

Achievements and Problems of Think-Aloud Protocols Application to EFL Education Research

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Abstract: Think-aloud protocols have drawn much attention over the past two decades. Given the expanse of the relevant literature, we narrow our focus on core papers on the application of this research method to EFL education research in China in the past 25 years, aiming to summarize the achievements of its application to EFL education research and discover the problems in the current research. In this systematic review, a total of 53 articles are retrieved. Adopting the methodological synthesis, we analyze the articles from the perspectives of the research trend, research areas, research design, data collection, data analysis, and presentation of results. It is found that the overall number of studies using think-aloud in EFL education is insufficient. The research using think-aloud in EFL writing accounts for the highest proportion, while few studies on EFL listening and speaking via this research method are conducted. Tertiary-level students are the most popular participants in the studies using think-aloud protocols. In addition, the descriptions of the data collection and data analysis processes are insufficient. Based on these findings, implications for teachers, curriculum designers, and researchers in EFL education are further discussed.

Keywords: think-aloud protocols; EFL education research; research trend; research areas; application

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1. Introduction

The research in the field of EFL education covers various perspectives, including listening, speaking, reading, writing, translation, etc. Many researchers tend to use research methods such as questionnaires (HU &



XU, 2024) and interviews (HU & QU, 2021) in conducting EFL education research. Although these methods can be used to investigate learners' behaviors or thoughts, the information is not received at the time when the learners are engaged in an activity. As memories fade, even recall recorded soon after the event can suffer from the fragmentary nature of awareness at that time (Cowan, 2017). Therefore, think-aloud is one of the methods for data collection that captures scholars' attention. It is a method through which participants speak out various information in their minds anytime and anywhere in the process of completing a certain task (Ericsson & Simon, 1980; Ericsson & Simon, 1993; GUO, 2007). Compared with questionnaires, think-aloud can reflect participants' thinking process immediately without the problem of information filtering (Green, 1998).

In the field of EFL education in China, think-aloud has received more and more attention, including not only the theoretical research on how to apply think-aloud to teaching but also the empirical research using think-aloud as the research instrument. Among them, empirical research accounts for the largest proportion. However, although think-aloud protocols can intuitively reflect the participants' thinking process, the reactivity, and veridicality of think-aloud have become an important topic of controversy. Improper operations of the think-aloud protocols may affect data reliability. What is more, compared with foreign countries, the research on the application of think-aloud protocols to EFL education in China started late and has not yet formed a relatively complete system. Based on this, it is necessary to sort out the application of think-aloud protocols in the research of EFL education in China and find out the current progress and shortcomings in the use of think-aloud protocols, which can provide clear ideas for the follow-up research. Though there are two Chinese papers (QIAN, 2015; Lin, 2019) that reviewed the studies using think-aloud protocols, neither of them gave a comprehensive picture of how think-aloud protocols were applied to Chinese EFL education research. For example, LIN (2019) only focused on the studies using think-aloud protocols in EFL writing. Moreover, they didn't give a review on the issues as to what weight has been given to each research area of Chinese EFL education in which think-aloud is applied, and whether the think-aloud protocols used in the research are proper. It is generally agreed that whether think-aloud can be used appropriately determines the credibility and accuracy of the research (Ericsson & Simon, 1980; YANG, ZHANG & Judy, 2020). What's more, they didn't have a clear analytical framework, which may make their research unscientific to some extent. Therefore, it is necessary to conduct systematic and comprehensive research to help researchers know the status quo of Chinese studies using think-aloud protocols in the field of EFL education so that they can produce more influential studies.

To make up for the above research deficiencies and to lay a foundation for future researchers to better use the think-aloud protocols in the field of EFL education, this review aims to systematically summarize the achievements of EFL education research in using think-aloud protocols in China and explore the existing problems from the perspectives of the research trend, research areas, and the application of think-aloud. Thus, the central questions of the current review are as follows: (1) What is the research trend of Chinese EFL education research in which think-aloud is applied? (2) What are the research areas of Chinese EFL education research in which think-aloud is applied? (3) What is the status quo of think-aloud application in Chinese EFL education research?

2. Method

This study, focusing on core papers on the application of think-aloud protocols to EFL education research in

China in the past 25 years, followed the research synthesis approach in terms of article identification and retrieval, data set coding procedures, and data analysis (Plonsky, 2013, 2014).

