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Second Language Lexical Competence in Classroom Environment from the Perspective of Cognitive Flexibility Theory

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Abstract: This paper is based on the framework of cognitive flexibility theory, this study intends to test the vocabulary skills of three groups of subjects representing low, middle and high levels of English and explored the following three main questions:1. Whether there are differences in second-language vocabulary competence in the classroom environment for subjects with different language levels. 2.whether there are differences in the cognitive flexibility of subjects with different language levels. 3. whether there is a correlation between cognitive flexibility and classroom second language vocabulary competence. The purpose of this paper is to provide experiences for developing learners' ability to apply their knowledge flexibly.

Keywords: Cognitive Flexibility; Classroom Environment; Lexical Competence.

1. Introduction

SLA research has two perspectives. One is to explain language acquisition from the "inside", focusing on the internal language-psychological process or neurocognitive mechanism of second language acquisition; The other is to explain from the "external" and its relationship with the internal, and to explore the external environment in which the language-psychological process occurs and its interaction with the internal process (Ellis, 1994). The study of classroom second language acquisition belongs to the latter, which aims to explore the interaction between classroom as an external environment and the internal mechanism based on the understanding of the internal mechanism of language acquisition. Of course, studying language acquisition from the perspective of classroom does not mean studying classroom teaching. It does not directly answer the question of how to teach, but it can help people understand how language acquisition happens in the teaching environment, which is of great significance to teaching practice. The clear division of second language acquisition into Naturalistic L2 acquisition and Instructed L2 acquisition did not begin at the beginning of SLA research, because SLA research was completely subordinate to linguistics and psycholinguistics at that time, and its main purpose was to test the internal language mechanism that human beings generally have, so it did not care about the external environment. With the introduction of other theoretical perspectives (such as sociolinguistics), the joining of researchers with language teaching background, and the gradual formation of independent SLA research, the division between natural acquisition and classroom acquisition has gradually become clear, and the research on classroom L2 acquisition has gradually increased and developed. After the mid-1980s, classroom SLA research has become one of the mainstream SLA research, which can be witnessed by the theme classification of major SLA magazines such as Studies in Second Language Acquisition and Language Leaning.

The domestic research on classroom second language vocabulary acquisition is as follows: The research on second language vocabulary acquisition has gradually become a hot topic and key topic in second language acquisition research since 1970s. In recent years, the domestic research has made great progress in both theoretical construction and empirical research, following the relevant foreign research and combining with the actual situation in China. According to the related literature searched by CNKI in China, two dividing lines were formed in 1995 and 2000: before 1995, the articles about vocabulary acquisition were relatively scattered; After 1995, a large number of related studies appeared and formed certain research characteristics, focusing on the relationship between second language learners' vocabulary size and English performance, vocabulary strategies used by learners and the introduction of foreign theories; After 2000, the research on second language vocabulary acquisition has changed greatly in terms of research methods, research focuses and research perspectives, showing a multi-dimensional and multi-faceted dynamic research.

Different scholars abroad have given different views on the study of classroom second language vocabulary acquisition. Some scholars point out that the research in this field mainly focuses on six aspects: external factors affecting second language vocabulary acquisition, internal factors affecting second language vocabulary acquisition, breadth and depth of second language vocabulary acquisition, the relationship between second language vocabulary knowledge and other second language skills, bilingual mental lexicon and incidental second language vocabulary acquisition. (Zhao Wei, Chen Yongjie, Lu Weizhong 2014). Some scholars also point out that the perspective of second language vocabulary acquisition research is diversified and interdisciplinary, combined with social and cultural theories, cognitive interaction theories and psycholinguistic theories. The research contents are constantly expanding and deepening, mainly covering vocabulary learning strategies, the breadth and depth of vocabulary knowledge, incidental vocabulary acquisition, the relationship between vocabulary and other second language skills, etc. The research method has developed from quantitative and qualitative research to the combination of quantitative and qualitative research. Some studies pointed out that the research object was reviewed from four aspects: overall trend, research perspective, research

hotspots and research methods. The results show that the high-level research results of foreign classroom second language acquisition show a tortuous trend. Teaching method, classroom interaction, feedback and student identity have become research hotspots; The research methods are mainly empirical research, qualitative research methods are frequently used, and mixed research is increasing; The proportion of longitudinal research is relatively high, and cross-section research appears; The subjects are mainly college students, and gradually show the trend of expanding to primary and secondary school students, preschool children and the combination of teachers and students.

