

การพัฒนาความคิดเชิงวิพากษ์ในวิชาการอ่านภาษาอังกฤษในฐานะ  
ภาษาต่างประเทศของนักศึกษาชาวจีน: การลดผลกระทบด้านลบที่เกิดจาก  
สมรรถภาพด้านภาษาอังกฤษ

**The Development of Critical Thinking in EFL Reading with Chinese  
Students: Reducing the Obstructive Effect of English Proficiency**

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**ABSTRACT**

Recently, the instruction of critical thinking, which is mostly conducted with learners in a western context, has expanded to EFL teaching and learning contexts and is emphasized in higher education in China. Previous studies found that Chinese EFL learners lack critical thinking due to their English proficiency. This study aims to explore a way to reduce the negative effects of English proficiency on the development of critical thinking. One natural class of English major freshmen was chosen as the sample. Selective translation and scaffolding were employed to curtail the obstruction of English proficiency in the development of critical thinking. The results show that obstruction of English proficiency in the development of critical thinking could be removed by selective translation and scaffolding. The findings provide some implications for the development of critical thinking in an EFL context.

**ARTICLE INFO**

*Article history:*

Received 10 August 2015

Received in revised form

20 November 2015

Accepted 25 November 2015

Available online

25 December 2016

**Keywords:**

critical thinking

(ความคิดเชิงวิพากษ์)

English proficiency

(สมรรถภาพด้านภาษาอังกฤษ)

English as a Foreign Language

(ภาษาอังกฤษในฐานะภาษา

ต่างประเทศ)

selective translation

(การแปลแบบคัดสรร)

scaffolding

(กระบวนการสอนแบบการต่อ

โครงสร้าง)

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## บทคัดย่อ

การสอนความคิดเชิงวิพากษ์ซึ่งส่วนใหญ่เกิดในสังคมตะวันตกได้เริ่มขยายเข้ามาในโลกของการเรียนการสอนภาษาอังกฤษในฐานะภาษาต่างประเทศเมื่อไม่นานมานี้และการศึกษาระดับสูงในประเทศจีนได้ให้ความสำคัญเป็นอย่างมาก ทั้งนี้จากการศึกษางานวิจัยที่เกี่ยวข้องพบว่านักศึกษาชาวจีน ยังขาดความสามารถด้านความคิดเชิงวิพากษ์โดยมีสาเหตุมาจากสมรรถภาพด้านภาษาอังกฤษที่จำกัด งานวิจัยเรื่องนี้จึงพยายามที่จะหาวิธีการลดผลกระทบด้านลบที่เกิดจากข้อจำกัดดังกล่าวที่มีต่อการพัฒนาความคิดเชิงวิพากษ์ โดยเลือกนักศึกษาชั้นปีที่หนึ่งเป็นกลุ่มตัวอย่างและใช้เทคนิคการแปลแบบคัดสรร (Selective Translation) และกระบวนการสอนแบบการต่อโครงสร้าง (scaffolding) เพื่อลดอุปสรรคที่เกิดจากข้อจำกัดทางภาษา ซึ่งผลของการวิจัยพบว่าอุปสรรคดังกล่าวสามารถลดลงได้ ด้วยวิธีการทั้งสองแบบ ผลการวิจัยในครั้งนี้ได้ให้ข้อเสนอแนะด้านการเรียนการสอนที่เป็นประโยชน์ต่อการพัฒนาความคิดเชิงวิพากษ์ในบริบทของการสอนภาษาอังกฤษในฐานะภาษาต่างประเทศ