2.1 Article identification and retrieval

The initial phase in synthesizing the current study was to identify and locate the domain of the studies within EFL education in China. According to Plonsky (2013, 2014), the domain was operationalized into three components, including location, time, and content. Location-wise, all the retrieved articles in this study were from China National Knowledge Infrastructure (CNKI), which was a widely accepted and used platform for literature search by scholars in China, and the articles included in it were all from the core journals (including SCI-source journals, CSSCI, CSCD, and Peking University core journals), namely *Journal of Xi'an International Studies University*, *Foreign Language Research*, *Technology Enhanced Foreign Language*, *Foreign Languages and Literature*, *Modern Foreign Languages*, *Journal of China Examinations*, *Foreign Language Education in China*, *Teaching & Administration*, *Experimental Technology and Management*, *Journal of PLA University of Foreign Languages*, *Foreign Language Education*, *Foreign Language Learning Theory and Practice*, *Foreign Languages and Their Teaching*, *Foreign Languages Research*, *Journal of Chongqing University of Posts and Telecommunications (Social Science Edition)*, *Foreign Language World*, *Language Planning*, *Journal of Lanzhou University (Social Sciences)*, *Journal of Inner Mongolia Normal University (Educational Science Edition)*, *Journal of Hebei University (Philosophy and Social Science)*, *Shandong Foreign Language Teaching*, *Foreign Language Teaching and Research*, and *Foreign Languages in China*. Furthermore, all the papers published from 1998 to 2022 were searched using the advanced search function with “English” and “think-aloud” as subject terms. It needs to be pointed out that the purpose of the current study is to know the specific situation of applying think-aloud protocols to Chinese EFL education research, so all the non-empirical papers such as literature reviews and theoretical studies are excluded. Thus, the criteria for selecting the papers are: (1) All the papers selected are from core journals in CNKI. (2) Articles are from 1998 to 2022. (3) Articles are empirical studies in the field of EFL education. Based on the above criteria, a total of 53 articles of empirical studies on EFL education using think-aloud protocols are obtained at last.

2.2 Coding

In this phase, the 53 articles were classified as writing, reading, vocabulary, translation, listening, speaking, and others according to the research area. Then, each category was coded separately for the following analysis. For example, the first paper which is about English writing is coded as W-1.

2.3 Data analysis

Due to the similarities between the think-aloud protocols and other research methods in the implementation process, the present study derived an analytical framework from the previous review by XU and LI (2020) who explored the specific situation of applying case study to Chinese EFL education research from the perspectives of research design, data collection, data analysis, and presentation of results. However, slight adaptations were made according to the purpose of the study as well as the characteristics of think-aloud. In the sub-criteria called “appropriate research questions”, we changed its original meaning into “be able to answer ‘what’ and ‘how’



questions through think-aloud” because a case study is used to answer “why” and “how” questions while think-aloud, is usually used to answer “what” and “how” questions. As Table 1 shows, the analytical framework contains 4 evaluation criteria and 10 sub-criteria with their specific meanings and purposes.

Criteria	Sub-criteria	Meaning	Purpose
Research Design	Appropriate research questions	Be able to answer “what” and “how” questions through think-aloud	The suitability of the research
	Selection of research participants	The range and representativeness of the research participants	The scientific and representative nature of the research
	Theory formulation	Present the theory involved in the study	The scientific nature of the research
Data Collection	The multiplicity of data sources	Use of multiple data sources	The credibility of the research
	Description of the data collection process	Describes the data collection process in detail	Normality and credibility of the research
Data Analysis	Description of the data analysis process	Describes the process of data analysis in detail	Normality of the research
	Use of triangulation	Triangulation validation between different data and third-party validation by non-researchers themselves	The credibility of study results
Presentation of Results	Description of research participants	A specific description of the basic situation of the research participants and the environment in which they are located	The credibility of the research
	Elaboration of theoretical claims	Validation and elaboration of findings by using existing theoretical frameworks	Contribution of research theories
	Construction of the Theoretical Framework	Constructing a theoretical framework consistent with the research	Contribution of research theories

Table 1 Analysis framework for the application of think-aloud

In this review, the title, abstract, keywords, and body parts were all analyzed based on the analytical framework. To improve the accuracy of the analysis, two writers in this review completed the analysis work together. If no consensus was reached during the analysis, a full discussion would be carried out. The detailed analysis steps were as follows:

Firstly, each article was read repeatedly and analyzed one by one according to the above analysis framework. If the article conformed to the description of the second dimension in the analysis framework, check marks would be made. The number of check marks in each dimension represented the number of papers that were in accordance with the description. After analysis, the number of qualified papers in each dimension was counted. For instance, the number of check marks in the dimension of “appropriate research questions” was 31, which represented that among the 53 retrieved articles, there were 31 papers that proposed appropriate questions. During this process, the research trend, research areas, as well as the application of think-aloud in Chinese EFL education research can be explored and expounded.



