

International Journal of Learning, Teaching and Educational Research
Vol. 22, No. 8, pp. 358-375, August 2023
<https://doi.org/10.26803/ijlter.22.8.19>
Received Jun 28, 2023; Revised Aug 22, 2023; Accepted Aug 24, 2023

Status of Memory Strategies Use among Medical English Students

Hongmei Cui^{1,2} 

¹Universiti Teknologi MARA, Shah Alam, Malaysia

² Ningxia Medical University, China

Naginder Kaur 

Universiti Teknologi MARA, Perlis Branch, Malaysia

Abstract. High exchange of medical information worldwide requires students to improve their medical English language skills to compete globally. However, it is known that language skills cannot be used effectively without sufficient vocabulary knowledge. In medical English vocabulary learning, students often feel overwhelmed and lack motivation in learning this type of lexis. Research shows that the difficulty of medical English lies in vocabulary learning although the use of strategies can significantly improve the level of vocabulary memorization. In view of this, this study aimed to investigate medical English students' use of memory strategies in vocabulary learning, using a questionnaire survey. A total of 500 medical undergraduates from Ningxia Medical University in China were selected as participants. The findings show that Chinese medical students apply memory strategies at an average level. The most frequently used memory strategy by Chinese medical English students is the repetition strategy, while the least frequently used is keyword strategy. Significant differences were found between male and female students' use of spelling, chunking, repetition and use of word lists and association strategies. There are also significant differences in comprehensive use of strategies among students of different language proficiency levels. Thus, it is suggested that teachers invest more time in teaching memory strategies and students practice medical English vocabulary more frequently in a natural environment to improve their vocabulary levels and English proficiency.

Keywords: medical English; vocabulary; learning; memory strategies; Chinese students

1. Introduction

Globalization has pervaded every field of human endeavor, and in the backdrop of the internationalization of the economy and information, there is an increasing exchange of medical information between countries. The position and role of

medical English education have become more prominent with the increase in exchange of information and cooperation in the medical industry. Medical students must, therefore, constantly understand the achievements of cutting-edge medical technology, expand their international vision and professional expertise, and improve their professional and technical skills to be able to keep abreast of the developments in the medical field. This prerequisite is to improve their medical English level, so they can be familiar with language communication skills and better adapt themselves to the development of the international medical industry in the future. In achieving this end, mastery of medical English vocabulary is the essential basis for effective medical English learning.

Medical English is a professional course for medical students, aiming to cultivate their ability to use English to acquire advanced knowledge and technology, in addition to conducting international academic exchanges (Belcher, 2009; Wang, 2016). The overwhelming amount of medical terminology not only increases the difficulty in learning medical English but also directly affects the learning of medical professional courses (Li et al., 2022), becoming the main factor restricting medical students' access to international medical information and exchanges (Wei, 2019).

In practice, medical English vocabulary is, thus, vital for medical students. As we know, vocabulary is the foundation of sentences and articles (Cui, 2018). In view of this fact, medical English vocabulary is the foundation of medical English learning, as lexical knowledge provides a solid language proficiency foundation for native and non-native English speakers (Kaur, 2020). According to statistics, the size of the medical English lexicon has reached more than 300 000 words (Zhao, 2019). About two-thirds of medical nouns and terms are derived from ancient Greek and Latin, and the vocabulary depends mainly on word structure, such as the combination of roots and affixes. In addition, with the continuous emergence of new human diseases, the development of medical disciplines has become more advanced, and many compounds or new medical terms are constantly appearing (Zhao, 2019).

Therefore, medical workers need to demonstrate specific and comprehensive English language ability, which is inextricably linked to mastering relevant medical vocabulary. For students in medical schools, medical English vocabulary is the basis for cultivating medical professional English ability, and is, thus, an essential part of the entire vocabulary learning system. Furthermore, only by learning medical English vocabulary can there be access to follow-up courses such as medical English literature reading, audio-visual, translation and thesis writing.

As highlighted earlier, medical English vocabulary is said to be extensive, vast and complicated (Zhang, 2020; Zhao, 2019), and is one of the challenging aspects of medical English instruction (Ismayilli-Karakoç, 2020) although using memory strategies can significantly improve students' English proficiency (Wang & Yu, 2018). However, it is disappointing that students have not mastered effective learning strategies (Pu, 2020). Thus, this study aims to investigate the status of memory strategies use among Chinese medical English students. The following research questions guided the enquiry:

1. What are the overall memory strategies used by Chinese medical English students in vocabulary learning?
2. What are the most frequently used memory strategies among Chinese medical English students used in vocabulary learning?
3. What factors influence Chinese medical English students' in using memory strategies?
4. Is there a significant difference in the use of memory strategies among different language proficiency students?

2. Literature Review

Medical jargon in English is complicated to learn by English as a Foreign Language (EFL) students. Words are the fundamental components of a language (Brown, 2001) which second language (L2) students need to master in order to cope with academic tasks (Kaur, 2020). Due to the challenging and time-consuming nature of acquiring medical English vocabulary, which is even perceived as intimidating by many students (Kaur, 2013), the teaching and learning processes face obstacles (Wen et al., 2021). Research indicates that the issues encountered by medical students include the lack of intentional English vocabulary learning and limited progress in gaining specialized medical English vocabulary (Reynolds et al., 2021). Therefore, it is essential to use some specific methods and approaches to enhance English lexis learning.

However, research has found that despite spending much time and energy on language learning, students have not benefited to any great extent. The core reason is that students do not apply effective language learning strategies (Chen, 2020). Therefore, in-depth understanding, analysis and application of different memory strategies should help students achieve more better learning outcomes. The relevant research on memory strategies in vocabulary is relatively rich and comprehensive. Nation (2003) believes that memory strategies are an essential branch of vocabulary learning strategies, which means students need to adopt certain memory strategies, follow specific memorization rules, store, memorize, process and retrieve learned words.

