

An Account of Systematic Review of English for Medical Purposes (EMP) Vocabulary Memorization*

Hongmei Cui

Academy of Language Studies, Universiti Teknologi MARA, Malaysia;
School of International Education, Ningxia Medical University, Ningxia, China

Naginder Kaur¹

Academy of Language Studies, Universiti Teknologi MARA, Perlis Branch, Malaysia

Tengku Intan Suzila Tengku Shariff

Academy of Language Studies, Universiti Teknologi MARA, Pahang Branch, Malaysia

Abstract—A high volume of global medical information exchanges has escalated due to the recent pandemic that has hit the world. In addressing international demands of sorts, it is imperative that students improve their English language proficiency, especially for medical purposes. Sufficient vocabulary knowledge is vital for language skills to be employed effectively. However, in China, limited attention has been given to vocabulary learning over the years, especially English for Medical Purposes (EMP) vocabulary since it is very large, complex and filled with jargon. Research shows that students perceive the difficulty of EMP to lie in the learning of vocabulary itself. Faced with problems and challenges in the process of EMP vocabulary learning through memorization technique, theoretical research is urgently required to comprehensively reveal the research status of EMP vocabulary memorization. Therefore, this study adopts the systematic literature review method to evaluate related research on EMP vocabulary memorization in China and abroad from 2011 to 2021. The main characteristics of EMP vocabulary memorization research, the factors that affect EMP vocabulary memorization, and the most popular memory strategies are elaborated in detail in order to integrate the existing fragmented knowledge and demonstrate the development of EMP vocabulary memorization technique(s).

Index Terms—English for Medical Purposes, memory strategies, research characteristics, systematic literature review, vocabulary memorization

I. INTRODUCTION

There is paramount importance in vocabulary learning (Kaur, 2020, 2017, 2015, 2014, 2013), as no language skills can be learnt effectively without adequate vocabulary knowledge (Kaur, 2020, 2017, 2015, 2014, 2013; Lu, 2020). However, vocabulary learning has not received much attention for many years (Lin, 2018). At present, modern medical technology is evolving and is in rapid development. As an important branch of English for Specific Purposes (ESP), English for Medical Purposes (EMP) is a tool for understanding foreign advanced medical technology and a bridge to medical communication, hence, its important role cannot be ignored (Jin, 2021; Shen, 2015). EMP is not only a medium for medical teaching and learning but also enables students to draw medical knowledge from other resources which may subsequently serve as a medium for publishing research work, even after medical students have become doctors (Džuganová, 2019). As such, vocabulary plays a key role in EMP learning.

EMP vocabulary is an open and ever-changing knowledge whose units often acquire new meanings (Džuganová, 2019). The complexity of EMP terminologies increases the difficulty of learning, as Evans and Morrison's survey found the lack of professional English vocabulary to be a major obstacle in students' learning (Zheng et al., 2021). In EMP learning, teachers feel that teaching activity is difficult to conduct, similarly, students think that EMP is difficult to learn (Lin, 2018). The difficulty in teaching and learning is largely due to the stumbling block of vocabulary (Kaur, 2017, 2015, 2014, 2013). The variability of EMP vocabulary requires learners not only to listen to the sounds, and recognize the shapes, but also to identify the meanings and truly internalize them.

Vocabulary memorization also has its logic and temporality. It is proven that scientific and appropriate methods can enhance the effect of memorization (Yang, 2021). Lei and Wu (2019) examined the effect of using roots and affixes in learning EMP vocabulary, showing that it can better improve short-term memorization. Tian and Jiang (2020) also used

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¹ Corresponding Author.

the survey questionnaire technique to investigate the effect of chunking strategy on nursing students, proving that chunking strategy is an effective memorization method with the highest usage rate among EMP learners. Meanwhile, Yang (2021) studied the association method to conduct a survey, which successfully achieved effective memorization effect. Similarly, Li and Zhu (2016) explored the memorization habits of medical students in EMP vocabulary learning. They investigated the effect of memorization methods adopted by students in professional English learning. These findings show that most students believe words are easier to remember with association strategy. Many scholars have also described the importance of comprehensively using various strategies in the process of EMP vocabulary learning. For example, Mei and Liu (2018) and Shen and Yang (2014) described the importance of using word-structure strategy, contextual strategy, and association strategy in learning medical English vocabulary. Additionally, Wu et al. (2018) investigated meta-memory prediction-related theories for clinical medical and English major students in terms of predictive judgment accuracy. It showed that the relative accuracy of prediction and judgment of clinical medical students is better while English major students are superior at absolute accuracy of prediction and judgment (Wu et al., 2018). Therefore, an in-depth understanding of the analysis and application of different memory strategies can assist learners in achieving more effective learning outcomes.