3. Results of the Literature Review

3.1 Research trend

As can be seen from Figure 1, the research on the application of think-aloud protocols to EFL education in China could be traced back to 25 years ago when WEN and GUO (1998) published a paper in *Modern Foreign Languages* to explore the relationship between thinking in L1 and L2 writing ability. Ever since then, a trend of fluctuating growth has appeared. In 2010, there was a significant increase in the number of papers using think-aloud protocols to conduct EFL education research in China, with the number of papers reaching a peak of 7. In 2011, the number of papers dropped rapidly to 2. It then showed a fluctuating increase between 2012 and 2020 but dropped to 0 in 2021. As far as the papers published since 1998 are concerned, after the amount of research increased to 7 in 2010, the number of papers using think-aloud to explore EFL education has decreased. Although there was a fluctuating growth trend during the period from 2011 to 2022, the number of papers published each year was insufficient.

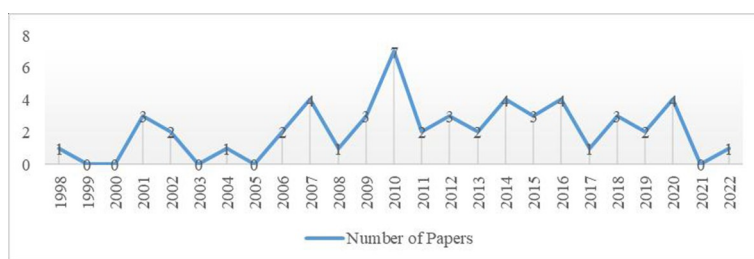


Figure 1 Trend of Chinese EFL education research using think-aloud

In addition, the data about the number of papers issued in each year interval can be obtained after dividing the publication years into five stages. As is shown in Figure 2, the total number of papers issued from 1998 to 2007 was relatively stable. From 2008 to 2012, there was a significant growth stage, with the total number of papers reaching 16. After 2012, the number of papers started to decline slightly. Therefore, the research on EFL education using think-aloud protocols in China can be roughly divided into three stages, namely, the starting stage (1998–2007), the significant growth stage (2008–2012), and the declining stage (2013–2022).

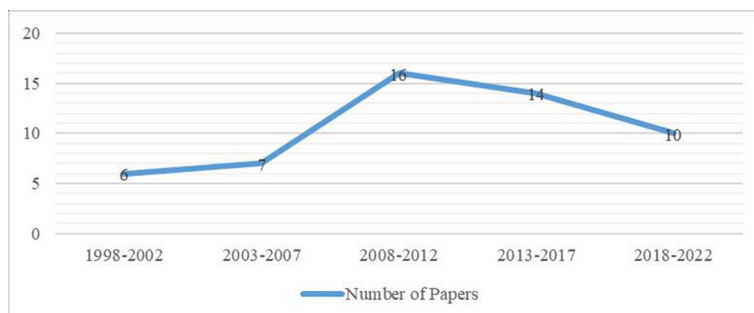


Figure 2 Number of papers issued in each year interval

3.2 Research areas

53 core journal papers are classified and sorted by analyzing the abstracts, keywords, research questions, and research conclusions. It is found that the research on the application of think-aloud to EFL education in China involves various fields, including listening, speaking, reading, writing, translation, vocabulary, etc. The specific research areas are shown in Table 2.