## Introduction

The instruction of critical thinking dates back to Socratic times in ancient Greece. Since then on, it has been emphasized as significant for learning, professional and civic societies (Paul & Elder, 2002). Most of the instruction is conducted with native language learners in a western context where education administrators and employers have taken critical thinking as one of the necessary outcomes of postsecondary education and an essential skill of quality graduates (Barnett & Francis, 2011; Davies, 2011; Niu, Behar-Horenstein, & Garvan, 2013). It is only in recent years that the instruction of critical thinking has spread to EFL teaching and learning contexts. Therefore, it comes as no surprise that its importance is emphasized in higher education in China. It was found that Chinese students lack critical thinking compared to those native language learners in a western context. Researchers believed that it is because of their poor English proficiency (Huang, 2008; Lun, Fischer, & Ward, 2010; Paton, 2005). Some studies have been conducted to examine the effects of English proficiency on the development of critical thinking in EFL learners (Kamali & Mansoor, 2011; Mansoor, Marzieh, & Minoo, 2010). However, few studies explore the way to reduce the negative effects of English proficiency in the development of critical thinking. This study intends to explore the way to reduce the negative effect of English proficiency on the development of critical thinking in an English reading class with Chinese EFL learners. Two practices were employed: selective translation and scaffolding in reading comprehension.

## Research Background

### The Effects of English Proficiency on the Development of Critical Thinking

In general English reading classes, EFL learners have to perform concurrent linguistic and critical

thinking tasks, which impose a heavier cognitive load on them than English native learners (Takano & Noda, 1993). The heavier cognitive load can interfere with critical thinking training, which might lead to the decline of critical thinking ability. Takano and Noda (1993) selected English-Japanese bilinguals and Japanese-English bilinguals as the sample in their study. They were required to concurrently perform a thinking task such as calculation and a linguistic task such as question-answering in their respective foreign language: Japanese for English-Japanese bilinguals and English for Japanese-English bilinguals. The results showed the decline of thinking ability with both bilinguals, which proved the negative effects of language proficiency on thinking ability due to the heavier cognitive load on learners of a foreign language.

Another empirical study conducted by Ng, Tsui, and Marton (2001) supported the obstructive effect of poor English proficiency on the development of critical thinking. In the study, the teacher taught the same lesson in English in one class and in Chinese in the other class in the same grade, in order to explore the effects of the medium of instruction on the learning achievement. The result showed that participants performed in the class using Chinese better than in the other class using English which is a foreign language. They concluded “Chinese students in Hong Kong are handicapped as far as the mastery of the content of the lesson is concerned when they are taught in English” (p.159). Paton (2005) holds the same view that Chinese students lack critical thinking in their academic world because they have to confront “the difficulties of study in the context of edge of knowledge discourse in a second, third or fourth language” (p.1). When they learn the content of various subjects, concurrently they have to struggle with learning English at a basic level, which leads to cognitive overload.

### **Translation of Assessment Instruments of Critical Thinking**

For critical thinking assessment, California Critical Thinking Skills Test, Watson-Glaser Critical Thinking Appraisal, and the Cornell Critical Thinking Test (Abrami, Bernard, Borokhovski, Wade, Surkes, Tamim, & Zhang, 2008; Fawkes, O’meara, Weber, & Flage, 2005; Niu et al., 2013) are the most commonly used tests of critical thinking skills. In empirical practice, these instruments 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 that can be incorporated into translation in order to reduce potential

threats as much as possible. One is the translation-back-translation procedure that is commonly used to guard against potential threats 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 leads 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 western and eastern culture, it is not an amiable task to achieve culturally appropriate translation. Another procedure is the 'multidisciplinary committee approach' through which a group of people from different areas prepare translation (van de Vijver & Tanzer, 2004). This can enhance the quality of translation through collective efforts, especially in the case when they have complementary expertise in different areas. However, it is practically unfeasible to group people with different areas of expertise, such as psychological, linguistic, and cultural.

