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Vocabulary Learning Strategies Employed by Korean Medical Students for Medical Terminology and General English Words

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This study explores how vocabulary learning strategies (VLS) adopted by medical students would differ in learning medical terminology and general English words. The participants were 109 medical students in a university located in a major city in Korea. Data were collected in the Fall 2021 semester using a survey questionnaire. The study found that there was not much difference in the most frequently used VLS for learning general English words and learning medical terminology. Only three differences existed among the top-ten most used strategies. Out of 66 strategies, about a half showed a statistically significant difference in the frequency of VLS use, and only six were used more frequently when learning medical terminology than when learning general English words. When the participants were divided into three groups by their GPA, the results showed that higher-achieving students are active learners in all circumstances, taking notes during their medical class, imagining word meaning in their cognition, and using space to draw words in meaning groups outside the classroom.

Keywords: English for medical purposes, vocabulary learning strategies, medical terminology, language learning strategies

Introduction

Vocabulary learning strategies (VLS) have been a central issue since vocabulary learning, which had been neglected in second language acquisition (SLA) until the 1980s, started to receive more attention and were viewed as important for language learning (O'Malley & Chamot, 1990; Oxford, 1990). To date, much learner VLS behavior has been discovered from a large volume of research conducted in different contexts, such as ESL or EFL, covering various academic disciplines. Yet, it is hard to find studies that focus on the VLS behavior of a homogenous group of students learning diverse vocabulary types with different degrees of specificity and learning purposes. For example, although it has been reported that medical English terminology acquisition accounts for the success of academic performance in medical school (Bensoussan et al., 2009), most studies have focused on the VLS that medical students employed to learn general English words, rather than to learn medical terminology in English. Furthermore, no study was found to reveal how a group of medical students would employ VLS differently when learning

general English words versus medical terminology.

This study aims to discover the differences in students' VLS behavior in a specific academic discipline, such as medicine, when they learn subject-specific vocabulary and general English words. In doing so, the study adopted Schmitt's (1997) VLS taxonomy by modifying it appropriately to cover students' VLS behavior of optimizing contemporary learning technology. Thus, researchers can use this study as a reference for further study.

Literature Review

Vocabulary Learning Strategies

Vocabulary is incredibly important for successful communication in second language learning. Binti et al. (2014) mentioned that people with a limited English-language vocabulary have difficulties in speaking, writing, reading, and understanding English as a second language effectively. However, learning vocabulary in a second language is difficult due to the large amount of unfamiliar words, and therefore learners need to use appropriate learning strategies to alleviate this difficulty and increase learning efficiency (Hadi & Guo, 2020).

According to Oxford (1999), learning strategies are defined as "specific actions, behaviors, steps, or techniques that students use to improve their own progress in developing skills in a second language." The learning strategies were then categorized in different ways. O'Malley and Chamot (1990) divided them into metacognitive, cognitive, and social strategies. Oxford (1990) divided them into six categories: affective, cognitive, compensation, memory, metacognitive, and social strategies. Based on these concepts and classification of learning strategies, VLS was developed.

VLS are the means learners use to understand and acquire vocabulary as a subset of learning strategies (Nyikos & Fan, 2007). Several researchers have categorized VLS in various ways. Gu and Johnson (1996) typified VLS into eight categories: beliefs about vocabulary learning, metacognitive regulation, guessing strategies, dictionary strategies, note-taking strategies, rehearsal strategies, encoding strategies, and activation strategies. Their classification fails to include social strategies, such as interaction with teachers and classmates, as they focus only on the instance when individual learners encounter new words. Schmitt (1997), classified VLS based on the taxonomy of Oxford (1990) and Cook and Mayer (1983). First, he adopted four of Oxford's (1990) categories: cognitive, memory, metacognitive, and social strategies. The cognitive strategies allow the learner to analyze and manipulate the target language, while the memory strategies connect new data to the person's existing knowledge. The metacognitive strategies involve decision-making that the learner plans, monitors, and evaluates to determine the best way to study. Finally, social strategies involve interactions with others to acquire vocabulary. In addition to the four, Schmitt (1997) added one more category, determination strategies, which the learner uses to find out unknown vocabulary without assistance from others. He then divided these five categories into two kinds, following the ideas of Cook and Mayer (1983). One is discovery strategies associated with discovering the meaning of a new word, and the other is consolidation strategies which strengthen vocabulary memory. The former includes determination and social strategies, while the latter is composed of memory, cognitive, and metacognitive strategies.