Research Field (Total)	Research Content	No.	Percentage
English Writing(16)	Influencing Factors of Writing	6	11.32%
	English Writing Process	3	5.66%
	English Writing Strategies	3	5.66%
	Essay Rating	3	5.66%
	Teaching in English Writing	1	1.89%
English Reading(13)	Influencing Factors of Reading	5	9.43%
	English Reading Process	4	7.55%
	English Reading Strategies	4	7.55%
Vocabulary(13)	Word or Phrase Reasoning Process	5	9.43%
	Word or Phrase Comprehension Strategies	4	7.55%
	Influencing Factors of Word Processing	4	7.55%
Translation(6)	Translation Process	3	5.66%
	Translation Strategies	2	3.77%
	Translation Rating	1	1.89%
English Listening(2)	English Listening Process	1	1.89%
	English Listening Strategies	1	1.89%
English Speaking(2)	Influencing Factors of Speaking	1	1.89%
Others(2)	English Test	1	1.89%
	Pragmatics	1	1.89%

Table 2 The research areas of using think-aloud in EFL education research

As can be seen from Table 2, Chinese scholars who use think-aloud protocols to conduct EFL education research are mainly inclined to study foreign language writing (30.19%), reading (24.53%), vocabulary (24.53%), and translation (11.32%), while listening and speaking research accounts for a small proportion. What's more, among all the sub-categories, the number of studies on the influencing factors of foreign language writing is the largest (11.32%), followed by the influencing factors of reading (9.43%) and the lexical reasoning process (9.43%), while the number of studies on translation rating, English listening process, English listening strategies, influencing factors of speaking, etc. is relatively small.

3.3 *Specific use of think-aloud protocols in EFL education research*

To answer the third research question, the present study analyzes 53 core journal papers from the following aspects: research design, data collection, data analysis, and presentation of results. The detailed analysis is as follows.

3.3.1 *Research design*

When conducting EFL education research by using think-aloud protocols, the first step is to design the research, including putting forward research questions, clarifying the research participants, and determining the theoretical basis. Through the descriptive analysis, it is found that in terms of research questions, 31 papers (58.49%) clearly and appropriately raised research questions, including “what” and “how” questions, which belong to the category of problems that can be solved by using think-aloud protocols. For example, WEN and GUO (1998) raised three questions in their research, namely, “What is the relationship between the amount of L1 involvement in thinking and L2 writing performance?”, “What are the functions of L1 in the process of L2 composition?” and “What are the differences in the use of L1 between those who scored high and those who scored low in composition?”. To answer the above questions, 6 Chinese students in senior Grade 2 and Grade 3 were selected as the research participants, and the students were asked to tell the whole process of reading pictures and writing English compositions by think-aloud. They answered these three questions by analyzing the transcribed data of think-aloud protocols, which showed the appropriateness of the research questions. Among the rest of the journal papers, 13 papers (24.53%) just stated the research purpose but didn’t pose any research question, and 9 (16.98%) did pose research questions but they need to be further improved. For example, ZHOU (2017) proposed only two research questions to explore Chinese students’ use of English reading strategies, but in fact, the study also explored the factors that influence students’ use of reading strategies by conducting an interview. Therefore, an additional research question such as “What are the factors that influence Chinese students’ use of reading strategies?” should be added to the research. In addition, some studies contain two or more sub-questions in one research question. For example, LIN (2006) posed three research questions in her analysis of learners’ thinking activities when the participants processed English idioms, but in fact, her questions included four sub-questions, namely, “How do Chinese EFL learners understand idioms without context?”, “How do Chinese EFL learners understand idioms in context?”, “Does context have a significant effect on the understanding of idioms?”, and “Can the native idiom comprehension model be applied to English idiom comprehension?”. In the process of analysis, Lin analyzed these four aspects respectively, while she incorporated question 2 and question 3 in her second research question. This is not appropriate and the second question she proposed should be divided into two separate questions.

In terms of the selection of research participants, a noticeable feature of the research participants in the EFL education research using think-aloud protocols lies in its primary concern with university and graduate students. As Table 3 shows, the participants of 41 studies (77.36%) were drawn from the population of university or graduate students, and the research that takes teachers as participants only accounts for 7.55%, while little research has focused on non-tertiary level learners, reflecting a marked lack of research on the application of think-aloud protocols in secondary and primary school settings.



