaluation:

1. Do you still remember the assessment standards?
2. How many of them can you remember? What are they?
3. Can you use the standards to assess arguments?  
If you can, why?  
If you cannot, why?
4. Which standard do you think is the most difficult? Why?
5. In a persuasive text, do you remember the elements of reasoning?
6. Can you discover these elements in a persuasive text?  
If you can, why?  
If you cannot, why?
7. Which element do you think is difficult to discover? Why?
8. What do you think of the teaching methods used by the teacher recently?
9. Among these teaching methods, which one do you think is the best?

## INTERVIEW QUESTIONS (Chinese Version)

### Questions for Interpretation:

1. 你曾听说过 argument?
2. 你曾听说过批判性思维?
3. 你现在能在文章中找到 argument? 怎么找出的?
4. 你认为 argument 有哪几个部分组成, 分别是什么?
5. 你也能找出 explanation, summary, description?
6. 你认为在找这四个过程中, 哪个最难? 为什么?
7. 哪个最容易? 为什么?
8. 你认为老师上课讲解对找 argument 有帮助吗?
9. 是讲解还是举例, 讨论、问问题有用?
10. 你经常回答老师的提问吗?
11. 老师提问时, 你会主动去思考吗?
12. 你经常参加课题讨论吗?
13. 你会主动将讨论结果告诉老师吗?
14. 你知道怎么去评价 argument 的好坏吗? 具体标准知道吗?
15. 你知道作者在整个文章的论证过程中的组成部分或是步骤吗?
16. 你知道评价整篇文章作者思想或观点的标准吗?

### Questions for Analysis:

1. 你现在找 argument 是不是比以前容易了? 为什么?
2. 找到 argument, 你能不能判断其是 deductive 还是 inductive? 为什么?
3. 根据什么标准判断?
4. 你知道什么是 assumptions?
5. 你能找出 assumptions? 为什么?
6. 你是怎么推理出 assumptions? 根据什么来推理?
7. 总体来说, 你觉得老师教学方法怎么样?
8. 课堂讨论、提问、布置任务等, 你认为哪种方法好? 为什么?

### Questions for Synthesis:

1. 你现在能发现并判断一个 argument 里的缺陷吗?
2. 找出 argument 里的缺陷有困难吗? 如有, 什么困难? 困难的原因是什么?
3. 你能用图表表示一个自然段里 argument 各个成分之间的逻辑关系吗?
4. 是否有困难? 为什么?
5. 你认为老师在教授这两个方面的内容时候, 方法有什么问题吗?
6. 你认为老师使用的方法中哪个对你最有帮助, 如讨论, 举例, 提问, 布置任务等? 为什么有帮助?

**Questions for Evaluation:**

1. 你还记得评价 argument 的标准吗?
2. 现在还能记得其中几个?
3. 你现在能用这些标准评价 argument?  
如果能的话, 为什么?  
如果不能的话, 为什么?
4. 你认为标准中哪个比较难? 为什么?
5. 你还记得一篇议论文中, 主要论证过程中有几个组成成分 (elements of reasoning) 吗?
6. 你现在能在一篇议论文中找出这些成份吗?  
如果能的话, 为什么?  
如果不能的话, 为什么?
7. 哪个成份难找? 为什么?
8. 你对近一段时间老师上课的方式和方法有什么意见?
9. 老师具体教学方法, 你认为哪个好?



## APPENDIX E

### Participant Perception Questionnaire

Thank you for your agreeing to take this questionnaire about your thoughts and feelings on the development of your critical thinking skills and on the instruction of critical thinking skills.

**Section 1:** This section requires you respond to each statement that describes your critical thinking skills by ticking one of boxes from 'strongly disagree' to 'strongly agree'.

		Strongly disagree	Disagree	Agree	Strongly agree
1	I can identify an argument in an essay.				
2	I can make inferences about implicit conclusions.				
3	I can make inferences about implicit reasons.				
4	I can make inferences about assumptions				
5	I can recognize the components of an argument.				
6	I can draw a diagram of the relationship among components of arguments.				
7	I can find out the elements of thought in an essay.				
8	I can give reasons to support my viewpoint or conclusion.				
9	I can find the weakness of an argument.				
10	I can find the strength of an argument.				
11	I can use thought standards to find the weakness and strength of an essay.				

**Section 2:** This section requires you to respond to each statement that describes how activities in a reading class have helped you with the development of your critical thinking skills. Please tick one of boxes from ‘strongly disagree’ to ‘strongly agree’.

		<b>Strongly disagree</b>	<b>Disagree</b>	<b>Agree</b>	<b>Strongly agree</b>
12	I enjoyed learning critical thinking skills in the reading class.				
13	I enjoyed discussion on questions asked by the teacher in the reading class.				
14	I think that questioning in class can help me much with my critical thinking skills.				
15	I think that explicit explanations of arguments can assist in learning critical thinking skills.				
16	I think that discussion can help me develop critical thinking skills.				
17	I enjoyed drawing a diagram to show relations among components of arguments.				
18	I think that practice of recognizing arguments and analyzing them can help me improve my critical thinking skills.				