Schmitt's (1997) VLS classification has been widely utilized and flexibly modified to identify VLS patterns for ESL and EFL learners. Schmitt (1997) conducted a study with Japanese students using his VLS classification. It turned out that a bilingual dictionary, asking the teacher to paraphrase, and analyzing pictures or gestures were the most commonly used strategies. By adopting a modified version based on Schmitt's classification (1997), Park (2001) found that the most frequently used strategies by Korean students were bilingual dictionaries, finding contextual meaning, and asking classmates for meaning. Wu (2005) also modified Schmitt's original version by taking technological development and Taiwanese culture into consideration. His study showed that using electronic dictionaries, asking

classmates for meaning, and guessing through textual context were the most popular strategies among Taiwanese students. Rachmawati (2018), who also modified Schmitt's (1997) classification to suit the local educational context, found that Indonesian EFL students engaged VLS by using bilingual dictionaries, guessing meaning from context, and analyzing pictures or gestures. Very recently, Laffey (2020) conducted an online experiment with 135 Korean university students. He added six meaning discovery and two consolidation strategies to the original list of 58 Schmitt's strategies. The newly added ones related to the technology advancement with which current learners were familiar. Among meaning-discovery strategies, using online dictionaries turned out to be both the most used and the most helpful. The most used strategy was note-taking, and the most helpful was using verbal repetition among consolidation strategies. A comparison of the results of Laffey (2020) and Schmitt (1997) revealed that technical VLS are widely used for meaning discovery and moderately used for consolidation.

In sum, researchers continue to follow Schmitt's VLS classification (1997) and modify it to fit their research context. Furthermore, they addressed the need to include strategies relevant to technology development, such as the Internet and smartphones, due to their impact on learning behavior (Collins, 2016; Laffey, 2020; Rachmawati, 2018).

Vocabulary Learning Strategies for Specific Academic Disciplines

English is an obstacle for non-native speaker students to achieve academic success (Keane, 1993; Olson, 2012; Telmesani et al., 2011). In particular, academic and technical vocabulary is hardly encountered nor used in everyday life, which hampers accidental acquisition. Therefore, learners need assistance to learn unfamiliar academic or technical vocabulary (Boonnoon, 2019) and VLS can serve that goal (Coady & Huckin, 1997). Notably, learning strategies have a positive impact on academic achievement by helping learners become more involved in monitoring their learning process (Green & Oxford, 1995; Scharle & Szabo, 2000).

By stressing the role of VLS in academic technical vocabulary acquisition, many studies have delved into the students' VLS use in higher education across various majors. Fan (2003) studied the most frequent VLS in 1,067 college freshmen in Hong Kong and found that they relied on the dictionary, a great deal of guessing, and analysis strategies. Gu and Johnson (1996) investigated the relationship between VLS and language learning outcomes in 850 Chinese college students, and revealed that two metacognitive strategies, such as self-initiation and selective attention, had a positive impact on the College English Test. In a study with 242 Taiwanese college students, rote memorization was used most frequently (Lai, 2013).

Among various disciplines, the medicine major requires high English proficiency to obtain scientific and medical information expressed in academic materials (Heming & Nandagopal, 2012), given that medical knowledge is represented by English terminology (Telmesani et al., 2011). Reportedly, students of non-native English speakers in the medical field have more difficulties in academic achievement. Keane (1993) reported that ESL nursing students in the USA were more likely to drop out than native English-speaking students. Similarly, Olson (2012) identified a language barrier as the biggest obstacle to educational success for nursing students in China who had to work in a non-native language. In Saudi Arabia, some students in medical school who had achieved high grades in their high school dropped out from the medical school mainly due to linguistic difficulties (Telmesani et al., 2011).

Despite the significance of English, there are only a limited number of studies related to VLS use in medical students compared to other majors. Rogulj and Čizmić (2018) conducted a study to investigate the relationship between VLS and vocabulary knowledge in Croatian medical students. They used a questionnaire on vocabulary learning strategies developed by a Croatian researcher (Pavičić Takač, 2008). Consequently, medical students used the VLS core inventory and there was a very small correlation between formal VLS and controlled productive vocabulary knowledge. Hashemi and Hadavi (2015) conducted a study with medical students in Rafsanjan Medical College. They used modified Gu and Johnson's (1996) questionnaire and performed a survey with 185 students of medical, dental, nursing, and