Participants	Number	Percentage
University & Graduate Students	41	77.36%
Students in different school level	5	9.43%
Raters	4	7.55%
Senior High School Students	2	3.77%
Junior High School Students	1	1.89%

Table 3 Types of research participants in EFL education research using think-aloud protocols

The theoretical foundation serves as a directional guide for writing papers and provides a basis for analyzing and answering the research questions. Among the 53 key journal papers, 13 (24.53%) explicitly proposed the theoretical foundations, including the comprehensible output hypothesis (GENG et al., 2015), dynamic system theory of second language acquisition (XU, 2012), semantic bootstrapping hypothesis and syntactic bootstrapping hypothesis (XIE & WEI, 2016), cognitive process theory of reading (KONG, 2020), schema theory (GONG & WANG, 2011), cognitive process theory of writing (XIU & XIAO, 2004), and so on. These theories laid a good foundation for their research. For example, KONG (2020) used the cognitive process model proposed by Khalifa and Weir as the theoretical basis for her study and used it as a guide to investigating the similarities and differences in the participants' thinking processes when answering two different types of reading comprehension questions.

3.3.2 Data collection

In the data collection process, the multiplicity of data sources and the description of the data collection process are the two questions that need to be considered. Through the analysis, it was found that 31 journal papers (58.49%) were able to pay attention to the limitations of think-aloud and adopt various ways to collect data to ensure the accuracy of analysis results. For example, ZHAO and SANG (2016) used a questionnaire and think-aloud protocols to explore the differences in the use of listening strategies between high-level and low-level non-English majors. Ju and WANG (2012) conducted a retrospective interview after the think-aloud, to add information that may have been missing from think-aloud and thus have a more comprehensive understanding of students' participation in their mother tongue in the reading process.

From the aspect of the description of the data collection process, it is found that 29 of the papers (54.72%) were able to give a detailed description of the data collection process. For example, QU (2014) introduced the specific steps and the lasting time of think-aloud training and formal tests. Specifically, she mentioned that "at first, each subject received about half an hour of technology and psychological guidance about think-aloud and then conducted the formal think-aloud test. The average time of think-aloud was 18 minutes and 52 seconds." These concrete figures contributed to the transparency and credibility of the paper. However, almost half of the papers didn't describe the process of data collection. Some of them lacked elaboration on the specific steps of think-aloud (ZHAO & SUN, 2009) and didn't indicate the time spent on the whole process of think-aloud (JU & WANG, 2012), and some didn't introduce the specific materials used for think-aloud (JIN, 2012).

3.3.3 Data analysis

Data analysis consists of the description of the data analysis process and the use of triangulation. In terms of

the description of the data analysis process, 36 journal papers (67.92%) clearly described the whole process of data analysis to readers, which enhanced the credibility of the research and made readers clearly understand how each research question is answered. For example, WANG (2011) introduced in detail how to count knowledge sources and reasoning strategies in think-aloud protocols, how to ensure the reliability of coding, and how to calculate students' success value of lexical reasoning when discussing the influence of reading level on the success rate of word guessing and the quantity and quality of the use of reasoning strategies and knowledge sources. Another example is the study by SUN (2019) which introduced the process of data coding in detail and explained the specific methods adopted to increase the credibility of coding. Later, in the part of the presentation of the results, he embedded the analyses of the raw data of think-aloud and then concluded according to these analyses. By contrast, in the remaining journal papers, some (28.30%) omitted the specific steps of data analysis, while others (3.77%) even neglected the whole process of data analysis and just showed their conclusions.

Triangulation strengthens a study by combining methods. It means using several kinds of methods or data, including using both quantitative and qualitative approaches (Patton, 2015: 478). However, the present study finds that although 31 papers used multiple data sources, only 18 papers integrated the data and triangulated the data results. WU and WANG (2006) are good examples of using triangulation. They used think-aloud protocols and retrospective interviews to explore the role of mother tongue in students' reading process. In the process of analysis, they concluded, according to the data of think-aloud that "those with lower English proficiency are more inclined to rely on their mother tongue as a tool to help understanding during the English reading process". Subsequently, they made further explanations with the data of retrospective interviews to make an echo with the data of think-aloud. This process well reflected the use of triangulation.

3.3.4 *Presentation of results*

The presentation of research results is one of the most important parts of a paper. This review mainly analyzes it from three perspectives: the specific description of the research participants, the elaboration of theoretical claims, and the construction of a theoretical framework.

Among the 53 papers, few of them could make a comprehensive and detailed introduction to the learning situation and environment of the research participants. 22 (41.51%) were able to give a relatively detailed introduction to the second language learning situation of the participants. For example, CHEN and ZHANG (2001) gave a detailed introduction to the age, gender, years of learning English, and the teaching materials used in learning English. SUN (2019) specifically introduced the age, gender, major, and English level of the participants, which increased the credibility of the research. But most papers omitted the introduction of participants' backgrounds.