Currently, the research on EMP vocabulary is fragmented which necessitates an urgency for theoretical research which can comprehensively reveal how the research on EMP vocabulary memorization technique(s) can benefit learners. This may help to overcome the problems and challenges in EMP vocabulary memorization processes. However, due to disintegration (non-streamlined methods) of existing research, it is difficult to suggest satisfactory ways for learners to improve their memorization techniques. Therefore, it is necessary to systematically sort out and integrate knowledge based on the existing literature. In this regard, the purpose of this study is to analyze the relevant research literature on EMP vocabulary memorization strategy. Using the systematic evidence-based method, and summarizing the research on EMP vocabulary memorization, popular memory strategies, and influencing factors, the present findings may provide a reference for any follow-up research and practice of EMP vocabulary memorization.

II. METHODS

This study adopted the systematic literature review (SLR) process (Borrego et al., 2014; Jesson et al., 2011) to comprehensively review the existing research on EMP vocabulary memorization. This is a qualitative research approach using content analysis procedure (Krippendorff, 2012) to validate the existing literature. The systematic literature review method integrates empirical research methodology, taking the answer to specific questions as its core. It is transparent and methodical, using standardized techniques to extract, integrate and analyze the selected literature data (Diekemper et al., 2015). Finally, it posts new questions and theoretical viewpoints. The essence is the scientific and rigorous realization of knowledge innovation (You & Huang, 2017). The systematic literature review method can collect, synthesize, and evaluate research results on specific issues rigorously and sustainably (Bearman et al., 2012) in contrast to the traditional review methods. As such, systematic literature review method has been widely used in a large number of studies (Atewologun et al., 2017). After the research questions are identified, the underlying steps of the systematic literature review method are implemented, namely, planning, retrieving literature, evaluating literature quality, extracting and integrating data, and writing the review (Huang et al., 2017). This makes SLR suitable in unfolding the EMP status.

A. Planning

The major tasks in the planning phase include careful mining of topics. This is to identify specific themes for the review. Next research questions are identified. The focus throughout the entire research process is to identify specific research themes to successfully conduct effective research. The research questions drive the entire research process, and particularly determine the inclusion and exclusion criteria of the literature. In order to understand the current research status of EMP vocabulary memorization, which is the scope of this study, the following research questions were identified:

- (1) What are the main research characteristics (research methods, participants, trends, topics) of EMP vocabulary memorization research?
- (2) What are the factors influencing EMP vocabulary memorization?
- (3) Which memory strategies are more prevalent in EMP vocabulary memorization?

B. Retrieving Literature

The selected databases for this study were CNKI (China National Knowledge Infrastructure), Wanfang Medical Data (a Chinese database mainly collected from both Chinese medical journals and foreign medical journals), Web of Science-SSCI, Scopus, and Google Scholar academic publication search engines. The publication time range was set from 2011 to 2021 (the studies on EMP vocabulary memorization are relatively insufficient, so the retrieval time was extended from 2011 to 2021), up to 31 December 2021. From English language-based resources, the frequently used lexical terms and English keywords used were “English for Medical Purposes vocabulary memorization”, “medical English”, “English for Medical Purposes”, “English vocabulary memorization”, “Vocabulary memorization methods”, “English for Medical Purposes vocabulary acquisition” and “memory strategies in English for Medical Purposes

learning.” A total of 81 literature sources were obtained. The retrieval lexical terms and keywords of the Chinese based search engines were “医学英语词汇记忆 (medical English vocabulary memorization)”, “医学英语 (English for Medical Purposes)”, “英语词汇记忆 (English vocabulary memorization)”, “词汇记忆方法 (memory strategies of English vocabulary)”, “医学英语词汇记忆策略 (memory strategies of medical English vocabulary)”, “医学英语词汇习得 (medical English vocabulary acquisition)”. In total, 93 documents were obtained. In both Chinese and English language resources, a total of 174 sources of literature were obtained.

C. Evaluating Literature

In this section, retrieved literature is usually appraised by determining the inclusion and exclusion criteria and evaluating the study design of the literature (Jesson et al., 2011) so as to ensure validity and reliability of the data. The retrieved literature is assessed to accurately ascertain its viability based on pre-defined inclusion or exclusion criteria of the literature in the review. To ensure the accuracy and reliability of the literature analysis results and precise presentation, the present research on EMP vocabulary memorization abided by the formulated literature inclusion/exclusion criteria based on Indriasari et al. (2020). A total of 174 literature papers were initially retrieved based on the research questions, as shown in Table 1. Items 1 to 3 were the screening criteria generally adopted by the systematic literature review method to ensure the accuracy and authority of the research samples. Item 4 was to limit the research period and to ensure the research publications ranged from 2011 to 2021. Item 5 aimed to focus on the research topic of the literature which was EMP vocabulary memorization and subsequently, eliminate research literature that did not focus on the targeted research area. Items 6 and 7 included the scope of language of the articles.

TABLE 1
LITERATURE INCLUSION/EXCLUSION CRITERIA

No.	Inclusion criteria	Exclusion criteria
1	Full text is available.	Full text is unavailable
2	The article is a journal article.	The article is book manuscript, conference paper, report, etc.
3	The article title only appears once.	There are repetitive titles.
4	The article is published between 2011 and 2021.	The publication date is not within 2011 and 2021.
5	Research focus is on EMP vocabulary memorization.	Research does not focus on EMP vocabulary memorization.
6	The article is written in English.	The article is not written in English.
7	The article is written in Chinese.	The article is not written in Chinese.