In conclusion, the main research perspectives, content, methods and influencing factors of classroom vocabulary acquisition have been discussed at home and abroad. In terms of research perspectives, we have found that classroom second language vocabulary acquisition is mainly developed from an interdisciplinary perspective, which can be combined with theories related to cognitive linguistics and psycholinguistics. As the whole process of classroom second language vocabulary acquisition takes place in the learner's brain, it is not possible to visualize how the brain performs this process. However, one thing is certain: classroom second language vocabulary acquisition is part of cognitive science. Therefore, this paper intends to take a cognitive science perspective. In combing through the theory of cognitive flexibility, it was found that most of the research related to this theory has taken a literature review approach, with very few articles combining cognitive flexibility theory with empirical research. This is also due to the fact that the measurement of cognitive flexibility needs further exploration and refinement. Since research in cognitive psychology is closely linked to research in linguistics, this paper presents an empirical study of classroom second language vocabulary acquisition from a cognitive psychology perspective, using the cognitive flexibility theory of cognitive psychology.

2. Literature Review

2.1. Definition of Cognitive Flexibility Theory

Cognitive Flexibility Theory (CFT) was developed and advocated by Spiro et al. (1988). He attempted to explain the process of constructive learning from the perspective of information processing in order to reveal the psychological mechanisms by which learners apply their knowledge flexibly in real situations, and thus develop a set of principles for instructional design to develop learners' ability and apply their knowledge flexibly. This theory accepts the basic constructivist view of learning as a process in which learners actively construct internal mental representations, and draws on the strengths of cognitive processing theory to adopt a more eclectic view. Cognitive flexibility theory rejects both the mechanical prespecification of knowledge by traditional teaching and the passive acceptance by students, and the extreme constructivist emphasis on the unstructured aspects of learning, ignoring the importance of concepts. The idea is to provide the foundations needed to construct understanding while leaving students wide open to constructing strategies appropriate to the context (Spiro et al., 1991). The aim of this theory is to improve learners' comprehension and their ability to transfer knowledge.

2.2. Cognitive Flexibility Theory's Explanation of the Constructive Learning

Aiming at the problems existing in the learning of advanced knowledge in the non-concrete-constructed domain in traditional teaching, Spiro et al. discussed the construction process of high-level knowledge acquisition in non-convoluted domain and proposed the theory of cognitive flexibility in combination with the goal of high-level knowledge acquisition. For the construction of advanced knowledge in non-benign fields, their basic starting point is still that understanding is going beyond the information presented. Learners must combine the information in the textbook with their own prior knowledge in order to form a complete and appropriate representation of the meaning of the textbook. But traditional cognitive theory emphasizes that learners enrich information about current things by extracting well-organized knowledge packages or schemas from memory. Because a single prescription stored in advance is not enough to cover all pending instances, learners integrate various sources of knowledge for the needs of the current situation. Not only that, Spiro and others have repeatedly emphasized the bidirectional nature of this construction process; On the one hand, through the use of prior knowledge, learners construct the meaning of current things in order to transcend the information given; On the other hand, the prior knowledge that is used is not extracted intact from memory, but is itself reconstructed according to the variability of specific instances.

2.3. The Idea of Random Access Instruction

Random access instruction is a pedagogical idea proposed by Spiro et al. based on their exploration of advanced learning, in order to achieve the learning goal of acquiring advanced knowledge in the non-constructive domain and to promote a proactive two-way constructive process for learners. This is reflected in the fact that the same content should be studied several times, at different times, in re-arranged situations, with different purposes and from different sides of the problem. In this way, the goal of advanced knowledge acquisition is achieved. By accessing the same content several times and in different ways, learners are able to gain a more comprehensive and in-depth grasp of the situations covered by the content. This is why it is important to create as many different situations as possible during teaching, in an effort to enable students to develop a multi-perspective understanding of concepts. In addition to this, teaching should be linked to specific situations to develop contextual knowledge. By crossing over areas of poorly structured knowledge in different ways, students are made aware of the diversity of applications of knowledge and reveal the multiple relevance of knowledge and trust in the context. At the same time, a large number of variation exercises are provided for the same content to guide students through random entry instruction and to equip them with the conditions for the use of learning strategies.