paramedical majors. The results showed that more than 50% of students used dictionaries to learn vocabulary, and the most frequently used strategies were social and guessing strategies. Furthermore, medical and dental college students used selective attention and learning assessments, whereas nursing and paramedical students relied more on social strategies. In a study that involved 89 nursing students in Taiwan, by using Schmitt's (1997) taxonomy, Yang (2005) found that the most preferred strategies among nursing students to learn medical terminology were written repetition, verbal repetition, and bilingual dictionary strategies; the most proficient students used other types of strategies more often than the less proficient ones. In a comparative study about VLS use among four different groups of learners in their major, including medicine, economics, engineering, agriculture, and health sciences, Boonnoon (2019) found Thai EFL students used dictionary and note-taking strategies most often and health sciences students used VLS more frequently than others.

Meanwhile, some older research focused on the effect of certain specific strategies for learning medical terms. For example, Fang's study (1985) found that the use of affixes and roots analysis facilitates learning medical terminology and Troutt (1987) showed that teaching using keyword strategies helped the early acquisition of medical terms a lot more than the traditional teaching method.

To date, no study has been conducted on differences in medical students' VLS patterns comparing general English versus medical terminology acquisition. Studies with medical students analyzed either VLS used for the general English acquisition or medical terminology acquisition. Thus, this study provides new insights and has significant implications for teaching English in the medical discipline. In this regard, the research questions are as follows:

1. What VLS do medical students employ when learning medical terminology?
2. Are there any differences in VLS use employed by medical students when learning general English vocabulary or learning medical terminology?
3. Are there any differences in the VLS used for learning medical terminology according to medical students' academic achievement in their major?

Methods

Participants

The study participants were all medical students enrolled in a university located in a major Korean city, where author A is affiliated. They were solicited in contact with the department's student representative, who maintained a close relationship with peers by social network service. Data were collected in the fall 2021 semester. The number of students was 109, 69 male and 40 female students. By their year in the program, 39 students (36%) were second-year, 43 (39%), third-year, and 27 (25%), fourth-year students. The second to fourth-year students were chosen because they had sufficient experience learning both medical terminology in their medical subjects and general English in the mandatory course in their first year.

Research Instruments

Owing to the significance of the survey instruments in the study, the authors devoted great effort to choose the most appropriate VLS questionnaire for the study purpose. As indicated above, many types of surveys have been developed so far. One of the study authors, who teaches a core medical subject in the university, reviewed most of the questionnaires published so far collaboratively with the other authors and selected the one he thought medical students would understand most easily and respond to without a problem due to unfamiliar SLA terminology and metalanguage. Furthermore, given that current students are familiar with multi-media and technology devices, the surveys that do not include learning behavior

with multi-media were excluded. Finally, Laffey's (2020) Korean version which was modified based on Schmitt (1997) was chosen. Before conducting the survey, the authors closely reviewed all items in consultation with Schmitt's original items; difficult items written in SLA terminology were re-written and paraphrased, or examples were provided for clarity. Sixty-six items were included, 20 on meaning discovery and 46 on consolidation strategies. The 20 meaning discovery strategies were then typified into determination and social strategies, while the 46 consolidation strategies were classified into social, memory, cognitive, and metacognitive.

Each question asked participants to mark "Yes or No"; if they had any experience of using the particular strategy, they were to mark "Yes" and if not, "No." The final form is shown in Appendix. In the survey, the students were asked to report their GPA from the previous semester along with their academic year and sex.

Data Collection and Analysis Procedure

Given the research purpose of comparing VLS for medical terminology and general English vocabulary employed by medical students, the participants were asked to answer identical questionnaires twice, one for medical terminology and the other for general English vocabulary. The two survey forms were developed in Google Forms and students were informed of two different links with a short introduction to the survey purpose. We stressed that both forms should be filled out to complete the survey.

Students' responses were collected and analyzed with SPSS version 26. In addition to descriptive statistics, non-parametric McNemar tests were adopted to compare the VLS of medical terminology and general English vocabulary. Furthermore, Chi-square tests were employed for the comparison of the VLS patterns used for learning medical terminology among different groups of students, divided by their GPA obtained on the medical subjects in the previous semester.

Results

Most Used VLS for Medical Terminology and General English Words

To answer the first research question, we first examined the frequency of VLS marked on medical terminology and on general English words. For each of the 66 VLS, a maximum of 109 marks (100%) were possible and the percentage of the students who marked Yes was reported in the Appendix. Among the 66 VLS, the ten most used and the five least used strategies are shown in Table 1.