After eliminating duplicate documents, the researchers screened the literature carefully at the preliminary screening stage. The retrieved documents were screened according to predefined criteria by sifting through the titles and abstracts. At the secondary screening stage, full texts were read with in-depth re-screening. It should be mentioned that at the second screening stage, two experts who were Chinese professors, proficient in both Chinese and English were invited to translate the main parts (research focus, methodology, findings, and conclusions) of each Chinese article respectively. Their similar translation copies were adopted. If the translations were significantly different, a re-translation was required until a similar translation was obtained, following which the authors independently identified the full texts in relation to the translations by these two language experts. A cross-check between authors was also performed to reach a consensus. Based on the literature obtained post two screenings, all cited references were searched, read, and screened according to the relevant criteria. Finally, 30 documents were included - 24 papers in Chinese and six (6) papers in English. The entire screening process and results are shown in Figure 1.

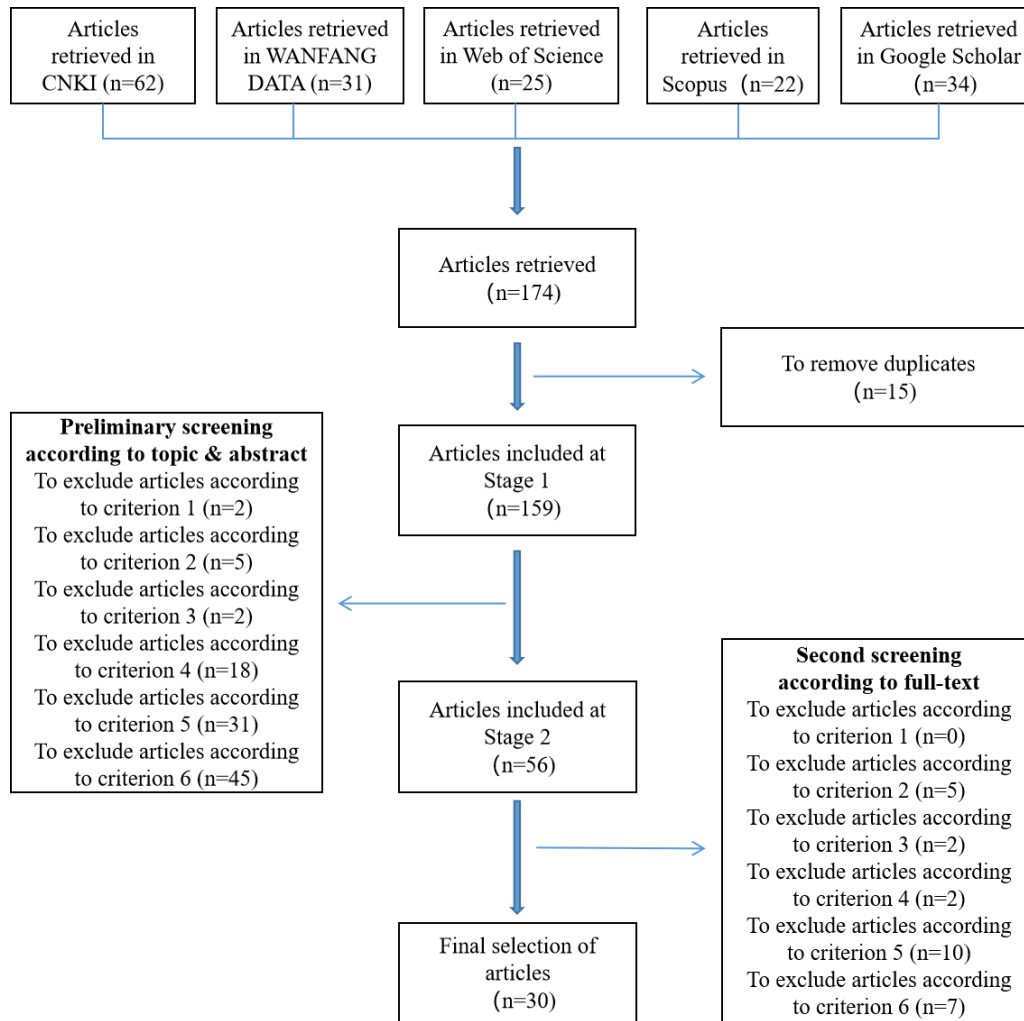


Figure 1. Literature Screening Process and Results

Additionally, the authors independently assessed the quality of the articles included to ensure validity of each paper. Discussions and conferrals ensured that disagreements during the counter-checking process were mitigated. Consequently, only qualified academic literature was retained and irrelevant academic literature was excluded.

D. Extracting and Integrating Data

To extract key information from the selected literature, the researchers systematically analyzed the research on EMP vocabulary memorization technique and compiled the literature information extraction list. The extracted information was analysed in five categories: (1) author(s), (2) year of publication, (3) research topic, (4) research participants, and (5) research methods. The extraction results of the basic information of the literature are shown in Table 2. To ensure the accuracy and rigor of the coding, issues emerging from the coding were discussed and adjusted accordingly, WeChat video meetings were held to discuss emerging problems during the review process.