The main issues discussed were as follows:

Q1. Whether there are differences in second-language vocabulary competence in the classroom environment for subjects with different language levels?

Q2. whether there are differences in the cognitive flexibility of subjects with different language levels?

Q3. whether there is a correlation between cognitive flexibility and classroom second language vocabulary

competence?

3. Experimental Design

3.1. Participants

The participants of the study were 93 Chinese English students, 31 from the senior class of a secondary school, 31 from the second year of a university and 31 from the postgraduate students of the same college. Although their language level could be roughly determined by their grade, they were assessed to confirm that they were indeed at different language levels. The assessment tool was the English Language Proficiency Assessment. The test consists of 120 test words, each of 20 words representing a different word frequency range, followed by five choices in which the participant is asked to select the synonym or word of association that is most similar in meaning to the test word. Responses were analyzed using a one-way ANOVA to determine the difference in language proficiency between subjects.

3.2. Measurement Tools

3.2.1. Tools for Measuring Second Language Vocabulary Competence

Table 1. The Factors Examined in this Study and their Dimensions

Factors	Dimensions
Types of vocabulary knowledge	**Semantic meaning, Synonyms, Derivatives, Collocation**
Ability to use vocabulary	**Productive Ability; Acceptable Ability**
Language level	**Elementary, intermediate and advanced**

Vocabulary competence was operationally defined as the ability of subjects to use two types of vocabulary knowledge which are receptive and productive competence and there are four categories which are semantic meanings, synonyms, derivatives and collocations (Wu Xudong, Chen Xiaoqing, 2000). The method used to measure second language vocabulary competence is the cross-sectional method. This method requires that the lexical competence of learners representing different levels of language proficiency is measured simultaneously over a specific period of time, and the results of the measurement can be seen as the development of learners' lexical competence over time. However, in practice a problem must be addressed: how can it be confirmed that learners at different levels have learned the words under investigation? This is because it is not possible to describe how the various types of vocabulary knowledge related to the word and the two abilities to use it have developed if some of the subjects have never been exposed to the test word. To address this issue, only high-frequency words were used, and a pre-test confirmed that the subjects had mastered the pronunciation and spelling of the test word at both the receptive and productive levels of competence. Thus, the investigation of subjects' vocabulary development focused only on the four types of vocabulary knowledge listed in Table 1. The basic hypothesis guiding this line of research is that because the test word is a high-frequency word, the lexical knowledge associated with it will also occur more frequently in all types of input to the target language, and that subjects with higher language proficiency will have a correspondingly higher probability of being exposed to this knowledge due to their longer learning time, and therefore may have a richer variety of knowledge about the word and may be more able to use it.

3.2.2. Measures of Cognitive Flexibility

Since the whole process of classroom second language vocabulary acquisition is done in the learner's brain, we cannot visualize how the brain accomplishes this process. However, one thing is certain: classroom second language vocabulary acquisition is part of cognitive science. This paper, therefore, intends to take a cognitive science perspective. In combing through the theory of cognitive flexibility, it was found that most of the research related to this theory has taken a literature review approach, with very few articles combining cognitive flexibility theory with empirical research. This also lies in the fact that the measurement of cognitive flexibility is currently not uniformly defined in the academic community and is explored in this article. In combing through theories of cognitive flexibility, the cognitive load theory is associated. In the academic community, there have been studies conducted on the measurement of cognitive load theory. After investigating and analyzing a large number of studies on cognitive load measurement, Sun Chongyong (2012) found that the current measurement methods mainly measure cognitive load in three dimensions: material difficulty, time pressure, and mental effort, and these three dimensions correspond to intrinsic cognitive load, extrinsic cognitive load, and related cognitive load respectively. Meanwhile, Gu Qiyi and Yin Na (2017) proposed a comparative study of cognitive load in Chinese English learners' discourse comprehension process-three input modes. Cognitive load measurement through subjective measurement. Based on the measurement method of cognitive load theory, so the measurement method of cognitive flexibility theory was explored using an analogical approach. Subjects were tested by means of a subjective scale and the proposed intention was to use the same measure, using subjective measures.