Memory strategies play an important role in assisting students to commit new words to memorization (Al-Qaysi & Shabdin, 2016). As such, the theories related to vocabulary memorization must be addressed. For instance, Craik and Lockhart (1972) introduced the need for in-depth processing of hypotheses, suggesting that the extent to which we mentally engage with information directly affects how well we remember it in the long term. In other words, the more deeply we think about and process the information, the better our chances of remembering and recalling it later on. This hypothesis holds that deep-level meaningful information processing can promote longer memorization than shallow-level sensory processing.

The depth of processing and the experts' classifications (Lv, 2001) provide a theoretical basis for classifying and comparing memory strategies. According to

these theoretical postulations, memory strategies in vocabulary learning can be classified into two macro categories: shallow encoding memory strategies and deep encoding memory strategies (Hong, 2007; Jiang, 2020). Strategies focusing on the features of word form and sound are classified as shallow encoding memory strategies, such as spelling strategy, keyword strategy, chunking strategy, repetition strategy and use of word lists strategy. Strategies focusing on semantic features are deep encoding memory strategies, which include use of word-structure strategy, contextual strategy, activation strategy, association strategy and metacognitive regulation strategy. In this study, both shallow encoding and deep encoding memory strategies are explored.

Many studies have shown that using memory strategies benefits vocabulary learning, which can significantly improve students' English language proficiency (Pu, 2020; Wang & Yu, 2018). It is found that using effective memory strategies significantly improves the extent of students' vocabulary memorization (Zhang, 2016). Medical English students can efficiently master professional vocabulary and accurately understand medical English literature materials by using memory strategies (Yang et al., 2013). For example, a study on low proficiency level students of EFL at a public school in Colombia (Perez & Alvira, 2017) shows that card memorization method, picture association idea and topic association idea effectively help students in improving vocabulary memorization. The experimental data also show that the root-affixes learning method leads to better short-term memorization in medical English vocabulary learning (Lei & Wu, 2019). Chunking strategy is also a professional learning method, most frequently used by nursing students (Tian & Jiang, 2020).

Substantial number of studies have shown that memory strategies can help students to master English vocabulary effectively and reduce the pressure and burden of vocabulary learning. This study thus further aims to demonstrate this by understanding how students use memory strategies.

3. Method

3.1 Research design used

In this study, a quantitative descriptive survey design was used. A survey design provides a quantitative description of trends, attitudes and opinions of a population, or tests for associations among variables of a population, by studying a sample of that population. It helps researchers answer descriptive questions, which are frequently used in social science research and especially in survey studies (Creswell & Creswell, 2018). The research questions in the current study are based on a survey.

Subsequently, a questionnaire survey was applied to investigate medical English students' use of memory strategies in vocabulary learning, the most frequently used memory strategies, the influences of individual factors on use of strategies and the differences between different language proficiency students.

3.2 The participants

A total of 500 second-year medical undergraduates at Ningxia Medical University, China, were conveniently selected as the participants for the questionnaire survey.

Table 1: Participant information

Category	Items	N
Gender	Male	200
	Female	300
Age	18 years or below	21
	19 - 20 years	286
	21 - 22 years	178
	23 years or above	13
	Not provided	2
Region	Rural	295
	Urban	205
Language proficiency level	High language proficiency	46
	Average language proficiency	225
	Low language proficiency	229

There were more female students (60%) than male students (40%), which is understandable as there are more female students enrolled at Ningxia Medical University. The majority of the students were 19 to 20 years old (57%). There were more rural students (59%) than urban students (41%). The ratio between average language proficiency students (45%) and low language proficiency students (46%) was similar, while high language proficiency students were small in number (9%).

3.3 Instrument

This study employed a 30-item survey questionnaire (see Appendix 1) adapted based on Gu's (2018) and Gu and Johnson's (1996) vocabulary learning questionnaire to collect the data. A total of 21 questionnaire items were directly extracted from the original questionnaire of Gu (2018) and Gu and Johnson (1996), while nine items were adapted from Chinese scholars' questionnaires (Hong, 2007; Jiang, 2020; Sun, 2019). These 30 items were identified into two categories: 1) shallow encoding memory strategies, and 2) deep encoding memory strategies, in which 10 sub-strategies were included: spelling strategy, keyword strategy, chunking strategy, repetition strategy, use of word lists strategy, use of word-structure strategy, contextual strategy, activation strategy, association strategy and metacognitive regulation strategy.

The questionnaire was composed of two parts. The first part briefly introduced the questionnaire and asked for participants' demographic information. The second part elicited responses on each sub-memory strategy corresponding to the 30 questions. The questionnaire applied a Likert scale, and the students were asked to rate each item as never (1), seldom (2), sometimes (3), usually (4), and always (5). A pilot study for the reliability and validity of the questionnaire was conducted with 30 students (excluding the participants in this study). Cronbach's alpha (α) was used to test the reliability of the questionnaire. The value was 0.94, which indicated that the questionnaire was reliable. Factor analysis was used to measure the validity of the questionnaire. KMO and Bartlett's Test for homogeneity of variances yielded value of 0.93, showing high validity of the

questionnaire. The questionnaire was translated into Chinese to ensure the students fully understood the items.

3.4 Data collection and analysis

The survey was conducted in August 2022. WJX (Wenjuanxing), a professional online questionnaire survey, examination, assessment and voting platform, was used to issue the questionnaire items and collect the data. The students answered the questionnaire once it was issued, and the researcher stopped collecting valid questionnaires when the numbers reached 500.

The Statistical Package for Social Science (SPSS) 26.0 was used to analyze and process all collected data. Descriptive statistics was used to analyze the participants' memory strategies. The average value, maximum value, minimum value, frequency, standard deviation and p values from independent sample t-tests and one-way variance tests were calculated.

4. Findings and Discussion

The results obtained from this study indicate the overall status of Chinese medical English students' use of memory strategies, which encourages the conscious use of strategies in vocabulary learning.