Additionally, in terms of theoretical elaboration, 23 papers (43.40%) used the existing theoretical framework to elaborate and analyze the obtained data, and 9 papers (16.98%) put forward their theoretical framework or improved the original framework. For example, WEN and YIN (2010) used the framework of strategies commonly used by German students in German-English translation proposed by Kiraly to explore the translation strategies used by Chinese students. In addition, XU (2010) built a dynamic operation model of cognitive context in polysemous word meaning recognition when investigating the semantic processing of cognitive context in polysemous word meaning determination.



4. Discussion

This review analyzes 53 core journal papers on the application of think-aloud protocols to EFL education in China in the past 25 years from the aspects of research trends, research areas, research design, data collection, data analysis, and presentation of results.

The research results show that there have been remarkable achievements in using think-aloud protocols in EFL education research in China in the past 25 years, covering various fields such as writing, reading, vocabulary, translation, listening, speaking, etc. This finding resonates with QIAN's (2015) research in which she reviewed the EFL education research using think-aloud protocols abroad and at home from the perspectives of reading, writing, listening, and translation. What's more, the research participants from kindergarten to college students and even teachers were involved, and some scholars explored the aspect of multilingualism, which has some promoting effects on the development of EFL education. Additionally, half of the studies used other methods together with think-aloud protocols, which is a good way to improve the credibility and reliability of the research. According to Hosseinpour and Kazemi (2022), "The intrusive nature of concurrent think-aloud procedure might interfere with normal composing processes and some activities and tasks, at some points of doing the activity or task, might be so spontaneous and automated that they might be inaccessible for concurrent think-aloud". Similarly, Wilson (1994) also questioned the validity and completeness of think-aloud protocols. Therefore, in terms of data resources, it is reasonable and necessary for scholars to use a combination of various research methods to collect different kinds of data to make up for the shortcomings brought by the think-aloud. Nevertheless, given the studies reviewed above, some problems can also be discerned.

Firstly, the amount of research on EFL education using think-aloud is relatively insufficient and the fluctuation is large. The results show that think-aloud has received increasing attention from scholars who study EFL education and has had a rapid increase from 2008 to 2012, the reason for which might be explained by the fact that GUO (2007) published a book called *Think-aloud* in China and introduced systematically for the first time how to apply think-aloud to EFL education. From then on, scholars in China have paid more and more attention to think-aloud protocols. However, after 2018, there was a downward trend. This may be due to the impact of the COVID-19 pandemic. In general, necessary training for the participants is needed to collect think-aloud data (GUO, 2017), which requires interaction and communication between researchers and participants. However, the epidemic situation may be one of the important factors hindering communication, which may lead to difficulty in implementing the think-aloud protocols. What is more, although the research on the application of think-aloud in EFL education involves many fields, the research results are not very rich. Even the studies on English writing which account for the largest proportion contain only 16 articles. Therefore, it is indicated that the EFL education research applying think-aloud still needs to be further enhanced in breadth and depth.

Secondly, the proportion of research content is unbalanced. As for the research fields, it can be found that although the range of research is wide, the proportion of each field is uneven. In recent years, most studies have focused on writing, followed by reading, vocabulary, and translation, while only a small portion of research concerns listening and speaking. This may be explained by the fact that think-aloud is a method in which information is verbalized at the time the participants are attending the task (Ericsson & Simon, 1980). It might be

difficult for participants to think aloud while doing listening and speaking tasks. However, the research finding above is slightly different from QIAN's (2015) conclusion. She found that English reading studies accounted for the largest proportion of all studies that used think-aloud. One of the possible reasons for this result is that the data sets used may be different. Also, the research Qian studied is the literature published before 2015. It is noted that in recent years, more and more scholars in China (CHEN, 2016; WU & XIAO, 2020; MA et al., 2022) have studied EFL writing with think-aloud protocols since 2015.