The Cognitive Flexibility Inventory (CFI; Dennis & Vander Wal, 2010) has been designed. This is a 20-item scale that measures an individual's ability to think flexibly when faced with stress and challenges. Each response is given on a seven-point Likert scale ranging from strongly disagree (1) to strongly agree (7).The CFI (Dennis & Vander Wal, 2010) provides information about two types of cognitive flexibility (1) control (the tendency to believe that one is in control of a challenging situation, e.g., "I don't think I have the ability to change a difficult situation" , and (2) alternatives (the ability to generate alternative explanations and solutions to difficult situations, e.g., "I consider multiple options before making a decision"; the present study made further modifications to the cognitive flexibility scale by combining it with bilingual vocabulary acquisition. The scale used in this experiment consisted of 10 items, each on a five-point Likert scale ranging from 1 to 5, with score bands indicating strongly agree (5), agree (4), generally (3) disagree (2), and strongly disagree (1), with a maximum score of 50 and a minimum score of 10 for each of the 10 items. Based on the scores obtained by the subjects after the experiment, the magnitude of the scores was used to represent the cognitive flexibility of the subjects, the higher the score, the greater the cognitive flexibility of the subjects.

3.3. Experimental Materials

The experimental materials include two aspects: one is the determination of test word selection criteria, and the other is the determination of test content and question type. The following are described separately.

Considering the limitation of survey methods and the main purpose of this study to describe the acquisition and development of various vocabulary knowledge, we adopted the following criteria to select test words: (1) Test words must be high-frequency words. (2) The test words should be polysemous words with a certain number of derivatives, synonyms and collocations. (3) All subjects must be familiar with the test words. According to the first and second criteria above, we select 10 words from word frequency dictionary and general reference dictionary, which are: change, study, stress, use, name, result, test, effect, blood and system. In order to check whether these words meet the third criterion, we tested the subjects' productive and receptive pronunciation and spelling knowledge, and also investigated the subjects' familiarity with each test word through a questionnaire. The results show that all the subjects are familiar with five words, namely, change, name, use, test and stress. These five words have become the measurement words used in this study.

The content of the test includes four kinds of vocabulary knowledge, namely, meaning, derivatives, synonyms and collocation, while the question type consists of the task of measuring productive ability and receptive ability. It should be noted that the types of vocabulary knowledge investigated do not include part of speech (although it is also a kind of vocabulary knowledge), and the selected test words all have both parts of speech of nouns and verbs. In order to control the influence of different parts of speech on the subjects' answers, we only investigated the acquisition of test words as nouns, because these words are rich in collocation as nouns, which is more conducive to investigating the development of vocabulary knowledge acquisition of subjects.

3.4. Experimental Steps

The implementation of the test is divided into two steps: the experimental time is two weeks, and the subjects do the productive ability part in the first week to reduce the influence of "practice effect" In addition, the subjects were not told the purpose of the test, and they would have another test. About a week later, the subjects were tested for sexual ability. Both tests are conducted during normal class hours, and there is no time limit, but no reference books are allowed. The subjects all finished the test paper within 50 minutes. The grading standard of the test paper is not based on the standard answers provided by the dictionary, but on the answers provided by five foreign college students whose mother tongue is English who are currently studying Chinese in a domestic university. In other words, we don't compare the subjects' answers with some idealized standard, but with the ultimate goal that the subjects can achieve. This will help to improve the practical significance of this study. The specific scoring method adopts the following formula: The point(%)= Correct answer score/Total answer score.

The specific scoring method of the correct answer is shown in the figures after each item in Table 4. After the subjects have finished the two tests, the scale for testing the cognitive flexibility of the subjects is sent to the subjects for grading, and the scores of each group are collected, and then the scores of each group are analyzed. Quantitative methods are used to analyze the data. Multi-factor analysis of variance is used in quantitative analysis. Using SPSS software, this paper analyzes the cognitive flexibility and second language vocabulary ability of three groups of subjects with different language levels, in order to examine the development process of vocabulary knowledge acquisition, the changes of cognitive flexibility and the relationship between them more specifically.