Given the defects of entire translation of assessment instruments of critical thinking, Geisinger (1994) advocated that "text in an instrument should not be translated from one language into another" and "it must be translated in concept" (p.306, 308). Therefore, in this study, selective translation was used for currently available English version instruments and some adaptations to them were made, i.e., rewording or altering or even creating new items and questions if necessary, so that, as van Widenfelt et al. (2005) pointed out, the original cultural flavor in the instruments can be maintained to a greater extent. At the same time, the negative effect imposed by English proficiency can be diminished. Operationally, in this study, selective translation refers to the translation of selected linguistic items in an instrument. The procedure of selective translation began with a pilot of the assessment instrument of critical thinking skills in which EFL test-takers reviewed and underlined the unknown linguistic items in items and questions. Then the data collected in the pilot was analyzed, according to which the translation of the selected unknown linguistic items was made.

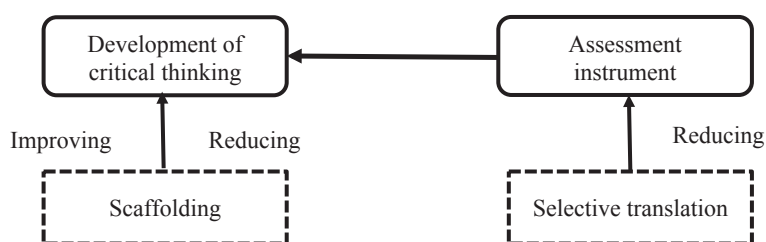
### **Scaffolding**

Wood, Bruner, and Ross (1976) introduced the concept of 'scaffolding' for students to obtain assistance from more capable peers and teachers on the basis of learners' Zone of Proximal Development (ZPD). ZPD, proposed in Vygotsky's (1978) sociocultural theory, refers to the distance between the actual developmental level and the potential developmental level. It represents what learners will achieve with help from others. Through scaffolding, learners can be guided or supported 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 in learners. After reviewing literature on scaffolding, Rafik-Galea and Nair (2007) found five types of scaffolding strategies. They are ‘modeling’, ‘feedback’, ‘questioning’, ‘contingency management’ and ‘asking for participation’. Normally, these scaffolding strategies are used collaboratively in the classroom. However, in teaching practices, what scaffolding strategy will be effectively employed depends on the subject matter, 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.

In teaching practice, 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 in teaching practices. 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 desire to base teaching on ZPD and scaffolding.

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 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 1.** Roles played by selective translation and scaffolding

In this study, scaffolding was mainly employed to improve the development of critical thinking, and in addition, it was used to reduce the obstructive effects of English proficiency on development (see Figure 1). As Rafik-Galea and Nair (2007) claimed, scaffolding can be used as “a tool for critical thinking among learners through interaction” and it can also “play an essential role in comprehension” (p.101).

Previous studies have proved the negative effects of English proficiency on the development of critical thinking in EFL learners. English proficiency is the underlining factor for Chinese EFL learners’ lack of critical thinking. This study aims to explore the way to lessen the obstruction of English proficiency on the development of critical thinking with Chinese EFL learners, i.e., selective translation used in the assessment instrument and scaffolding employed in the development of critical thinking skills (see Figure 1). It attempts to answer the following research questions:

- RQ 1: Through selective translation of the instrument and scaffolding in reading comprehension, are there significant differences among participants with different levels of English proficiency in the development of critical thinking?
- RQ 2: For each critical thinking skill, is the process of development of critical thinking similar or different?

## Method

### Participants

Participants in this study were chosen from one regular class in Tongling University in China East where the researcher as the teacher taught English reading. In the university, English is taught as a foreign language for English majors in the School of Foreign Languages who have to develop their listening, speaking, reading, writing and translating abilities over four years, and non-English majors from other schools, who learn English as a compulsory course over two years. The English reading course was compulsory for freshmen and sophomores of English majors to develop their reading ability. The study was conducted with 50 freshmen of English majors in the School of Foreign Language. The reason for selecting freshmen rather than sophomores as the sample is that they have similar EFL learning experiences which are different from those in a college context and they have not been influenced by learning experiences in university.