4.1 Chinese medical English students' overall use of memory strategies in vocabulary learning

The mean score of Chinese medical English students' overall use of memory strategies was 2.84 (SD=.60). According to the scoring system by Oxford (1990), scores between 1.0 and 2.4 on the five-point Likert scale indicate as a low strategy use. Mean scores ranging between 2.5 and 3.4 indicate a medium strategy use, while scores between 3.5 and 5.0 are regarded as high strategy use. Therefore, based on Oxford's (1990) scoring system, Chinese medical English students use memory strategies at a medium (average) level.

Table 2: Mean score of overall use of memory strategies

N	Minimum	Maximum	Mean	Std. Deviation (SD)
500	1.00	5.00	2.84	.60

As is known, effective learning strategies can improve learning efficiency to a great extent, and develop students' autonomous learning ability, ultimately improving their comprehensive language efficacy (Kaur, 2020). This result is similar to previous empirical studies on memory strategy use among students, reported by Pu (2020) and Jiang (2020). Pu (2020) conducted a questionnaire survey on 720 first-year university students in China and found that, although university students had the idea of using memory strategies, their overall frequency was not high. Jiang (2020) also found that students' overall strategies use at Beihai in China was at a medium level. A similar result was found by Al-Qaysi and Shabdin's (2016) study on vocabulary memorization strategies among Arab postgraduate English foreign language students, which found Arab students to be medium strategy users.

Descriptive statistics were conducted respectively on the commonly used memory strategies to obtain insights into the students' use of each specific memory strategy. The mean value and frequency use of each memory strategy were analyzed.

Table 3: Mean value and frequency use of each memory strategy

Strategy	N	Minimum	Maximum	Mean	SD	Category
Spelling strategy	500	1.00	5.00	2.92	.86	Medium
Keyword strategy	500	1.00	5.00	2.39	.84	Low
Chunking strategy	500	1.00	5.00	2.88	.76	Medium
Repetition strategy	500	1.00	5.00	3.23	.84	Medium
Use of word lists strategy	500	1.00	5.00	2.86	.82	Medium
Use of word-structure strategy	500	1.00	5.00	2.94	.82	Medium
Contextual strategy	500	1.00	5.00	2.77	.84	Medium
Activation strategy	500	1.00	5.00	2.71	.79	Medium
Association strategy	500	1.00	5.00	2.82	.81	Medium
Metacognitive regulation strategy	500	1.00	5.00	2.83	.76	Medium

The frequency of use reveals that Chinese medical English students are, on the whole, not good at using strategies in vocabulary learning. None of the strategies can be classified as highly used in this study. Similarly, Deng (2020) investigated 275 non-English majors from three universities in Guangxi, China, to find out their strategies for vocabulary learning. The results revealed that the average value of each learning strategy was between 2.5 and 3.4, indicating that Chinese non-English majors generally used strategies at medium frequency. A similar result was found by Ma (2019), who conducted a questionnaire survey and interviews with 410 non-English major fresh undergraduates, finding that students were not good at grasping memory strategies in English vocabulary learning; thus, frequency of strategies use was average. Zhou (2022) also found that non-English major college students used most learning strategies at a very low frequency in English vocabulary learning.

Other studies indicate that Chinese students are not proficient strategies users for learning English vocabulary. For example, Chinese rural students were found to apply relatively few memory strategies; their memory methods were singular, and the memorization effect was not good (Jiang, 2020). The findings of this study are aligned with findings by Dai (2019) pointing out that, in general, Chinese rural junior high school students use strategies less frequently, especially for deep processing strategies, and also lack a certain understanding of memory strategies. Consequently, most Chinese senior high school students could not find the correct method to memorize English words, which caused them to lose interest in learning English (Li, 2019).

4.2 The most frequently used memory strategies by Chinese medical English students

The most frequently used memory strategies by Chinese medical English students were repetition strategy, use of word-structure strategy, spelling strategy, chunking strategy and use of word lists strategy. The use frequency of these strategies was higher than the average value (Mean=2.84).

Table 4: The most frequently used memory strategies

Strategy	Rank	Mean	SD
Repetition strategy	1	3.23	.84
Use of word-structure strategy	2	2.94	.82
Spelling strategy	3	2.92	.86
Chunking strategy	4	2.88	.76
Use of word lists strategy	5	2.86	.82

In this study, repetition strategy ranks highly in the first place and is students' first choice. It is consistent with Li's (2019) findings that Chinese students tend to use repetition strategies as a memory strategy because they lack knowledge of other scientific methods of memorizing vocabulary. Li (2020) also conducted a questionnaire survey to understand use of memory strategies in learning English vocabulary among 83 second-year English major students in China and found that most students still relied on repetition methods to learn English vocabulary. The main reasons for students frequently using repetition strategy are that it is easy to operate and enables students in learning a large number of vocabulary items in a short time (Yang, 2021). Furthermore, medical students face a lot of learning pressure, such as coping with complex medical courses, preparing for mid-term or final exams, and taking part in medical English vocabulary competitions (Jin, 2021), so they have little time and energy to think if there are other alternative methods to remember words. They thus resort to the more straightforward method of repetition.

The word-structure strategy is the second most favored strategy. In English language, the vocabulary is large and extensive (Cui, 2021; Liu, 2018), but most words have their own word-structure rules. By understanding the use of word-structure, students can reduce the burden of memorization when learning words (Li, 2019). In medical English vocabulary, the lexis comprises prefixes, roots and suffixes. After mastering the roots, affixes and finding out the internal rules of word-structure, students can grasp the characteristics of medical vocabulary more effectively, which may be why students prefer to use word-structure strategy. Thus, grasping word-structure rules is a prerequisite for using word-structure strategy.