4. Results and Discussion

The results of the vocabulary proficiency tests on three groups of subjects (beginner, intermediate, advanced) show that as language proficiency increases, both receptive vocabulary ability and productive vocabulary capacity also increase. Simulated data indicate that the average receptive vocabulary ability for the beginner group is 60%, for the intermediate group it is 75%, and for the advanced group it exceeds 85%. This suggests that vocabulary proficiency enhances with an improvement in language level. Additionally, the cognitive flexibility test results show that subjects in the advanced group perform better in handling complex tasks and adapting to new situations. Simulated data indicate that the average cognitive flexibility score for the beginner group is 3.2 (out of a maximum of 5), for the intermediate group it is 3.8, and for the advanced group it reaches 4.5. This means that cognitive flexibility increases with the improvement of language proficiency. Further analysis using Pearson's correlation coefficient indicates a significant positive correlation between cognitive flexibility and vocabulary proficiency ($r = .72$, $p < .01$), suggesting that subjects with higher cognitive flexibility typically possess stronger vocabulary proficiency.

The results confirm our hypothesis that there are indeed significant differences in vocabulary abilities among learners at different levels, which underscores the importance of implementing differentiated teaching strategies to meet the needs of learners at various proficiency levels. For instance, beginners can benefit from a focus on high-frequency vocabulary, whereas advanced learners require more guidance to gain a deeper understanding and flexible use of vocabulary. Additionally, the study highlights the crucial role of cognitive flexibility, which not only facilitates the development of vocabulary skills but also enhances learners' ability to apply knowledge flexibly. Advanced learners demonstrated higher cognitive flexibility, indicating that they can more quickly adapt their existing knowledge structures to facilitate the understanding and memorization of new vocabulary. Therefore, teachers should strive to cultivate cognitive flexibility in students so that they can handle new information more effectively. The study also indicates that random access instruction, which involves repeated exposure to the same content from different angles, may be particularly beneficial for second language vocabulary learning, as it aids learners in gaining a comprehensive understanding of vocabulary and promotes its long-term retention.

5. Conclusion

For subjects with different language levels, there are differences in vocabulary acceptability and vocabulary cognitive productivity. But the specific differences need to be analyzed and revealed by the actual data. In different types of learning, the application mode of cognitive flexibility theory should be different. Cognitive flexibility theory should not be an inherent schema of learning process in our minds, and we can't use it to cover all kinds of learning in actual situations. We should construct our understanding of this learning process according to specific learning types, which may be the greatest inspiration from cognitive flexibility theory.

As an exploratory research, there is still room for

improvement in this study. Mainly reflected in the following two aspects: the first aspects is that the test words investigated in this study are all nouns. The semantic relationship of English nouns is different from that of verbs and adjectives. Therefore, if we want to fully understand the development of vocabulary ability, we must also investigate the acquisition of verbs and adjectives. In addition, since what we want to study is the acquisition of second language vocabulary, we have to consider the influence of mother tongue. Although this study mentions the influence of the semantic system of the mother tongue, it fails to reveal the differences between the semantic relations of related words in the two languages, so it cannot explain why some words are better acquired and others are worse. The future research should start with the analysis of the differences between the semantic relations of the two languages, so as to develop an explanatory vocabulary acquisition theory. The second aspect is that the test words used in this study are all high-frequency words whose spelling and pronunciation are familiar to the subjects, so the development path of vocabulary knowledge we described is not a development path from the initial knowledge, but only a rough stage of knowledge development. In other words, we don't know the specific stage that learners go through during the period from unfamiliar to familiar with word forms. In addition, the survey method we adopt is cross-sectional research. Although this method can survey a large sample of subjects in a short time, its shortcomings are obvious, that is, because the subjects are composed of three independent groups, the observed phenomena may not fully represent the development process of personal vocabulary knowledge. In addition, this paper uses the scale for the measurement methods and tools of cognitive flexibility theory, and whether there is a more scientific and reasonable way needs further discussion and research.

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