**Section 3:** Please answer the following questions in details.

19. So far, you have learned all the critical thinking skills. Which one do you think you are good at?
20. If you are good at some critical thinking skills, how did you make it?
21. Among all the critical thinking skills you have learned so far, which one are you not good at? And why?
22. Were you often engaged in activities in a reading class? Please give your reasons!
23. Among questioning, discussion and drawing a diagram, which do you think can assist you much in improving critical thinking skills? Please give your reason!
24. How can these activities of questioning, discussion and diagram assist you in improving critical thinking skills?
25. With what critical thinking skills do you think these activities can help you much?

**Section 4:** Demographic information you provide will be only used for categorizing and summarizing questionnaire data. Your name and any facts that point to you will not appear when we present or publish the results of this study.

26. What is your gender?

Male

Female

27. What is your age?

A. under 18

B. 18-19

C. 20-21

D. 22-23

E. 24 or older

28. How many years have you learned English?

29. Have you ever studied abroad?

Yes

No

30. In order to categorize questionnaire data, I would like to ask you for your name and student ID:

Name: \_\_\_\_\_

Student ID: \_\_\_\_\_

**Thank you for completing our questionnaire!**

## APPENDIX F

### PAF Critical Thinking Skills Training Package

The critical thinking skills training package is based on “the Model of Reading-Embedded Critical Thinking Skills” (see Figure 2.4 in Chapter 2) and used to train EFL learners’ critical thinking skills in the English reading course. The procedure of a lesson is based on instruction sequence of critical thinking skills (see Figure 2.5 in Chapter 2); the guided instruction of critical thinking skills is based on the model of guided instruction (see Figure 2.6 in Chapter 2); the development of a critical thinking skill is based on the model of critical thinking skills development (see Figure 2.7 in Chapter 2).

General Information of Training	
Instructor	Wang Sheng
Goal	Develop the ability to interpret, analyze, synthesize and evaluate arguments and thoughts.
Objectives	Build the knowledge of reasoning principles, concepts and procedures. Apply the knowledge to interpret, analyze, synthesize and evaluate arguments and thoughts. Form the habit of using skills of interpretation, analysis, synthesis and evaluation.
Theoretic Foundation for critical thinking skills development	Adaptive Control Theory (ACT)
Theoretic Foundation for guided instruction	Zone of Proximal Development (ZPD) and scaffolding
Teaching Approach	Infusion
Teaching Strategies	Questioning, group discussion and concept mapping
Teaching Materials	Reading texts in EFL learners’ extensive reading textbooks, handouts
Length	Thirty-six lessons

#### Training Preparation

The following is the critical thinking skills and corresponding sub-skills. The Training Package emphasizes as the instructor provides instruction and facilitation.

#### Critical Thinking Skills:

##### Interpretation

1. Identifying arguments and recognizing explicit premises, reasons and conclusions
2. Distinguishing argument from description, explanation, and summary
3. Paraphrasing arguments to others

### Analysis

4. Making inferences about implicit premises, assumptions and conclusions
5. Detecting flaws in the argument

### Synthesis

6. Discovering hierarchical interrelations among arguments in support of the main position or view
7. Diagramming arguments

### Evaluation

8. Evaluating global structure of thought by using elements of reasoning and criteria of thought
9. Evaluating local arguments and their relationships by using criteria of thought

### Elements of reasoning:

- Purpose the author is trying to accomplish
- Point of view the author is trying to express
- Concept the author is employing
- Question the author focuses on
- Information the author is using to draw a conclusion
- Inference the author is making to come to conclusions
- Assumption the author is based on to come to conclusions
- Implication the conclusions have

### Criteria of thought:

The statements the author is trying to express are

- Clear
- Accurate
- Precise
- Relevant
- Deep
- Bread
- Logical
- Significant
- Fairly justified