Spelling strategy is also a frequently used strategy that can enable English students to establish a strong connection between the sound, shape and meaning of words, enhancing vocabulary memorization. It has previously been found to be a shared memory strategy that Chinese English language students use in vocabulary learning (Lv, 2001). As medical English students have to recall many letters and word combinations after a period of phonetic learning, they can achieve good memorization by using these combinations. Thus, spelling strategy is frequently used in vocabulary learning. In addition, spelling strategy in medical English vocabulary learning is basically the same as in learning ordinary English words; hence, students can avoid mistakes and effectively learn words by mastering the correct pronunciation and spelling rules (Jin et al., 2020).

Furthermore, lexical chunks integrate semantic, syntactic and pragmatic relationships, which can significantly facilitate the acquisition of deep lexical

knowledge (Tian & Jiang, 2020). In vocabulary and language learning, Nattinger and Decarrico (1992) believe that language fluency is dependent on the number of lexical chunks stored. Students can integrate their existing knowledge to chunk vocabulary so that it can be encoded quickly and efficiently. Thus, chunking strategy is found to promote students' memorization and improve their interest in vocabulary learning (Wen, 2018). Furthermore, it positively impacts students' vocabulary learning experience, awareness and interest (Yang, 2020).

Moreover, the use of word lists strategy is also found to be popular with medical English students. This strategy relies on existing or self-developed word lists (such as small word books and word cards) to remember new words. Nation (1982) studied the use of word lists and concluded that it was an effective method for accumulating a large amount of vocabulary in a short time. This method is also a mechanical memory method, which is relatively simple and easy to apply. However, although this strategy is relatively time-saving, it has shortcomings, such as low efficiency. Thus, Li (2019) suggested that teachers give appropriate guidance to students to help improve memorization.

In contrast, keyword, activation, contextual, association and metacognitive regulation strategies were less frequently used, with average use frequency lower than the overall strategies use (Mean=2.84). Keyword strategy was the least used, indicating students least preferred this strategy.

4.3 The influence of Chinese medical English students' individual factors on memory strategies use

Individual factors such as age, gender, and region on the use of memory strategies were analyzed to investigate the influence of individual differences on memory strategies use in vocabulary learning.

Table 5: The influence of individual factors on memory strategies

Strategy	Gender		Age		Region	
	F	Sig.	F	Sig.	F	Sig.
Spelling strategy	3.76	.03	2.48	.06		
Keyword strategy	.04	.22	1.47	.22		
Chunking strategy	10.31	.02	1.96	.11		
Repetition strategy	.04	.00	1.20	.30		
Use of word lists strategy	3.24	.00	2.33	.07	.79	.74
Use of word-structure strategy	3.24	.22	.08	.97		
Contextual strategy	1.95	.06	1.96	.11		
Activation strategy	1.19	.97	.20	.89		
Association strategy	.48	.00	.65	.57		
Metacognitive regulation strategy	.58	.22	.66	.57		

Gender is an important aspect of individual factors of students (Lu, 2020). In this regard, however, this study did not yield any significant difference in male and female students' use of keyword strategy ($p=.22>.05$), use of word-structure strategy ($p=.22>.05$), contextual strategy ($p=.06>.05$), activation strategy ($p=.97>.05$), and metacognitive regulation strategy ($p=.22>.05$). Conversely, significant differences were recorded on their use of spelling strategy ($p=.03<.05$),

chunking strategy ($p=.02<.05$), repetition strategy ($p=.00<.05$), use of word lists strategy ($p=.00<.05$), and association strategy ($p=.00<.05$), indicating that medical English students of different genders have significant differences in the use of these memory strategies. This result is similar to Liang's (2018) investigation on Chinese senior high school students; that is, the use of repetition strategy, association strategy and use of word lists strategy have a remarkable effect on female students' English vocabulary learning, while no significant effect is found on their male peers. On the other hand, Ahsanah (2020) surveyed 66 junior high school students and 52 senior high school students in Paciran, East Java and found no significant gender difference in their choice of language learning strategies.

Age is another aspect of individual factors, so the impact of age on the choice and use of memory strategies was analyzed. No significant difference was seen in students' overall use of strategies among different age groups, which suggests age has little effect on use of memory strategies, and medical English students of all ages apply memory strategies with similar frequency. However, Ahsanah (2020) found that in learning EFL, there was a statistically significant difference in language learning strategies used by younger and older students, as younger students tended to use strategies more frequently than older students. Similarly, Wang and Xu (2007) found that age had a pronounced influence on the use of language learning strategies; when students' cognitive abilities increased with age, their cognitive styles also changed in tandem, directly affecting their use of learning strategies. The older the students, the more frequently they would use strategies, which was inconsistent with the lowest frequency of strategy use among students aged 23 or above in this study.

Region is another determinant or aspect of individual differences among students (Lu, 2020). In this study, the participants were from 25 provincial-level administrative regions, accounting for 73.5% of the regions in China. The detailed data for each region was omitted. Different regions have different English teaching qualities, so students' English proficiency is affected differently (Yan, 2021). The quality of English education received varies regionally, thereby affecting students' strategy use. However, in this study, no significant difference ($p=.74>.05$) was found among medical English students from different regions in the overall use of memory strategies, indicating that regions have no noticeable effect on their use of strategies. In comparison, Xiao et al. (2017) surveyed 43 kindergartens in Chongqing, Shandong and Sichuan in China through questionnaire survey and interviews, and found that there were differences in the effectiveness of English education for children in different regions, which affected the sustainable and effective development of children's English education. Ellis (1999) also applied the second language acquisition method and concluded that different learning environmental factors could affect students' strategy choices.

4.4 Memory strategies use by medical English students of different English proficiency

The purpose of using memory strategies is to improve the learning experience and find out if there are differences in the use of memory strategies among medical English students of high, average and low English proficiency in vocabulary learning. The results are shown in Table 6.