Some of the students began to study English as a foreign language in primary school; some of them in junior middle school; some even in kindergarten. The average time for EFL learning was 8.12 years before they obtained admission to university. Among the participants, there are 5 male

and 45 female students with ages of 18-20. None of them have been abroad to study.

Participants' English proficiency was assessed by the National Higher Education Entrance Examination (NHEEE). 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 higher education institutions 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.

For those students who take the National Higher Education Entrance Examination, three subjects are mandatory across the country. They are 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. Students can choose either of the two integrated tests according to their interest in science or the humanities. The overall mark for a student is generally a weighted sum of marks for 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 have taken the National Higher Education Entrance Examination administered in the 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. The reason for employing the National Higher Education Entrance Examination is that it is authoritative because it is administered by the government and the results are accepted by all higher education institutions in China. The other reason is that it has recognizable reliability and validity. When students are enrolled in the university, their scores for English are kept in the School of Foreign Languages. As an English teacher, the researcher has ease of access to the scores of participants.

### **Instruments**

There is one instrument: the reading-embedded critical thinking skill test (RCTST). It was used to evaluate the development of critical thinking.

Standardized multiple-choice tests which are commonly-used to assess critical thinking can only reveal test-takers' recognition of knowledge, not their underlying critical thinking ability (Ku, 2009), but the reading-embedded critical thinking skill test utilized a format of questions and giving reasons

for the answers to questions for each passage, an open-ended, but focused approach which was suggested by Ennis (1993). It has three forms: Form A, B and C. Each form has the same format structure which consists of a few short passages and one long passage. The short passages were adapted from the activities and exercises in two books: *Critical thinking skills: Developing effective analysis and argument* (Cottrell, 2005) and *Critical thinking* (9<sup>th</sup> ed.) (Moore & Parker, 2008). One long passage was adapted from *The international critical thinking reading & writing test* (Paul & Elder, 2006). The questions for the passages were developed by the researcher. The instrument was piloted with students from another natural class and accordingly revised before it was administered to participants in the study.

The three forms of RCTST were developed to assess the same four critical thinking skills: interpretation, analysis, synthesis and evaluation, which were developed on the basis of Paul's model (Paul & Elder, 2008) and Bloom's taxonomy (Bloom, 1956). Interpretation refers to the skill to identify an argument and its components: premises and conclusions, to distinguish argument from non-argument such as description, explanation, and summary, and to describe and characterize deductive and inductive arguments. Analysis refers to the skill to make inferences about implicit premises, assumptions and conclusions, and to detect flaws in an argument. Synthesis is a skill used to discover hierarchical interrelations among arguments, and to diagram them. Evaluation refers to the skill to use elements of reasoning to evaluate the complete structure of the whole global thought repressed in a written text, and to use standards of thought to evaluate both local arguments and global thought.

## Treatment

Treatment includes selective translation of RCTST, scaffolding in reading comprehension and the instruction of critical thinking skills. The English version RCTST was piloted and test-takers were required to underline the unknown words they thought constitute barriers to their understanding. These words were grouped according to word families and were indexed with their difficulties according to their places in a word frequency list (Davies & Gardner, 2010). Those with high difficulty indexes were translated into Chinese selectively. For scaffolding in reading comprehension, it was instantiated through five techniques: modeling, questioning, contingency management, feedback and asking for participation. In terms of modeling, before participants performed a task, the teacher demonstrated how to perform the task by using examples. Through questioning, participants were asked for the meanings of words, expressions and complex sentences, for the main idea of a paragraph, and for the relations among sentences and paragraphs. Contingency management refers to the recognition



of participants' actions and promptly adjusted scaffolding activities. Through feedback, the answers were provided heuristically, and some correctness was checked through enabling participants to compare themselves to others. Asking for participation aims to engage participants in class activities. This 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 in reading class and work collaboratively to assist participants in reading comprehension.