Thirdly, the selection of research participants is skewed toward college students. Among all the papers selected, most scholars invite college students learning in their schools to participate in their research. However, although the English proficiency of college students enables scholars to collect data relatively easily in research that uses think-aloud protocols, the lack of research using think-aloud protocols in primary and secondary school EFL teaching is detrimental to the development of students' English proficiency in these settings. Similarly, ZHOU and WANG (2022) also mentioned that the English level of students in primary and secondary school determines, to a certain extent, their abilities to use language in an integrated way to solve problems in university. Therefore, it is insufficient to select the research participants based on the ease of data collection. Attention should and must be paid to students' developmental needs and the current problems of Chinese students in foreign language learning so that the problems can be addressed.

Fourthly, the descriptions of the research are not detailed and systematic. As for data collection, almost half of the studies could not describe the data collection process in detail. One of the possible reasons to explain this situation might be the requirements of Chinese journals. Due to the limited word count and layout of Chinese journals, many scholars have to reduce the description of the data collection process to make more space for the presentation and analysis of the data results. Nevertheless, ZHANG and ZHANG (2019) argued that reporting how to provide think-aloud training would enhance the validity of the think-aloud data. Thus, when writing a paper, scholars should describe the whole process of data collection as detailedly as possible, including the implementation process of think-aloud, duration, and materials used for thinking-aloud, to ensure the credibility of the research.

Like the description of the data collection, in the data analysis process, there are still many studies that could not introduce how the data was analyzed. A possible explanation for the omission of the specific steps of data analysis could be the limitation of words in Chinese journals (XU & LI, 2020). However, it is difficult for readers to understand the results without a specific analysis of the data, and it will confuse readers about how the results are obtained through the data. Therefore, it's better to give a relatively specific introduction about how the author analyzes the data he or she collects. What's more, most studies didn't give a detailed description of the triangulation process although more than one research method was used in these studies. Nevertheless, triangulation is one of the useful ways to strengthen studies (Patton, 2015) and to make up for the drawbacks of think-aloud protocols (ZHANG & ZHANG, 2019). This indicates that when using multiple research instruments to collect data, scholars should clarify the specific role of each research instrument and strengthen the learning and use of triangulation.

Moreover, in the result presentation process, most of the studies couldn't give a detailed description of the participants' background information. This could be attributed to the fact that most of the readers of the papers published in Chinese journals are students, teachers, and educational institutions in China, echoing what was



revealed in XU and LI's (2020) study. They believed that since the Chinese researchers are familiar with the educational mechanism of China, the years of English study, and the learning environment of students, it was unnecessary to include a detailed description of students' learning backgrounds.

5. Implications of the Research

Given the deficiencies in the amount of research, research content, research participants, and description of the research in the reviewed papers, we would like to present several suggestions to EFL teachers, curriculum designers, and scholars in EFL education research respectively to encourage more attention and effort to be given to EFL education research using think-aloud protocols.

Firstly, EFL teachers should strengthen their awareness and application of think-aloud protocols. The data collected by using think-aloud protocols are usually regarded as truthful representations of participants' mental activity or processes (Ericsson & Simon, 1980; Ericsson & Simon, 1993). If think-aloud can be widely applied to Chinese foreign language teaching, it may fundamentally improve the learning situation of foreign language learners (GUO, 2007). Therefore, EFL teachers must strengthen their awareness and apply think-aloud to their teaching practice more often to deeply explore the status quo and existing problems during students' learning process, and then help students overcome learning difficulties effectively and improve their learning efficiency. Additionally, teachers in primary and secondary schools should strengthen their cooperation with researchers in universities to break educational barriers. In line with such a call, ZHOU and WANG (2022) also proposed that future scholars should break the pattern of university students' domination and vigorously carry out research at the basic education level. Specifically, primary and secondary school teachers should actively cooperate with university researchers, and effectively combine various research methods to gain a deeper understanding of students' learning, which helps them to change from knowledge-imparting teachers to teacher researchers and promote their professional development in conducting EFL education research.

Secondly, curriculum designers in universities, especially normal universities, should include the learning of think-aloud protocols in research method courses. Like other research methods, think-aloud protocols have strict standards and scope of application. If think-aloud protocols are not used properly in training or formal implementation, it will affect the accuracy of the research results (GUO, 2007; Cowan, 2017). Therefore, course developers should pay attention to the development of research method courses, so that more scholars in the field of EFL education can learn the application scope, training process, implementation process, advantages, and disadvantages of think-aloud and then apply it to their research in the future. Moreover, since the descriptions of data collection and data analysis processes in many studies are insufficient, it is suggested that curriculum designers should provide opportunities for their students to apply think-aloud protocols as a research method in their paper writing practice. During these processes, they can cultivate awareness of using think-aloud protocols and improve their abilities to write papers.