Table 6: The use of memory strategies among medical English students of different English proficiency

Strategy	Mean of low language proficiency students	Mean of average language proficiency students	Mean of high language proficiency students	F	Sig.
Spelling strategy	2.73	3.02	3.39	14.33	.00
Keyword strategy	2.31	2.42	2.63	3.05	.04
Chunking strategy	2.74	2.99	3.05	7.18	.00
Repetition strategy	3.07	3.32	3.60	10.59	.00
Use of word lists strategy	2.69	2.96	3.18	10.53	.00
Use of word-structure strategy	2.80	3.07	2.97	6.33	.00
Contextual strategy	2.67	2.81	2.99	3.28	.03
Activation strategy	2.59	2.76	3.07	8.06	.00
Association strategy	2.67	2.92	3.08	8.37	.00
Metacognitive regulation strategy	2.73	2.90	2.97	3.65	.02

From the analysis, it was found that low language proficiency students' mean value of each memory strategy use was the lowest compared to that of average and high language proficiency students. It suggests that the frequency of memory strategies is positively correlated with improved language proficiency. Similarly, Xu (2013) found that language proficiency significantly influenced the use of learning strategies, so students with lower language proficiency are more inclined to use learning strategies such as repetition and recitation owing to low self-confidence. This fact is indicated by the data presented in Table 6 – there is a significant difference in the type of strategy use for different English language proficiency students (p-value of each memory strategy is smaller than .05).

Moreover, to further investigate whether there is difference between students of different English proficiency, multiple comparisons were conducted. Table 7 shows multiple comparisons of medical students of different language proficiency.

Table 7: Multiple comparison of medical students of different English proficiency

(I) English proficiency	(J) English proficiency	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Average language proficiency students	High language proficiency students	-.17	.09	.19	-.40	.06
	Low language proficiency students	.21*	.05	.00	.08	.35
High language proficiency students	Low language proficiency students	.39*	.09	.00	.15	.62

*mean difference is significant at .05 level.

From Table 7, significant differences were recorded in memory strategies use between high and low language proficiency students ($p=.00<.05$), and among average and low language proficiency students ($p=.00<.05$). Nevertheless, no significant difference existed in memory strategies use between high and average language proficiency students ($p=.19>.05$). As such, it is apparent that low language proficiency students seem to use memory strategies the least frequently.

The results also show that improving language proficiency makes English language students' vocabulary learning strategies more flexible and diverse. Psycholinguistics posits that language and thinking are unified, and language is not only a tool for human speech thinking but also plays a guiding and regulating role in organizing people's actions and forming intellectual activities (Gui, 2011). With the improvement in language proficiency, the scope of students' exposure to second language vocabulary gradually expands, the content becomes more and more complex, they begin to use more strategies, and the cognitive processing gradually deepens. Different language proficiency levels are the primary reasons for the differences in vocabulary acquisition methods (Yang, 2018). Oxford and Nyikos (1989) also believe that if students' language learning ability is improved, they will become more confident and motivated to learn a language and apply more learning strategies, which will consequently promote their language ability.

5. Conclusions and Implications

The study aimed to investigate Chinese medical students' use of memory strategies. Although the use of strategies is self-evident in EFL vocabulary learning, the results found in this study are not satisfactory. Chinese medical English students are generally not proficient in using memory strategies; their overall memory strategies use is at a medium/average level. All 10 sub-memory strategies are used at medium frequency, except for keyword strategy, which is the least frequently used. Despite not being good at using strategies, students are inclined to use some strategies: repetition strategy is the most frequently used, followed by use of word-structure, spelling, chunking and use of word lists strategy.

In addition, individual factors also affect students' strategies use. Significant differences were noted between female and male students' use of spelling, chunking, repetition, use of word lists and association strategies. Female students applied memory strategies more frequently than their male peers. Nevertheless, no statistically significant differences existed in students' overall use of the 10 strategies among different age groups and urban and rural students. However, regarding language proficiency, significant differences were recorded among students of different English language proficiency on each strategy use, especially between high and low language proficiency students and average and low language proficiency students. No statistical difference was found between high and average language proficiency students in memory strategy use.

The study provides implications for future medical vocabulary teaching and learning. Teachers apply a learning approach which involves actively engaging students with course materials through discussions, problem-solving, case studies

and role-playing (Uden et al., 2022) to stimulate students' learning interest, and students use strategies in lexical learning to improve medical vocabulary learning.

6. Recommendations

Findings of this study show that the overall status of medical English students' use of memory strategies in the process of vocabulary learning is not ideal, and their ability to use memory strategies needs to be improved. Thus, the following recommendations are put forward.

- 1) Cultivating students' awareness of using memory strategies is essential. Medical English is one of the necessary prerequisites for medical students to communicate internationally. Medical English students can acquire words effectively using various memory strategies in vocabulary learning. However, in practical learning, students mainly rely on reading aloud or repeated writing and reading, which are boring and lead to poor learning outcomes. Therefore, improving students' awareness of using strategies is vital. Teachers ought to introduce interesting strategies, such as creating keywords or instructing students to learn lexis in context to enhance their knowledge of strategies they can use and encourage them to use these more frequently and efficiently.
- 2) Increasing memory strategies training in vocabulary teaching is essential and timely. The survey results show that limited knowledge of memory strategies is one of the causal factors for low frequency use of strategies. Based on these results, teachers should train students to use strategies effectively. The training methods should be based on the actual use, regardless of whether the training is carried out as centralized training or individual tutoring. In addition, students should understand the use of strategies properly to realize the impact of strategy on medical English vocabulary learning.
- 3) Focusing on students' differences in strategy use is necessary. This study has demonstrated that different students have different tendencies in using strategies. For example, some students like spelling strategy, while others prefer the word-lists strategy; it depends on students' individual preference. Teachers can give students more personalized advice by paying attention to their differences in use of memory strategies. They also need to understand the characteristics of medical English vocabulary, guiding students to apply strategies according to their learning characteristics. By combining students' cognitive levels and learning characteristics, teachers can teach students the various strategies, guiding them in a planned, purposeful and step-by-step (systematic) manner to develop effective memory strategies suitable for individuals. Furthermore, teachers can introduce a few threshold concepts, which are fundamental to the thinking and practice within a discipline (Beitelmal et al., 2022) to help students better understand medical English vocabulary and improve learning.
- 4) Creating as many scenarios as possible and organizing actual language practice activities are beneficial. The richer the language environment is, the more information (input) can be provided and the learning of the target vocabulary can be stimulated. Hence, language environment and materials of

the classroom are contingent on students' cognitive level. The language materials should be displayed to the students in various ways. Meanwhile, the language environment of extra-curricular is also crucial, so creating an extra-curricular vocabulary learning environment is necessary. For example, participating in international medical conferences allows students to practise knowledge learned in a classroom. It supplements knowledge outside the classroom, creating conditions for practising and using vocabulary. More importantly, students can enhance their confidence in learning English vocabulary by practising strategies, further improving the outcomes of English vocabulary learning.