TABLE 2
BASIC INFORMATION OF THE EXTRACTED LITERATURE

No	Author	Year	Research topics	Research participants	Research method
1	Li & Zhu	2016	Effect of memory strategies usage (imagery, association, keyword strategy)	Medical undergraduate	Teaching experiment
2	Chen & Zhu	2020	Iconicity and vocabulary memorization		Descriptive analysis
3	Tian & Jiang	2020	Effect of memory strategies usage (chunking strategy)	Medical undergraduate	Questionnaire
4	Shen	2015	Description of memory strategies (spelling strategy)		Descriptive analysis
5	Kang	2021	Description of memory strategies (spelling, association, contextual, and use of word-structure strategy)		Descriptive analysis
6	Yang	2021	Description of memory strategies (repetition, association strategy)		Descriptive analysis
7	Shen & Tian	2014	Description of memory strategies (use of word structure, repetition, association, contextual, comparative strategy)		Descriptive analysis
8	Kong	2011	Characteristics of EMP vocabulary and description of memory strategies (use of word structure, association, spelling, comparative strategy)		Descriptive analysis
9	Zhao	2013	Description of memory strategies (use of word structure, association, and etymology strategy)		Descriptive analysis
10	Zhang & Gao	2011	The influence of writing on EMP vocabulary memorization	Medical undergraduate	Descriptive analysis
11	Yan	2013	Description of memory strategies (use of word structure, association, contextual, and cultural strategy)		Descriptive analysis
12	Liu	2013	Characteristics of EMP vocabulary and description of memory strategies (use of word structure, etymology strategy)		Descriptive analysis
13	Yang et al.	2013	Characteristics of EMP vocabulary, and description of memory strategies (use of word structure, classification, association, and etymology strategy)		Descriptive analysis
14	Lei & Wu	2019	Description of memory strategies (use of word structure, contextual, and cultural strategy)	Medical undergraduate	Descriptive analysis
15	Wu et al.	2018	Description of memory strategies (metacognitive regulation strategy)	Medical undergraduate	Descriptive analysis
16	Xiao	2015	Iconic characteristics of EMP vocabulary and memory strategies (spelling, use of word structure, association, etymology strategy)	Corpus-based lexical	Corpus-based lexical study
17	Zhu & Chen	2018	Iconic characteristics of EMP vocabulary		Descriptive analysis
18	Jin	2021	Characteristics of EMP vocabulary and description of memory strategies (use of word-structure strategy)		Descriptive analysis
19	Xiao	2012	Description of memory strategies (imagery strategy)		Descriptive analysis
20	Yang et al.	2011	Description of memory strategies (contextual strategy)		Descriptive analysis
21	Cui et al.	2013	Effect of memory strategies usage (use of word structure, association, repetition strategy)	Medical undergraduate	Vocabulary test and interview
22	Zhao	2012	Description of memory strategies (etymology, use of word-structure strategy)		Descriptive analysis
23	Zheng et al.	2021	Description of memory strategies (use of word structure strategy)		Descriptive analysis
24	Božena	2019	Characteristics of EMP vocabulary		Descriptive analysis
25	Sinadinović	2013	Characteristics of EMP vocabulary	Medical undergraduate	Questionnaire
26	Džuganová	2017	Characteristics of EMP vocabulary		Descriptive analysis
27	Khan	2016	Characteristics of EMP vocabulary and the difficulties of using EMP vocabulary (terms)	Hospital professionals	Questionnaire
28	Panocov á	2016	Characteristics of EMP vocabulary	Corpus	Descriptive Approach
29	Reynolds et al.	2020	Effect of memory strategies usage (use of word-list strategy)	Medical undergraduate	Mixed methods
30	Mo	2011	Characteristics of EMP vocabulary and description of memory strategies (use of word-structure strategy)		Descriptive analysis

III. FINDINGS AND DISCUSSION

This study focuses on the EMP vocabulary memorization technique, the characteristics of the research, influencing

factors, and most popular memory strategies in EMP vocabulary learning. Therefore, the presentation of findings and discussion are aligned to these themes. These findings are based on 30 thoroughly analyzed articles.

A. Basic Characteristics of EMP Vocabulary Memorization Research

In this study, the basic characteristics of EMP vocabulary memorization are systematically analyzed according to research methods, research participants, research topics, and research trends. These items offer a comprehensive understanding of each text for future applications.

(a). Commonly Adopted Research Methods

The authors analysed the types of research methods used in EMP vocabulary memorization in China from 2011 to 2021. It was found that 63% (n=30) of studies on EMP vocabulary memorization in China as reported in the literature have conducted descriptive analysis while 17% carried out teaching experiments, and 10% administered questionnaire surveys. Corpus analysis testified for 7%, while mixed methods research accounted for 3% of the research methods used by previous researchers to investigate EMP vocabulary memorization in China. Descriptive analysis research, categorized as non-empirical research was found to occupy 63% of the types of research methods. Teaching experiments, questionnaire surveys, corpus analysis, and mixed methods research literature which are classified as empirical research made up 37% of the total proportion. In these cases, empirical research has mainly investigated the effect of using memory strategies, while non-empirical research has focused on describing the use of various vocabulary learning strategies (see Table 2). Figure 2 is drawn to illustrate the findings on the past research methods adopted in the study of EMP vocabulary memorization research.