TABLE 1
Most Used and Least Used VLS

Vocabulary Learning Strategies	%	Kind	Vocabulary Learning Strategies	%	Kind
Most used strategies			*Most used strategies*		
Compare to a similar known English word	93.6	Meaning Discovery	Use an online dictionary	95.4	Meaning Discovery
Use an online dictionary	93.6	Meaning Discovery	Guess from context clues	92.7	Meaning Discovery
Guess from context clues	89.9	Meaning Discovery	Study the sound of the word	90.8	Consolidation
Use verbal repetition	89.9	Consolidation	Compare to a similar known English word	89.9	Meaning Discovery
Study the sound of the word	89	Consolidation	Study the spelling of the word	86.2	Consolidation
Study the configuration of the new word	85.3	Consolidation	Use verbal repetition	85.3	Consolidation
Take notes in class	83.5	Consolidation	Imagine the word's meaning	83.5	Consolidation
Analyze the root word and any affixes	82.6	Meaning Discovery	Connect the word to a personal experience of yours	83.5	Consolidation
Use a bilingual dictionary	82.6	Meaning Discovery	Use written repetition	83.5	Consolidation
Study the spelling of the word	81.7	Consolidation	Analyze the root word and any affixes	83.5	Meaning Discovery
Least used strategies			*Least used strategies*		
Ask a teacher for a translation	8.3	Meaning Discovery	Use the Peg Method to remember words	14.7	Consolidation
Use flashcards	7.3	Consolidation	Use semantic feature grids when studying	10.1	Consolidation
Use semantic maps like word webs	5.5	Consolidation	Use semantic maps like word webs	9.2	Consolidation
Ask a teacher to check flashcards or word list for accuracy	5.5	Consolidation	Put English labels on physical objects	7.3	Consolidation
Use flashcards to find the meaning	4.6	Meaning Discovery	Ask a teacher to check flashcards or word lists for accuracy	6.4	Consolidation

According to Table 1, the strategies that medical students frequently used when learning medical and general English were generally similar. Specifically, only three of the top ten VLS most used for learning general English and medical terminology were different; studying the configuration of the new word (for general English 74.3%), taking notes in class (for general English 69.7%), and using a bilingual dictionary (for general English 77.1%) were listed in the top ten VLS for medical terminology, while the top ten VLS for general English included imagining the word's meaning (for medical English 75.2%), connecting the word to a personal experience (for medical English 70.6%), and using written repetition (for medical English, 80.7%). On the contrary, the strategies of using an online dictionary (determination strategy), guessing from context clues (determination strategy), studying the sound of the word (memory strategy), comparing to a similar known English word (memory strategy), and using verbal repetition (cognitive strategy) were ranked as the most frequently used strategies both for medical terminology and general vocabulary.

VLS Comparison with Different Frequency for Medical Terminology and General English Words

McNemar analyses were conducted to find out whether the frequency of each strategy that medical students adopted to learn medical terminology was different from that of general English words. A statistical significance was found for 32 strategies, which was about half of the strategies included. Among the 32 VLS that were statistically significant different, only six were used more frequently by medical students when learning medical terminology than when learning general English vocabulary. In other words, medical students used strategies more frequently to acquire general English vocabulary. Table 2 shows the results of the McNemar analyses of the 32 strategies.

TABLE 2
VLS with a Statistically Significant Difference in the Use for Medical Terminology and General English Words