7. References

- Ahsanah, F. (2020). Gender and age differences in the use of language learning strategies by junior and senior high school students. *Journal of English Teaching*, 6(1), 50-59. <https://doi.org/10.33541/jet.v6i1.1405>
- Al-Qaysi, F. H., & Shabdin, A. A. (2016). Vocabulary memorization strategies among Arab postgraduate English foreign language students. *Advances in Language and Literary Studies*, 7 (5), 184-196. <http://doi.org/10.7575/aiac.all.v.7n.5p.184>
- Beitelmal, W. H., Littlejohn, R., Okonkwo, P. C., Hassan, I. U., Barhoumi, E. M., Khozaei, F., Hassan, A. M., & Alkaaf, K. A. (2022). Threshold concepts theory in higher education - Introductory statistics courses as an example. *Education Science*, 12(11), 748. <https://doi.org/10.3390/educsci12110748>
- Belcher, D. (2009). *What ESP is and can be: An introduction. ESP in theory and practice.* <http://www.press.umich.edu/tilleDelaiIDcsc.do?id=770237>
- Brown, H. D. (2001). *Teaching by principles: An interactive approach to language pedagogy (2nd ed.)*. Pearson Education Company.
- Chen, Y. (2020). *The application and research on association strategy in English vocabulary teaching* [Master Dissertation, Qufu Normal University]. Qufu Normal University Research Repository.
- Craik, F. I. M. & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, 11(6), 671-684. [https://doi.org/10.1016/S0022-5371\(72\)80001-X](https://doi.org/10.1016/S0022-5371(72)80001-X)
- Creswell, J. W., & Creswell, D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches (5th Ed.)*. SAGE Publications, Inc.
- Cui, H. (2021). *Study on English vocabulary memory strategies*. China Agriculture Press.
- Cui, N. (2018). Yixue yingyu cihui jiaoxue celve tan xi [Exploring on teaching strategies of medical English vocabulary]. *English on Campus*, 42, 17. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2018&filename=xyyy201842013&dbcode=cjfq>
- Dai, X. (2019). *Empirical research on English vocabulary memory strategy of rural junior high school students* [Master Dissertation, Chongqing Normal University]. Chongqing Normal University Research Repository.
- Deng, W. L. (2020). *A survey on non-English majors' application of English vocabulary learning strategies* [Master Dissertation, Guangxi Normal University]. Guangxi Normal University Research Repository.
- Ellis, R. (1999). *The study of second language acquisition*. Oxford University Press.
- Gu, Y. (2018). Validation of online questionnaire of vocabulary learning strategies for ESL students. *Studies in Second Language Learning and Teaching*, 2, 325-350. <https://doi.org/10.14746/ssllt.2018.8.2.7>
- Gu, Y., & Johnson, R. K. (1996). Vocabulary learning strategies and language learning outcomes. *Language Learning*, 4, 643-679. <https://doi.org/10.1111/j.1467-1770.1996.tb01355.x>

- Gui, S. (2011). *What is psychological linguistics*. Shanghai Foreign Language Education Press.
- Hong, Z. (2007). *An empirical study on English vocabulary memory strategy of senior high school students* [Master Dissertation, Nanjing Normal University]. Nanjing Normal University Research Repository.
- Ismayilli-Karakoç, A. (2020). *Teaching medical terminology to speakers of English as a foreign language*. In Z. S. Genç & I. G. Kaçar (Eds.), *TESOL in the 21st century: Challenges and opportunities* (pp. 235-252). Peter Lang.
- Jiang, L. (2020). *A Survey on junior high school students' current use of English vocabulary memory strategies: A case study of X middle school in Beihai* [Master Dissertation, Nanning Normal University]. Nanning Normal University Research Repository.
- Jin, G. Q. (2021). Discussion on the influence of affixes and abbreviation strategies on medical English vocabulary memorization from the characteristics of medical English vocabulary. *Speed Reading*, 9, 56-57.
https://qikan.chaoxing.com/detail_38502727e7500f2698d0a5b2c924ce9c0c4299dce921edcc1921b0a3ea255101fc1cf1fbb4666ae6d46d05a563b8163a5c53cc7a1c016aa6e83632cfaee961b3bef5081627096a44fcecddc16f2e8af4
- Jin, L., Wang, X., Chen, X., & Li, M. (2020). Yixue yingyu cihui xuexi celve diaocha ji jiaoxue jianyi [A survey of medical English vocabulary learning strategies and teaching suggestions]. *Modern English*, 6, 7-9.
<https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2020&filename=xwym202006003&dbcode=cjfq>
- Kaur, N. (2013). The need for autonomous vocabulary students in the Malaysian ESL classroom. *GEMA Online® Journal of Language Studies*, 13(3), 7-16.
<https://ejournal.ukm.my/gema/article/viewFile/4216/2334>
- Kaur, N. (2020). Metacognitive awareness in lexical learning among Malaysian students. *International Journal of English Language and Literature Studies*, 9(3), 161-171.
<https://doi.org/10.18488/journal.23.2020.93.161.171>
- Lei, J., & Wu, D. (2019). A preliminary study on the effect of English for medical purpose vocabulary discourse learning and memory. *Scientific Teaching Journal*, 33, 71-73.
<https://doi.org/10.16400/j.cnki.kjdkx.2019.11.035>
- Li, C. L., Chen, Y., Zhang, Y., Dai, J. X., Li, K. X., Guo, H. Y., Wan, G. J., & Feng, R. N. (2022). Analysis of the application of English literature science translation in medical English teaching. *Yixue Jiaoyu Yanjiu yu Shijian*, 30(5), 567-571.
<https://doi.org/10.13555/j.cnki.c.m.e.2022.05.009>
- Li, J. (2020). *Study on the effect of applying mobile learning APP on optimizing the English majors' memory strategies - Taking Baicizhan App as an example*. [Master Dissertation, Inner Mongolia Normal University]. Inner Mongolia Normal University Research Repository.
- Li, Y. (2019). *An empirical study on high school English vocabulary memory strategies* [Master Dissertation, Huazhong Normal University]. Huazhong Normal University Research Repository.
- Liang, E. (2018). *Research on senior high school students' vocabulary memorization in the background of English morning reading - Taking Dongguan No. 1 middle school as an example* [Master Dissertation, Huazhong Normal University]. Huazhong Normal University Research Repository.
- Liu, X. (2018). Inquiry of the integration of English language vocabulary development mechanism and memory strategy. *Heihe College Journal*, 2, 144-145.
<https://doi.org/10.3969/j.issn.1674-9499.2018.02.069>
- Lu, Y. (2020). *Research on Chinese vocabulary learning strategies for international students studying in China* [Doctoral Dissertation, Huazhong Normal University]. Huazhong Normal University Research Repository.