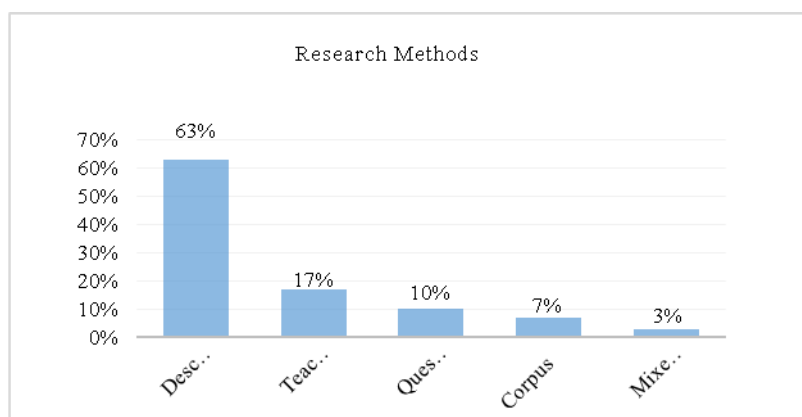


Figure 2. Research Method Used in EMP Vocabulary Memorization Research

Figure 2 shows the commonly adopted research methods in the past years have mainly been non-empirical research. Empirical research-based method was found to be insufficient in exploring studies on EMP. This may be related to the characteristics of EMP vocabulary items themselves, which are complex, long, and difficult to memorize. Learners can understand and memorize EMP terms by mastering memory strategies knowledge in vocabulary learning (Zheng et al., 2021). Therefore, the past research has primarily focused on describing the types of strategies that should / have been used. While acknowledging the characteristics of EMP vocabulary, most researchers summarize memory strategies and subsequently recommend that learners use corresponding strategies in the process of EMP vocabulary learning (Jin, 2021). This leads to the next section of the literature which was analysed.

(b). Research Participants in Past Studies

In previous studies, 70% (n=10) of research participants were medical undergraduates, 10% hospital professionals, and 20% were from other medical-related professions. It is clear that in research on EMP vocabulary memorization, research participants have mainly been medical students, and relatively little attention has been offered to other non-health-based students such as biomedical engineering or biomedical entrepreneurship students. Details of specific profiles of research participants are presented in Figure 3.

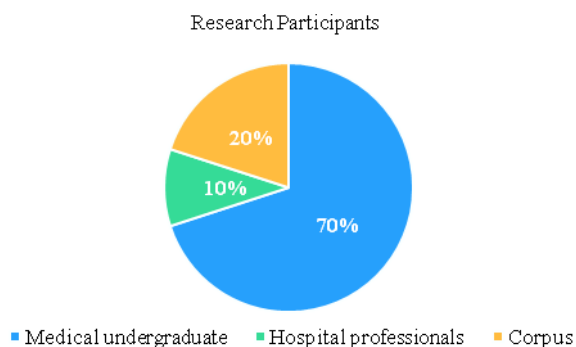


Figure 3. Research Participants in EMP Vocabulary Memorization Research

As seen in Figure 3, the research participants in EMP vocabulary memorization research were mainly focused on medical undergraduates, hospital professionals, and corpus accounts, which made up a small percentage. This may be because EMP is a specialized English segment and highly targeted at professionals. It is designed to allow learners to learn specialized lexis and expressions, and improve fluency and confidence in using English in professional settings (Spalević et al., 2018). Another reason is that EMP has become a compulsory course for medical students (Xiao, 2015), so it is generally learned at the university. This results in the research participants being mainly undergraduates. Moreover, to improve the scientific research level of hospital professionals, some hospitals also offer certain EMP elective courses (Khan, 2016). Therefore, some research participants do include hospital staff/personnel. In addition, as the focus of the previous research methods on empirical studies on EMP vocabulary memorization has been insufficient, this may also lead to narrowed scope of research participants. As research type has a bearing on the selected participants, the next action is to unfold the research trend to scaffold research needs and gaps.

(c). Research Trends

From the time of publication, the current research on EMP vocabulary memorization has shown an irregular and fluctuating trend from 2011 to 2021 as a whole (Figure 4), indicating that research on EMP vocabulary memorization has seen irregular development. From 2011 to 2017, the research on EMP vocabulary memorization fluctuated, but from 2017 to 2021, it began to show a gradual upward trend.



Figure 4. Research Trend From 2011 to 2021

Figure 4 shows that from 2011 to 2021, the research on EMP vocabulary memorization experienced an irregular and fluctuating trend. It was not until 2017 that it gradually witnessed an upward trend, indicating the research on EMP has attracted more attention from scholars in recent years. This is related to the acceleration of globalization and the increasing communicative exchanges between countries. With the acceleration of the internationalization process, medical exchanges between countries have also increased (Lei & Wu, 2019; Yang, 2021). The importance of EMP is gradually emerging, especially in view of the new virus / pandemic around the world. It may only be through close communication or by exchanging views with other countries, health experts can jointly defeat the virus and protect human health. Therefore, the role of EMP communication has become more relevant and obvious. This highlights the common topics studied under EMP.