On the basis of reading comprehension, four critical thinking skills were instructed. Firstly, handouts which contained the relevant knowledge for each skill were given to participants. Then, after participants understood one or two paragraphs in a text, they were required to use the knowledge for interpreting, analyzing, synthesizing and evaluating. For interpretation, participants were required to perform tasks such as identifying the view in one or two paragraphs and the supportive reasons, or distinguishing arguments from non-arguments, for instance, identifying summary, explanation and description. For analysis, participants were required to infer the assumptions as reasons and judge whether an argument had some faults and discover them. For synthesis, participants were required to judge logical relations among sentences which contain claims in one or two paragraphs and diagram the logical relations. For evaluation, participants were required to use reasoning elements to evaluate the whole global thought expressed in a text and thought standards to evaluate a local argument expressed in one or two paragraphs of a text. Interpretation was the precondition for the development of the other three skills, because the identification of arguments was a prerequisite for analyzing, synthesizing and evaluating.

### **Procedure**

The data collection procedure consisted of the classification of participants' English proficiency, the instruction of critical thinking which was infused into EFL reading teaching activities, and the administration of RCTST. Firstly, participants' scores for the entrance examination for English were taken as criteria for assessing the level of their English proficiency. Overall scores are 150 points, of which at least 90 points are required for admission to the School of Foreign Languages in the university. Actually, the lowest and highest score of students are 105 points and 137 points, respectively. Therefore, by the statistical standard, scoring of 90-118 points is counted as a low level of English proficiency; scoring of 119-122 as an intermediate level; scoring of 123-137 as a high level. Secondly, the instruction of critical thinking was infused into EFL reading teaching activities. Four critical thinking skills were instructed in the order of interpretation, analysis, synthesis and evaluation. That is, when the skill of

interpretation was completely instructed, then the instruction of analysis began. Afterwards, the skill of synthesis was instructed and finally, the skill of evaluation was instructed. Before the instruction was conducted, RCTST Form A was administered. In the middle of the instruction, that is, after the skills of interpretation and analysis were instructed, RCTST Form B was administered. At the end of the instruction, that is, when the instruction of synthesis and evaluation was finished, RCTST Form C was administered immediately. As a result, numerous instances of overlearning and skill decay occurred, which could affect the development of critical thinking skills.

## Results

Data were analyzed by repeated-measures ANOVA and mixed ANOVA. Repeated-measures ANOVA was performed to explore the development of critical thinking skills. Mixed ANOVA was used to explore the effects of English proficiency on the development of critical thinking skills. The three forms of RCTST could be counted as two stages: the first stage from Form A to Form B, the second stage from Form B to Form C, examining the developmental process of critical thinking skills.

### Development of Critical Thinking Skills

As we can see in Table 1, 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,  $\chi^2(2) = 0.56, p > .05$ . This means that it is appropriate to perform repeated-measures ANOVA. The results show that, in general, there were significant differences across RCTST Forms 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,  $F(2, 90) = 3.04, p > .05$ . This indicates that, in general, the three skills of interpretation, analysis and synthesis were developed over time. This finding was corroborated by effect size estimates: a very large effect on interpretation,  $\eta_p^2 = 0.60$  and analysis,  $\eta_p^2 = 0.51$ , a large effect on synthesis,  $\eta_p^2 = 0.34$ , and a medium effect on evaluation,  $\eta_p^2 = 0.06$ .

**Table 1** Facilitation of the guided instruction in the development of critical thinking skills

<i>Critical Thinking Skill</i>	<i>Mauchly's test</i>		<i>df</i>	<i>F</i>	<i>p</i>	$\eta_p^2$
	$\chi^2(2)$	<i>p</i>				
Interpretation	2.92	.23	2, 90	66.85	<.001	0.60
Analysis	0.02	.99	2, 90	47.16	<.001	0.51
Synthesis	0.32	.85	2, 90	23.53	<.001	0.34
Evaluation	0.56	.76	2, 90	3.04	.053	0.06

In order to examine the specific development of critical thinking skills in each stage, tests of contrasts were performed.