- Ma, L. (2019). *A research on the relationship between English self-concept and language learning strategies of non-English majors* [Master Dissertation, Northeast Normal University]. Northeast Normal University Research Repository.
- Nation, I. S. P. (2003). *Teaching and learning vocabulary*. Beijing Foreign Language Research Press.
- Nation, I. S. P. (1982). Beginning to learn foreign vocabulary: A review of the research. *RELC Journal*, 13, 14-36. <https://doi.org/10.1177/003368828201300102>
- Nattinger, J., & Decarrico, J. (1992). *Lexical phrases and language teaching*. Oxford University Press.
- Oxford, R. & Nyikos, M. (1989). Variables affecting choice of language learning strategies by university students. *The Modern Language Journal*, 73(3), 291-300. <https://doi.org/10.2307/327003>
- Oxford, R. L. (1990). *Language learning strategies: What every teacher should know*. Newbury House.
- Perez, L. M., & Alvira, R. (2017). The acquisition of vocabulary through three memory strategies. *Colombia Applied Linguistics Journal*, 19(1), 103-116. <http://dx.doi.org/10.14483/calj.v19n1.1003>
- Pu, X. Y. (2020). *An empirical study on vocabulary memory strategies and vocabulary size of non-English major freshmen* [Master Dissertation, Yunnan Normal University]. Yunnan Normal University Research Repository.
- Reynolds, B. L., Zhang, X. F., & Chen, D. (2021). A mixed-methods study of English vocabulary for medical purposes: Medical students' needs, difficulties, and strategies. *Applied Linguistics Review*, 119. <https://doi.org/10.1515/applirev-2020-0119>
- Sun, M. (2019). *The Research on the efficiency of mobile learning on the senior high school students' English vocabulary memory strategies* [Master Dissertation, Shanghai Normal University]. Shanghai Normal University Research Repository.
- Tian, J., & Jiang, D. (2020). "Yi qiguan wei zhuxian" yixue yingyu cihui zukuai jiyi fa wenjuan diaocha fenxi [The questionnaire survey and analysis of the memory method of English for medical purpose: Chunking strategy of "Organ system as the main line"]. *English on Campus*, 537(45), 38-39. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2020&filename=xyyy202045019&dbcode=cjfq>
- Uden, L., Sulaiman, F., & Lamun, R. F. (2022). Factors influencing students' attitudes and readiness towards active online learning in physics. *Education Science*, 12(11), 746. <https://doi.org/10.3390/educsci12110746>
- Wang, J., & Yu, J. Y. (2018). On the mastery and memory strategies of the four level English vocabulary. *Journal of Jiamusi Vocational Institute*, 2, 363-364. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2018&filename=jm sj201802216&dbcode=cjfq>
- Wang, S. R. (2016). "Daxue yingyu jiaoxue zhinan" yaodian jiedu [Interpretation of the main points of the "College English Teaching Guide"]. *Foreign Languages World*, 174(3), 2-10. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2016&filename=wjy201603001&dbcode=cjfq>
- Wang, X., & Xu, P. (2007). Yingxiang yingyu xuexi celve de yinsu ji duice [Factors and countermeasures that affect the English learning strategy]. *Science & Technology Information*, 27, 517-518. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2007&filename=kjxx200727425&dbcode=cjfq>
- Wei, G. Y. (2019). How to make medical students establish medical English vocabulary system. *Education Teaching Forum*, 23, 161-162. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2019&filename=jyj>