**Handouts:**

<b>Critical thinking skill</b>	<b>Sub-skill</b>	<b>Handouts</b>
Interpretation	Sub-skill 1	1. <b>Argument:</b> A set of claims of which one is a conclusion and the remainder are premises, intended as support for the conclusion. The claim we are trying to get others to accept is the <b>conclusion</b> . The claims intended to give us reasons for accepting the conclusion are the <b>premises</b> .
	Sub-skill 2	2. <b>Descriptions</b> give an account of how something is done, or what something is like. <b>Explanations</b> do not attempt to persuade the audience to believe or agree, even though it has similar structure to the argument. They are used to account for why or how something occurs. <b>Summaries</b> are reduced versions of longer messages or texts. Typically, a summary repeats the key points as a reminder of most important aspects.
	Sub-skill 3	3. A <b>deductive argument</b> is one in which the arguer attempts to demonstrate that the truth of the conclusion necessarily follows from the premises. An <b>inductive argument</b> , on the other hand, is one in which the arguer attempts to demonstrate that the truth of the conclusion probably follows from the premises.
Analysis	Sub-skill 1	4. <b>Implicit premises/conclusions:</b> these are propositions assumed or intended by the arguer as reasons in support of the conclusion or the conclusion itself, but which are not actually expressed by any sentence provided by the arguer.
	Sub-skill 2	5. It is <b>flawed reasoning</b> to assume that because two things are found together, or occur at the same time, there must be a link between them. For most types of critical thinking, <b>comparisons</b> must be valid, and add to our understanding of the situation.
		6. In order to prove an argument, certain supporting reasons or evidence will be essential to it. These are called <b>necessary conditions</b> . If it is not present, there is a gap in the argument, and the outcome could be different. If the outcome could be different, then the argument isn't proved. Even if a necessary condition is met, this might not be <b>sufficient</b> to prove a case: there may be other <b>conditions</b> that must be met.
	7. <b>Deflective language:</b> An author can use language to suggest there is no need to prove the argument, deflecting the audience from critically evaluating the reasoning. <b>Complicity:</b> the author acts as if the reader were already part of a group of like-minded thinkers. This can be a	

		powerful way of enticing the audience into agreement. <b>Other flaws:</b> emotive language, attacking the person, unwarranted leap, castle of card, sleight of hand, misrepresentation, trivialization, tautology, two wrongs don't make a right.
Synthesis	Sub-skill 1	8. <b>Chain arguments</b> consist of a chain of reasoning, with conclusions drawn earlier in the passage serving later as premises for subsequent conclusions. An <b>extended argument</b> contains several subarguments. The claims that do double duty as conclusions and premises are called <b>intermediate conclusions</b> . The intermediate conclusions and the premises that support them are known as <b>subarguments</b> .
		9. When a passage contains more than one conclusion following from the same premise(s), as in this case, it is known as <b>an argument with multiple conclusions</b> .
	Sub-skill 2	10. An <b>argument diagram</b> provides a visual representation of the argument's structure. It indicates whether the premises provide dependent or independent support for the conclusion, and whether the argument contains one or more subarguments supporting the premise(s) of the main argument. It can be used to diagram a variety of arguments including those with unstated conclusions and implied premises, multiple arguments, and extended arguments.
Evaluation	Sub-skill 1	11. All reasoning has a <b>purpose</b> . All reasoning is an attempt to figure something out, to settle some <b>question</b> , to solve some <b>problem</b> . All reasoning is based on <b>assumptions</b> . All reasoning is done from some <b>point of view</b> . All reasoning is based on <b>data, information, and evidence</b> . All reasoning is expressed through - and shaped by - <b>concepts and ideas</b> . All reasoning contains <b>inferences</b> by which we draw <b>conclusions</b> and give meaning to data. All reasoning leads somewhere, has <b>implications, and consequences</b> .
	Sub-skill 2	12. Statement should be clear, because <b>clarity</b> is a gateway standard and determines <b>accuracy and relevance</b> . However, a clear statement does not mean that the statement is accurate. Being accurate requires that something is represented in accordance with the way it actually is. A statement is both clear and accurate, but not necessarily precise. To be <b>precise</b> is to give the details to students for exactly understanding what is really meant. A statement can be clear, accurate and precise, but may not be relevant to the issue under the investigation. <b>Relevance</b> can be obtained when something is directly connected with the issue. A statement lacks <b>depth</b> when it treats a complex issue superficially. They further explained that a line of reasoning can lack <b>breadth</b> even though it is clear, accurate, precise, relevant and deep. If an issue involves alternative perspectives and we fail to consider all the perspectives, we think narrowly, though we can obtain

		insight into one side the issue. For <b>logicalness</b> , when we think, we bring together and combine a variety of views in some order. If combined thoughts are supportive of each other and make sense in combination, the thinking is logical. The thinking can be logical, but not significant, because we fail to recognize the most significant among the ideas or concepts relevant to an issue we think about. As a result, our line of reasoning lacks <b>significance</b> . When the thinking is logical and significant, we want to make sure that the thinking is also justified. To justify the thinking is to think fairly in accordance with reasons in context.
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### PAF Critical Thinking Skills Training Content

The content of PAF Critical Thinking Skills Training Package includes critical thinking skills and corresponding sub-skills, the estimated number of lessons for the instruction, materials used for the instruction, and the performance criteria.