The result of tests of contrasts is presented in Table 2, which shows that, 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 they performed significantly better than in Form B,  $F(1, 45) = 98.27$ ,  $p < .001$ , indicating that the development of interpretation was improved significantly in both stages. Mean difference and effect size indices indicate that the effects had different degrees in different stages. In the first stage, the effect was moderate, revealing significant and slow development, *Mean Difference* = 1.81,  $\eta_p^2 = .09$ , and then in the second stage, the effect was very large, showing significant rapid development, *Mean Difference* = 6.80,  $\eta_p^2 = .69$ . For interpretation there appeared different degrees of development in different stages, presenting a slow-rapid pattern.

**Table 2** Differences of students' performance across three forms of the RCTST

<i>Critical Thinking Skill</i>	<i>RCTST Form Contrast</i>	<i>Mean Difference</i>	<i>df</i>	<i>F</i>	<i>p</i>	$\eta_p^2$
Interpretation	A vs B	1.81	1, 45	4.41	.041	0.09
	B vs C	6.80	1, 45	98.27	<.001	0.69
Analysis	A vs B	5.58	1, 45	79.27	<.001	0.64
	B vs C	-4.87	1, 45	59.63	<.001	0.57
Synthesis	A vs B	1.60	1, 45	28.65	<.001	0.39
	B vs C	0.20	1, 45	0.49	.490	0.01
Evaluation	A vs B	0.35	1, 45	0.78	.381	0.02
	B vs C	0.65	1, 45	2.56	.117	0.05

For analysis, students performed in Form B significantly better than in Form A,  $F(1, 45) = 79.27$ ,  $p < .001$ , however, in Form C they performed significantly worse than in Form B,  $F(1, 45) = 59.63$ ,  $p < .001$ , which was indicated by positive and negative mean differences. This reveals that in the first stage, analysis was improved significantly and in contrast, in the second stage, analysis was not improved but exacerbated significantly. This distinctive finding was supported by the mean difference and effect size. Mean differences and effect size indices indicate a very large positive effect on development in the first stage and a very large negative effect on development in the second stage. Analysis developed very rapidly in the first stage, *Mean Difference* = 5.58,  $\eta_p^2 = .64$ , and then deteriorated very rapidly in the second stage, *Mean Difference* = -4.87,  $\eta_p^2 = .57$ . This presented a distinctive development with completely opposing trends in different stages, and a consistently-rapid-improvement-deterioration pattern. Such a developmental pattern may be due to the interactive effects of some factors, such as skill complexity, skill proficiency interval, overlearning, and skill decay. A specific explanation will be offered in the 'Discussion' section.

For synthesis, students performed in Form B significantly better than in Form A,  $F(1, 45) = 28.65.72$ ,  $p < .001$ , and then, in Form C they performed better than in Form B although not significantly, indicating that only in the first stage, synthesis was improved significantly. This finding was also supported by the mean difference and effect size. Mean difference and effect size indices show a large influence in the first stage, *Mean Difference* = 1.60,  $\eta_p^2 = .39$ , and then a very small effect in the second stage, *Mean Difference* = 0.20,  $\eta_p^2 = .01$ . This reveals that synthesis developed rapidly in the first stage but very slowly in the second stage, presenting a rapid-tardy pattern.

For evaluation, though students performed in Form B better than in Form A, and then, in Form C they performed better than in Form B, there were not significant differences, indicating that evaluation developed very slowly in both stages. This finding was strengthened by the mean difference and effect size. Mean differences and effect size indices show small effects on both stages, *Mean Difference* = 0.35,  $\eta_p^2 = .02$ , and *Mean Difference* = 0.65,  $\eta_p^2 = .05$ . This finding suggests that evaluation developed very slowly over time, presenting a consistently-slow pattern.