- u201923072&dbcode=cjfq
- Wen, H. L., Zou, T., Li, X. W., & Feng, C. (2021). Application of medical English in clinical medicine teaching. *China Educational Technology & Equipment*, 24, 131-133. <https://doi.org/10.3969/j.issn.1671-489X.2021.24.131>
- Wen, Q. (2018). *An experimental study on English vocabulary teaching based on memory strategy of chunk construction in senior high school* [Master Dissertation, Guangzhou University]. Guangzhou University Research Repository.
- Xiao, S., Li, J., & Zhang, M. (2017). Study on regional differences on the effectiveness of kindergarten English education. *The Science Education Article Collects*, 392 (7), 107-108. <https://doi.org/10.16871/J.CNKI.kjwhb.2017.07.046>
- Xu, H. Q. (2013). Yingxiang jundui yuanxiao yingyu xuexi celve ruogan yinsu fenxi ji jiaoxue celve [The factors influencing English learning strategies in army schools and teaching countermeasures]. *Journal of Hubei Academy of Education*, 19, 177-178. <https://doi.org/10.16019/j.cnki.cn42-1578/g4.2013.01.023>
- Yan, J. (2021). Neimenggu diqu daxue yingyu jiaoyu yu peixun xuexiao xiaoguo bijiao yanjiu [Research on the English education between colleges and training schools in Inner Mongolia]. *Overseas English*, 5, 121-122. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2021&filename=hwy202105057&dbcode=cjfq>
- Yang, L., Li, M., & Xiong, Q. (2013). Methods of memorizing English medical words. *Journal of Chengdu University of Traditional Chinese Medicine (Education Science Edition)*, 3, 74-81. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2013&filename=cdyy201303032&dbcode=cjfq>
- Yang, M. (2018). *The study of incidental vocabulary acquisition of CSL Students* [Doctoral Dissertation, East China Normal University]. East China Normal University Research Repository.
- Yang, S. (2020). *The application of chunking strategies in English vocabulary teaching in high school*. [Master Dissertation, Harbin Normal University]. Harbin Normal Research Repository.
- Yang, S. Q. (2021). Qian xi yingyu cihui jiyi zhong de butong jiyi fa [An analysis of different memory methods in English for medical purpose vocabulary recognition]. *Minghui*, 1, 122-123. http://ss.zhizhen.com/detail_38502727e7500f266d5cdc1e31352b3ce989fb9897775ab81921b0a3ea255101fc1cf1fbb4666ae664dbe7f321dc11e716a52d19927ca59da20156c19124d76c0b1b754329b9be5fb894687a36f06941?
- Zhang, X. (2016). *An empirical study on the teaching of English vocabulary memory strategies for high school students* [Master Dissertation, Hainan Normal University]. Hainan Normal University Research Repository.
- Zhang, Y. (2020). Renzhi yingyu shijiao xia de yixue yingyu cihui jiaoxue yanjiu [Research on medical English vocabulary teaching from the perspective of cognitive metaphor]. *Overseas English*, 19, 253-254. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2020&filename=hwy202019118&dbcode=cjfq>
- Zhao, Y. (2019). Yuyanxue lilun zai yixue yingyu cihui zhong de yingyong [The application of linguistic theories in medical English vocabulary]. *Think Tank Era*, 2, 245-247. <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=cjfd2019&filename=zksd201902157&dbcode=cjfq>
- Zhou, M. (2022). *An investigation of vocabulary learning strategies of non-English majors in mobile learning environment* [Master Dissertation, North China University of Technology]. North China University of Technology Research Repository.

Appendix 1

Memory Strategies Use Questionnaire for Medical University Students

No	Item	Degree
1.	I memorize the spelling of a word aloud.	1 2 3 4 5
2.	When I try to remember a word, I repeat its pronunciation in my mind.	1 2 3 4 5
3.	I repeat the spelling of a new word by following the recording.	1 2 3 4 5
4.	I associate the Chinese word with an English word that sounds like some part of the Chinese word (keyword), and then to form a mental image of the word interacting with the English translation (e.g., using <i>ban dao le</i> (Chinese) to memorize <i>bandage</i> ; I <i>ban dao le</i> and broke my arm, so I need a bandage).	1 2 3 4 5
5.	I associate a known English word as the keyword to memorize a new word (e.g., associate <i>apple</i> as the keyword to learn <i>appetite</i>).	1 2 3 4 5
6.	I create a mental image of the new word to help me remember it (e.g., when I memorize <i>chill</i> , imagine <i>c</i> as <i>yueya</i> (Chinese) and <i>hill</i> as <i>shan</i> (Chinese); the mental image is he is chilling when appreciating <i>yueya</i> in winter on <i>shan</i>).	1 2 3 4 5
7.	I remember words together that share same letter combinations.	1 2 3 4 5
8.	I associate a new word with a known English word or part of a known English word (e.g., <i>kidney</i> = <i>kid</i> (known) + <i>ney</i>).	1 2 3 4 5
9.	I remember the word with its set collocation (e.g., routine, routine blood test)	1 2 3 4 5
10.	When I try to remember a word, I write it again and again.	1 2 3 4 5
11.	When I try to remember a word, I repeat it aloud to myself.	1 2 3 4 5
12.	I write both the new words and their translation in Chinese again and again in order to remember them.	1 2 3 4 5
13.	I go through my vocabulary list several times until I remember all the words on the list.	1 2 3 4 5
14.	I make vocabulary cards and take them with me wherever I go.	1 2 3 4 5
15.	I make regular reviews of new words I have memorized.	1 2 3 4 5
16.	When I learn new words, I pay attention to prefixes, roots, and suffixes (e.g., inter-nation-al).	1 2 3 4 5
17.	I intentionally study how English words are formed in order to remember more words.	1 2 3 4 5
18.	I memorize the commonly used roots and prefixes.	1 2 3 4 5
19.	When I try to remember a word, I also try to remember the sentence in which the word is used.	1 2 3 4 5
20.	I put words in set expressions or sentences in order to remember them.	1 2 3 4 5
21.	I remember a new word together with the context where the new word appears.	1 2 3 4 5
22.	I make up my own sentences using the words I just learned.	1 2 3 4 5
23.	I try to use the newly learned words as much as possible in speech and writing.	1 2 3 4 5
24.	I try to use newly learned words in real situations.	1 2 3 4 5
25.	I remember a group of new words that share a similar part in spelling.	1 2 3 4 5
26.	I associate a group of new words that share a similar part in spelling with a known word that looks or sounds similar to the shared part.	1 2 3 4 5
27.	I create a sentence in Chinese when I link a new word to a known word.	1 2 3 4 5
28.	I know whether a new word is important in understanding a passage.	1 2 3 4 5
29.	I know which words are important for me to learn.	1 2 3 4 5
30.	When I meet a new word or phrase, I know clearly whether I need to remember it.	1 2 3 4 5