Thirdly, scholars in EFL education research should broaden their research perspectives. Most of the studies on EFL education using think-aloud protocols focus on foreign language writing and reading, while there is a relative lack of research on listening and speaking. As such, more efforts need to be made in foreign language listening and speaking research in which think-aloud protocols are applied. For instance, future researchers can

analyze the process of foreign language listening, the use of listening strategies, and the factors influencing students' foreign language listening and speaking, to enrich the research on EFL education in China. In addition to the basic English skills, researchers can also apply think-aloud protocols to explore learners' various affective factors such as happiness, optimism, empathy, and resilience since these factors also play significant roles in foreign language learning (XU, 2020). What's more, scholars should use triangulation flexibly to ensure that the data analysis is scientific and systematic. Think-aloud has aroused some concerns about veridicality and reactivity (Wilson, 1994; Barkaoui, 2011; YANG and ZHANG, 2015; YANG, 2019) although it is a useful way to explore participants' cognitive processes. To compensate for the drawbacks, leveraging methodological triangulation can be a very useful strategy (ZHANG & ZHANG, 2019). Just as Patton (2015: 479) said "Studies that use only one method are more vulnerable to errors linked to that particular method, unlike studies that use multiple methods, in which different types of data provide cross-data validity checks". Therefore, in subsequent research, scholars are supposed to read more excellent papers and learn how to effectively relate various types of data to derive research results and then answer research questions. In addition, in the paper writing process, researchers should first clarify the purpose of using each type of research instrument, categorize research instruments that address the same research questions, and then discover commonalities or differences from different research data as a way to achieve triangulation.

6. Strengths and Limitations

Think-aloud is a good way to explore the thinking process in one's mind, and data collected using this method is more authentic and objective (GUO, 2007). In this review, we analyze Chinese papers using think-aloud protocols in the field of EFL education by using a systematic framework. Researchers using this analytical framework can have a comprehensive understanding of whether the research questions are appropriate, whether the think-aloud protocols are used properly, and whether the descriptions of the study are sufficient. What's more, in this review, we analyzed all the Chinese core papers using think-aloud protocols in the field of EFL education in CNKI, which enables readers of this review to comprehensively know the achievements and drawbacks of studies using think-aloud protocols in China and then strengthen their awareness and application of think-aloud protocols. Additionally, reviewing Chinese papers using think-aloud protocols in EFL education research also enriches the research in the field of research methods. However, due to the database indexing issues, the present study may not include all of the papers that use think-aloud protocols in EFL education research in China. Another limitation is that the data analyzed in this review is confined to the authors' interpretation, which may impact the results of this review to some extent. More objective and fine-grained inquiries into think-aloud protocols in EFL education research might have greater pedagogical implications for teaching English as a foreign language in practice.

7. Conclusion

This review draws on XU and LI's (2020) framework and retrieves 53 key journal papers that apply think-aloud protocols to EFL education research during the past 25 years. Our review demonstrates that although EFL



education research in China has made remarkable achievements in applying think-aloud protocols, there are still some problems to be solved, including the insufficient number of studies, unbalanced research content, unbalanced research participants, and inadequate description of the research. In a word, there is much room for improvement in both the quantity and quality of research on the application of think-aloud to EFL education in China. Based on the findings above, we have good reasons to believe that more studies using think-aloud protocols in EFL education research, especially in the field of primary and secondary schools in China are necessary and promising. Non-tertiary teachers should strengthen their awareness of think-aloud protocols and enhance their cooperation with scholars at universities. Curriculum designers are recommended to include think-aloud protocols in research method courses in English teacher training programs. Researchers in EFL education are also suggested to broaden their research perspectives and use triangulation properly. It is through these ways that we may better fulfill the goal of producing more influential research achievements in the future.

Although this review provides much insight into the status quo of the EFL education research using think-aloud protocols in China, there are still some limitations, such as the limited number of papers indexed and the subjectivity in interpreting the results. It is suggested that future studies should expand the data source to include more studies in which think-aloud protocols are adopted, and future researchers should apply various research methods to ensure the objectivity of the research results.

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