Different developmental patterns for different critical thinking skills may be due to the interactive effects of some factors, such as skill complexity, skill proficiency interval, overlearning, and skill decay. A specific and detailed explanation will be offered in the 'discussion' section.

### Effects of English Proficiency

We can find in Table 3 that, in general, 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,  $F(2, 43) = 0.19$ ,  $p > .05$ . This indicates that, generally, there was no significant main effect of English proficiency on participants' performance, averaged across the three forms. On average, the participants with high English proficiency did not perform better than those with intermediate proficiency, and in turn, those with intermediate proficiency did not perform better than those with low proficiency. Effect size indices showed different degrees of effects imposed by English proficiency. There was a small effect on interpretation,  $\eta_p^2 = .05$ , analysis,  $\eta_p^2 = .04$ , and a very small effect on evaluation,  $\eta_p^2 = .01$ , and almost no effect on synthesis,  $\eta_p^2 = .00$ .

**Table 3** Effects of English proficiency on the development of critical thinking skills

Critical Thinking	Effect	df	F	p	$\eta_p^2$
Interpretation	Proficiency	2, 43	1.17	.320	0.05
	Form x Proficiency	4, 86	1.47	.220	0.06
Analysis	Proficiency	2, 43	0.99	.380	0.04
	Form x Proficiency	4, 86	1.48	.215	0.06
Synthesis	Proficiency	2, 43	0.06	.941	0.00
	Form x Proficiency	4, 86	0.92	.459	0.04
Evaluation	Proficiency	2, 43	0.19	.827	0.01
	Form x Proficiency	4, 86	0.88	.478	0.04

As can be seen in Table 3, 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,  $F(4, 86) = 0.88$ ,  $p > .05$ . This indicates that the differences in participants' performance across the three forms 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 an intermediate level and in turn, those with an intermediate level did not necessarily significantly develop their critical thinking skills more quickly than those with a low level. However, although not significant, effect size estimates showed that English proficiency had different degrees 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,  $\eta_p^2 = 0.04$ .

## Discussion

The results indicate that through selective translation and scaffolding, EFL learners developed critical thinking skills and their English proficiency did not constitute barriers to development. This finding lends support to the findings of previous studies which showed that selective translation and scaffolding effectively improve reading comprehension (Fitzgerald & Graves, 2005; Silliman, Bahr, Beasman, & Wilkinson, 2000). Selective translation assisted participants in their understanding of the assessment instrument of critical thinking skills and scaffolding assisted in understandings of reading materials in an EFL reading class, and therefore, facilitated their reading process and reduced burden on their limited cognitive resources. Consequently, participants could concentrate their limited cognitive resources on the development of critical thinking skills rather than on struggling with understandings of linguistic items.

Because selective translation and scaffolding have improved reading comprehension and removed one major barrier of understanding to the development of critical thinking skills for all participants, each one of them could invest their limited cognitive resources on development. Otherwise, according to cognitive load theory, they had to spend more cognitive resources on solving unfamiliar linguistic items in the assessment instrument and reading materials and therefore, less cognitive resources for development of critical thinking skills, given the limited cognitive resources (Paas, Renkl, & Sweller, 2003, 2004; Sweller, 2011; Van Merriënboer & Sweller, 2005). As a result, their English proficiency did not cause significant differences among them in the development of critical thinking skills, and all participants could develop critical thinking skills at a similar rate.

However, the developmental patterns of critical thinking skills were heterogeneous rather than homogeneous. Different skills presented different developmental patterns. This implies that, except for English proficiency, there might be other factors affecting the development of critical thinking skills. The possible factors for different patterns of development include skill complexity, skill proficiency interval, overlearning, and skill decay. Skill complexity can be 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). The criterion was set at “one errorless trial” (Driskell, Willis, & Copper, 1992, p.615). Skill proficiency interval refers to the length of the training in a skill from the beginning to the successful performance of the skill. One errorless trial is taken as an indication of successful performance. Overlearning refers to the deliberate continuous practice of a skill beyond successful performance defined by a set of criterion (Dougherty & Johnston, 1996; Driskell et al.,

1992). Skill decay can be defined as “the loss or decay of trained or acquired skills after a period of nonuse” (Arthur, Bennett, Stanush, & McNelly, 1998, p.58).