(d). Common Research Topics

From 2011 to 2021, research topics on EMP vocabulary memorization mainly included the effect of memory strategies usage, description of memory strategies, characteristics of EMP vocabulary, iconicity and vocabulary memorization, and the influence of writing on EMP vocabulary memorization. Among these, research on the description

of memory strategies accounted for 49% (n=30), research on characteristics of EMP vocabulary reported for 29%, research on the effect of strategies usage made up 11% and research on both iconicity and writing on vocabulary memorization accounted for 11% of the total percentage (see Figure 5). This is parallel to the data presented in Table 2. This shows that past research has mainly focused on descriptive analysis of various memory strategies and the characteristics of EMP vocabulary.

The topics studied in EMP have been primarily related to learners of EMP. This covers the discussion of research participants in this study. As mentioned earlier, undergraduates are the main target group of EMP learning research. As students, they usually concentrate on how to use strategies to learn vocabulary to improve English proficiency. Hence, by knowing memory strategies and characteristics of EMP vocabulary, they can choose suitable strategies to better learn EMP vocabulary. EMP vocabulary has always been the most difficult to memorize as learners lack mastery of memory strategies (Jin, 2021) which leads to loss of interest in learning. The difficulty in practical application (Lei & Wu, 2019) is also a contributor, therefore, both factors making the effect of using strategies to be relatively difficult to develop. To sum up, there have been more analyses of strategy descriptions and lexical characteristics, and fewer studies have been conducted to detect the memorization effect.

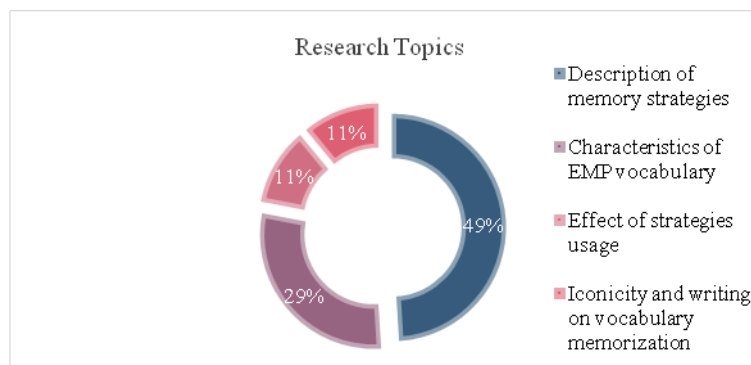


Figure 5. Research Topics of EMP Vocabulary Memorization

B. The Most Prevalent Memory Strategies Studies

According to the current systematic analysis, it was found that between 2011 and 2021, research on memory strategies was diverse and varied. The scope included the use of word-structure strategy, association strategy, contextual strategy, spelling strategy, repetition strategy, use of word-list strategy, imagery strategy, metacognitive regulation strategy, classification strategy, comparative strategy, keyword strategy, and chunking strategy. Among these strategies, the use of word-structure strategy, association strategy, contextual strategy, spelling strategy, and repetition strategy are the most popular strategies, accounting for 84% (n=44) of the total, while the remaining seven strategies accounted for 16%. Hence, the most widespread memory strategies are the use of word-structure strategy, association strategy, contextual strategy, spelling strategy, and repetition strategy (Figure 6). Other studies revolved around the relationship between etymology, cultural background, iconicity, and lexical memorization.

Although English words are difficult to learn and remember, they have inherent rules to follow. Although the number of English words is huge, the number of elements, morphemes, roots, prefixes, and suffixes that make up the words is limited. Therefore, as long as learners know the roots, affixes, and stems, they will experience obvious effects in the process of memorization, which is why the use of word-structure strategy is widely used (Jin, 2021; Lei & Wu, 2019). Association strategy refers to memory strategy in which learners use various identical or similar features as activation factors for memorization, which can effectively help students learn words (Li & Zhu, 2016). Contextual strategy refers to the use of context to memorize English vocabulary reading, which is a good method of vocabulary memorization. Because of the help of context and example sentences, students do not only learn conceptual meaning of words, but will also have some understanding of the syntactic, pragmatic, and associative meanings (Kang, 2021). In addition, reading new words loudly and correctly is part of a successful memorization technique (Lewis, 1978). Therefore, various spelling rules can be used to improve the efficiency of memorization under spelling strategy. Repetition strategy is also timeless and easier to implement, and is therefore, widely preferred by learners. O'Malley and Chamot (1985) also believed that repetition memorization is also an effective method of memorizing words. To sum up, these five memory strategies have become the most popular strategies, which both learners prefer to use and researchers like to study.