Training Content			
Critical thinking skill	Sub-skill (Lesson)	Material	Performance criteria
Interpretation	Sub-skill 1 (Four lessons)	Handout 1	Students can identify arguments and the components: premises and conclusions between the lines.
	Sub-skill 2 (Four lessons)	Handout 2	Students can distinguish arguments from descriptions, explanations and summaries and decide whether a given paragraph is about an argument, or a description, or an explanation, or a summary.
	Sub-skill 3 (Four lessons)	Handout 3	Students can paraphrase an argument and its components, and decide whether it is a deductive argument or an inductive argument.
Analysis	Sub-skill 1 (Six lessons)	Handout 4	Students can give implicit premises and conclusions based on explicit information beyond the lines.
	Sub-skill 2 (Six lessons)	Handout 5 Handout 6 Handout 7	Students can find the flaws in an argument because of invalid comparisons or false correlation. Students can find the flaw in an argument because of unnecessary or insufficient premises. Students can realize that the author may use some rhetoric devices to persuade rather than reasoning and find such flaws in an argument.

Synthesis	Sub-skill 1 (Six lessons)	Handout 8 Handout 9	Students know the differences between a single argument and chain arguments. For a given argument, they can decide whether it is a single argument or chain arguments. Students know what an argument with multiple conclusions and can recognize it in a paragraph.
	Sub-skill 2 (Six lessons)	Handout 10	Students can use a diagram to clearly present the structure of a single argument, chain arguments, extended argument and the argument with multiple conclusions.
Evaluation	Sub-skill 1 (Six lessons)	Handout 11	Students can find the author's purpose in writing the text, the most important question, problem, or issue in the text, the most fundamental assumptions of the text, and the author's point of view in the text. The students can find the most significant information or data in the text, The most basic concepts, theories, or ideas in the text, the most basic conclusion in the text, and the most significant implications of the text.
	Sub-skill 2 (Six lessons)	Handout 12	Students can make judgments on whether the author's statement is vague or clear, whether the author's claims are distorted or accurate, whether the author provide details and specifics and whether these details are relevant, whether the author introduce irrelevant information, whether the author has got into the important complexities in the subject. Students can make judgments on whether the author consider alternative views, whether the author's reasoning is consistent and logic or contradictory, whether the author focuses on important or trivial aspects of the subject, whether the author takes a justifiable or one-sided approach.

### Sample of the Lesson Plan

Summary		
<b>Objective</b>	To understand the real meaning of the text To understand the hardship for the author to be successful Critical thinking skill to recognize arguments between the lines	
<b>Materials</b>	The text “The Shadowland of Dreams” in the textbook <i>English Extensive Reading Student’s Book II</i> (3 <sup>rd</sup> edition) Handout 1	
<b>Approach</b>	Infusion	
<b>Teaching strategies</b>	Mixed of questioning, discussion and concept mapping	
<b>Teaching stages</b>	Comprehension—presentation—application—habit	
<b>Participants</b>	EFL English-major freshmen	
<b>Time</b>	Four lessons	
<b>Step</b>	<b>Activity</b>	<b>Purpose</b>
Step1	Ask warm-up questions concerning the topic of the story	As an introductory step to the topic of the story
Step2	Provide background information about the writer and his novel, the magazine, the prize and the organization	Help comprehension and learn something about American culture
Step3	Present knowledge of an argument and its components, and of the procedure to identify it in a reading text.	Presentation stage, in order to help learners acquire knowledge of reasoning concepts, principles and procedures and build declarative knowledge.
Step4	Ask questions about the main idea of paragraphs, and the meanings of words and sentences. Assign tasks of translation from English to Chinese for some complex sentences.	Help learners understand paragraphs in a reading text.
Step5	Ask questions about premises and conclusions. Assign tasks of identifying arguments and components, and implied assumptions. Ask learners to draw diagrams of some complex arguments on the blackboard.	Application stage, practice using declarative knowledge to identify and interpret arguments.
Step6	Discuss the following topic: which is more important for success, luck or persistence?	Habit formation stage, Practice using declarative knowledge to express the point of view supported by reasons and build procedural knowledge.
Step7	Assign extra exercises after class	Practice procedural knowledge.

## **CURRICULUM VITAE**

Sheng Wang was born on September 3, 1970 in Hanshan County in China. He earned his Bachelor of Arts degree in English Language and Literature from Anhui University in 2000. In 2006, he graduated from Guizhou University with Master of Arts degree in English Language and Literature.

He started his teaching career in Tongzha Junior Middle School upon graduation from a local normal school and had been teaching English there until 2003. Afterwards, he worked in Tongling University in 2006. He is currently a lecturer at School of Foreign Languages, Tongling University, China.

In 2011, he enrolled in the Ph.D. program of English language studies at School of Foreign Languages, Institute of Social Technology, Suranaree University of Technology, Thailand. Since then on, he had been studying there until he earned his Ph.D. degree in English language studies in academic year of 2015 from Suranaree University of Technology, Thailand.