Skill complexity determines the skill proficiency interval. Higher skill complexity requires a longer skill proficiency interval. The level of overlearning is negatively related to the amount of skill decay (Arthur et al., 1998; Rohrer, Taylor, Pashler, Wixted, & Cepeda, 2005). According to the relevant knowledge involved in different critical thinking skills, analysis has a higher skill complexity than evaluation, and evaluation has a higher skill complexity than interpretation, and interpretation has a higher skill complexity than synthesis (see Table 4). Therefore, correspondingly, for development, analysis requires a longer skill proficiency interval than evaluation, and evaluation requires a longer skill proficiency interval than interpretation, and interpretation requires a longer skill proficiency interval than synthesis (see Table 4). Practically, critical thinking skills were trained in the order of interpretation, analysis, synthesis and evaluation. But interpretation was a basis for the other skills, and therefore, practically, was allocated with more time and practice than the other three skills which were allocated with similar times and practice. Therefore, interpretation was offered with more overlearning than the other skills. More overlearning means less skill decay (see Table 4). 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.

**Table 4** Factors affecting the developmental patterns of critical thinking skills

	Skill Complexity	Skill Proficiency Interval	Overlearning	Skill Decay
Interpretation	3	3	1	4
Analysis	1	1	4	1
Synthesis	4	4	2	2
Evaluation	2	2	3	3

Notes: 1, 2, 3, 4 presents different degrees. 1 for highest degree > 2 > 3 > 4 for lowest degree.

For synthesis which has a lower skill complexity than the other skills, it demands a shorter skill proficiency interval correspondingly. However, practically, a similar amount of time and practice to that of analysis and evaluation means higher overlearning, but this 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 (see Table 4). This might lead to its

initial rapid development, and then, with the focus of the training changing to evaluation, skill decay occurs during periods of nonuse, which drove down the rapid development. Therefore, the development became slow.

For evaluation, more relevant knowledge than interpretation and synthesis means higher skill complexity (see Table 4). However, less time and practice, which might mean less overlearning, than skill proficiency interval requirements relative to its skill complexity, lead to its slow 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 the longest skill proficiency interval. However, practically, a similar time and amount of practice for synthesis and evaluation, i.e., much less time and practice—bigger minus overlearning than its skill proficiency interval requires, and more skill decay during longer periods of nonuse than synthesis and evaluation (see Table 4), lead to its initial rapid development and then the skill decayed drastically.

## Conclusion

Through selective translation and scaffolding in reading comprehension, the main barrier imposed by EFL learners' English proficiency could be removed, so that all participants could use all of their limited cognitive resources to develop critical thinking skills. Therefore, the obstructive effects of their English proficiency on the development of critical thinking were consequently removed. However, critical thinking skills developed in various patterns. The various developmental patterns of critical thinking skills might be the interactive effects of four factors: skill complexity, skill proficiency interval, overlearning, and skill decay. This is a preliminary study which focuses on reducing the negative effects of English proficiency on the development of critical thinking in Chinese EFL learners. Its findings could provide some implications for the development of critical thinking in other EFL contexts. However, deep insights into facilitation of selective translation and scaffolding in reducing obstructions to English proficiency need further research. The inclusion of a control group in future research could provide strong evidence for the effect of selective translation and scaffolding in reducing the obstruction imposed by English proficiency. In addition, further study is also needed to explore the effects of skill complexity, skill proficiency interval, overlearning, and skill decay on the development of critical thinking in EFL learners.



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