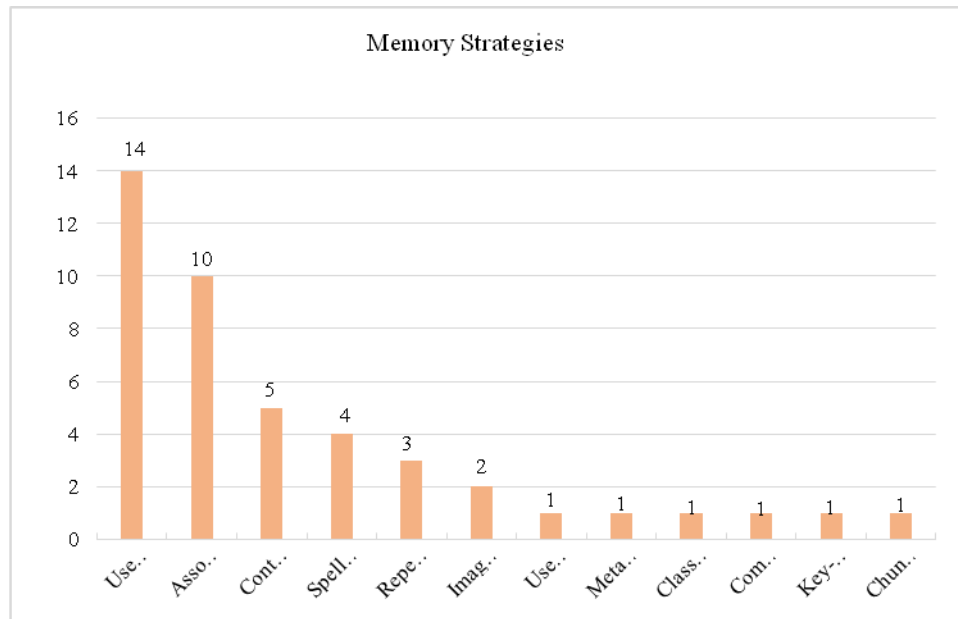


Figure 6. Memory Strategies Used in EMP Vocabulary Memorization

C. Influencing Factors of EMP Studies

Based on the systematic literature review from 2011 to 2021, the factors influencing studies on EMP vocabulary memorization are synthesised as follow:

(a). Complex Vocabulary

The main sources of EMP vocabulary are Greek and Latin. In EMP nouns, Greek constitutes about 70% of the medical words, Latin-derived words are 25% of the total, while vocabulary derived from English is less than 5%, and other words are derived from French, Arabic, and German (Jin, 2021). Most EMP words originated from Latin and Greek have derived words, containing roots and affixes (Khan, 2016; Kong, 2011; Shen, 2015). The EMP roots and affixes in modern English mainly originated from Greek and Latin, such as *dyspnea* or *dysfunction*, in which the prefix *dys-* + root forms a series of new words (Shen & Tian, 2014; Yang et al., 2011; Zhao, 2013). Due to the history of the medical profession, the morphemes of Greek and Latin occupy a very high proportion, and these EMP words are generally strange and unfamiliar, and the word structure is long and complex, taking great challenges in vocabulary memorization (Yang, 2021). Hence, complex vocabulary is a vital factor which exerts a lot of influence on the learning effect. Although they are aware of the importance of EMP, many learners are discouraged, lose enthusiasm and confidence in learning when encountering large numbers of EMP vocabulary with complex word structures (Xiao, 2021). Hence, usage of word-structure strategy has been the preferred topic of study among scholars, with the purpose of helping learners become efficient in vocabulary learning. Moreover, because of the complex characteristics of EMP vocabulary, many learners opt to use strategies which are easier to manage, namely, the repetition strategy and spelling strategy.

(b). Relatively Long Words, Tedious, and Complex to Remember Words

People often have difficulty remembering long words, a lot of EMP vocabulary items are composed of prefixes + roots + suffixes. Hence, long words in EMP vocabulary are very common, such as *contraindication*, *submicroscopic*, *deoxyribonucleic*, and *immunodeficiency*. Such long words are integral and inherent in many EMP articles and literature. However, as long as learners master word-structure rules of EMP vocabulary, it is relatively easy to remember. Therefore, decomposing long words from the perspective of word structure patterns will achieve a better effect (Jin, 2021). According to statistics, the average EMP vocabulary for the medical profession includes 16 characters, which are mainly loan words (Zhao, 2013; Zheng et al., 2013). The field of medicine not only includes many disciplines of basic medicine and clinical medicine, but also involves basic disciplines of chemistry and physics as well as many disciplines and specialties in social sciences. All these disciplines challenge learners' willingness to memorize EMP lexis. In this regard, knowing more memory strategies will certainly benefit learners in EMP vocabulary learning.

(c). Lack of Systematic Memory Strategies Usage Guidance

Memory strategies training is very important for students who wish to learn EMP vocabulary. The use of strategies can greatly improve students' vocabulary memorization levels. Research on memory strategies in English vocabulary learning accompanies the entire process of English language learning, and the use of strategies varies from person to person (Cui et al., 2013). As long as learners grasp some characteristics of EMP vocabulary and the rules of word structure, they can more effectively improve vocabulary learning, expand vocabulary size, and improve the quality and

efficiency of reading EMP content. This is a long-term process of study and exploration, which will also enable students to improve professional quality, and promote the development of medical knowledge, learning, and communication by using memory strategies (Khan, 2016; Shen, 2015; Zhao, 2013; Zhao, 2012). However, many students do not even know what memory strategies are as teachers usually ignore the importance of teaching memory strategies owing to heavy teaching tasks and limited class time. Hence, students generally lack systematic memory strategies usage guidance. It is revealed that many medical university teachers do not realize the importance of EMP vocabulary teaching, because they think vocabulary teaching is time-consuming and inefficient, so they usually merely explain the literal meaning and usage of the words. They are often not aware of what vocabulary students must learn (Pournia, 2019). Therefore, knowledge of vocabulary learning strategies is rarely introduced to students, consequently, leading to students having minimal understanding or comprehension of memory strategies.

(d). Lack of Opportunities to Utilise EMP Vocabulary in Practical Situations

The use of EMP vocabulary in a practical situation is unique. In most cases, EMP words will only be used in medical-related environment. Therefore, even if medical students have taken the EMP course, they still do not have the right environment for language immersion. Consequently, lack of actual language practising environment is one of the factors that affect students' opportunity for strengthening their medical skills (Khan, 2016; Reynolds et al., 2020). Over time, the knowledge they have learned will gradually be forgotten. In addition, the survey results show that most students reveal rare opportunity to use EMP vocabulary for practice after class, which will result in loss of long term retrieval of word from memory. It is interesting to note that lack of opportunity to practise medical terms has also been an issue in Saudi Arabia, although to varying degrees (Khan, 2016).

Additionally, financial problems, low demand, and short learning periods are also factors affecting EMP vocabulary learning. Some students are reluctant to learn EMP vocabulary because of poor economic conditions of the family and knowing their family's inability to support their studies can be very discouraging. Hence, their willingness to learn EMP vocabulary is very low. Meanwhile, others believe they do not need to write medical articles, participate in international conferences and go abroad to study, thence, maintain low inclination for learning EMP vocabulary. Moreover, registration for EMP course is open for a limited period only, but the course is loaded with content where students need to complete huge tasks of reading, writing, and translation in a limited time, hence, reduced time spent on vocabulary learning.

IV. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are obtained based on the review of literature and preceding sections of data analysis. In this study, the main characteristics of EMP vocabulary memorization focus on research methods, participants, trends and topics. The research methods of EMP vocabulary memorization are mainly of non-empirical research, while empirical research is found to be relatively lacking. Research participants are mainly medical undergraduates, while a small percentage are hospital professionals and medical force. The research trend from 2011 to 2021 showed an irregular pattern of development. It was not until 2017 that it gradually showed an upward trend. Research topics on EMP vocabulary memorization have also mainly focused on the description of strategies, followed by analysis of lexical characteristics, and finally the effects of strategy use. The most popular and widely studied strategies are found to be the use of word-structure strategy, association strategy, contextual strategy, spelling strategy, and repetition strategy. In addition, the factors affecting EMP vocabulary memorization are attained as a complex source of vocabulary, relatively long, boring and difficult to remember words, lack of systematic guidance on memory strategies usage, and lack of opportunities to use vocabulary in practical situations.

As such, memorization of EMP vocabulary is more difficult than that of general English vocabulary. Students should follow the characteristics of EMP vocabulary and word structure rules. Most students lack knowledge of vocabulary learning strategies which cause them unable to master basic EMP vocabulary, which will directly restrict their future career development. This puts forward higher requirements for teachers and a need to stimulate students' interest in learning EMP vocabulary, helping them master more EMP lexis, be able to understand more professional medical articles, and lay a good English foundation for future work and study.

In conclusion, the present study makes specific suggestions. Firstly, it is suggested that the number of output-oriented courses such as EMP listening and speaking, writing, and translation be increased. Secondly, it is necessary to require students to use the language, by repeating the audio-visual content and summarizing the audio-visual effect in EMP audio-visual courses. Thirdly, instructors need to get students to use new words to construct sentences or write short texts in EMP reading courses. Next, it is crucial to fully grasp the connotations of output theory, encourage students to use their language to express, and truly realize the transformation from input to output in EMP translation, writing, and other output courses. Finally, it is imperative for language instructors or teachers to have heightened awareness in teaching memory strategies, in tandem with increased learner awareness of using various memory strategies.

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Hongmei Cui is a PhD. student at the Academy of Language Studies, Universiti Teknologi MARA Malaysia, with research interests in applied linguistics. She is also a lecturer at the School of International Education, Ningxia Medical University. She teaches English as a Second Language (ESL) courses to Chinese students as well as Chinese as a Foreign Language (CFL) to international students.

Naginder Kaur (PhD) is an Associate Professor at the Academy of Language Studies, Universiti Teknologi MARA, Perlis Branch, Malaysia. Her research interests include the scope of Malaysian University English Test (MUET), autonomous learning, vocabulary instruction, and ESL writing.

Tengku Shariff Tengku Intan Suzila (PhD) is an Associate Professor at the Academy of Language Studies, Universiti Teknologi MARA, Pahang Branch, Jengka Campus, Pahang, Malaysia.