	Frequency		
	Medical English %	General English %	McNemar *p*-value
Meaning discovery strategies(type)			
Analyze any available pictures or gestures (DET)	79.8	65.1	.011
Analyze the part of speech (DET)	51.4	76.1	.000
Use an electronic dictionary (DET)	34.9	55.0	.000
Use a smartphone dictionary app (DET)	50.5	61.5	.012
Use a word list to find the meaning (DET)	12.8	41.3	.000
Use flashcards to find the meaning (DET)	4.6	15.6	.002
Keep reading, hoping the meaning will become clear (DET)	40.4	65.1	.000
Ask a teacher for a translation (SOC)	8.3	21.1	.001
Ask a teacher for an example sentence (SOC)	8.3	21.1	.004
Consolidation strategies			
Group words together spatially on a page (MEM)	72.5	25.7	.000
Underline the initial letter of the new word (MEM)	44.0	27.5	.002
Study the configuration of the new word (MEM)	85.3	74.3	.017
Use physical action when learning words (MEM)	67.9	45.0	.000
Take notes in class (COG)	83.5	69.7	.006
Interact with a native speaker (SOC)	13.8	33.9	.000
Connect the word to a personal experience of yours (MEM)	70.6	83.5	.007
Connect the word to its synonyms and antonyms (MEM)	57.8	72.5	.007
Use “scales” for gradable adjectives (MEM)	36.7	54.1	.001
Use new words in sentences (MEM)	29.4	50.5	.001
Imagine the word form/spelling (MEM)	63.3	74.3	.023
Remember the part of speech (MEM)	38.5	62.4	.000
Paraphrase the word’s meaning (MEM)	23.9	41.3	.001
Learn the words of an idiom or phrase together (MEM)	26.6	60.6	.000
Use word lists (COG)	40.4	55.0	.017
Use flashcards (COG)	7.3	21.1	.001
Use the vocabulary section in your textbook (COG)	39.4	53.2	.024
Keep a vocabulary notebook (COG)	32.1	59.6	.000
Use English-language media (MET)	18.3	43.1	.000
Test yourself with word tests (MET)	40.4	56.0	.003
Use spaced word practice (MET)	32.1	45.9	.004
Use a smartphone language learning app (COG)	16.5	33.9	.001
Use an online language learning program (COG)	13.8	31.2	.001

The results indicated that analyzing any available pictures or gestures was used more often to discover word meaning to learn medical terms than to learn general English words. Among consolidation strategies, five strategies such as grouping words together spatially on a page (memory strategy), underlining the initial letter of the new word (memory strategy), studying the configuration of the new word (memory strategy), using physical action when learning words (memory strategy), and taking notes in class (cognitive strategy) were used more frequently to learn medical terms than to learn general English words. It follows that the memory strategies were used more frequently among the four types of consolidation strategies when learning medical terminology than when learning general English.

Comparison of VLS Used by Different Groups of GPA in Their Major

The study analyzed VLS used for learning medical terminology by different groups of medical students subdivided by the GPA obtained in the previous semester. Note that the possible highest GPA is 4.5. Tables 3 to 5 show the ten most used and the five least strategies among students with a GPA above 4.0, 3.0 to 4.0, and below 3.0 respectively, to learn medical terminology.

TABLE 3
Most Used and Least Used VLS among Students above a 4.0 GPA

Vocabulary Learning Strategies	Frequency (%)	Kind
Most used strategies		
Use an online dictionary	26 (96.3)	Meaning Discovery
Analyze the root word and any affixes	24 (88.9)	Meaning Discovery
Compare to a similar known English word	24 (88.9)	Meaning Discovery
Take notes in class	24 (88.9)	Consolidation
Study the sound of the word	23 (85.2)	Consolidation
Use verbal repetition	23 (85.2)	Consolidation
Continue to study the word over time	23 (85.2)	Consolidation
Guess from context clues	22 (81.5)	Meaning Discovery
Imagine the word's meaning	22 (81.5)	Consolidation
Study the spelling of the word	22 (81.5)	Consolidation
Least used strategies		
Use flashcards	1 (3.7)	Consolidation
Put English labels on physical objects	1 (3.7)	Consolidation
Use an online language learning program	1 (3.7)	Consolidation
Use flashcards to find the meaning	0 (0.0)	Meaning Discovery
Ask a teacher to check flashcards or word lists for accuracy	0 (0.0)	Consolidation

First, we examined the results of students with a GPA of 4.0 or higher. Their most frequently used strategy was using an online dictionary (96.3%), followed by analyzing the root word and any affixes, comparing to a similar known English word, and taking notes in class, which all had the same frequency at 88.9%. Yet, students reported that they had never adopted two strategies: using flashcards to find meaning and asking a teacher to check flashcards or word lists for accuracy.

TABLE 4
Most Used and Least Used VLS among Students with a GPA of 3.0 to 4.0

Vocabulary Learning Strategies	Frequency (%)	Kind
Most used strategies		
Compare to a similar known English word	61 (96.8)	Meaning Discovery
Guess from context clues	59 (93.7)	Meaning Discovery
Use an online dictionary	59 (93.7)	Meaning Discovery
Study the sound of the word	58 (92.1)	Consolidation
Use verbal repetition	58 (92.1)	Consolidation
Study the configuration of the new word	57 (90.5)	Consolidation
Take notes in class	55 (87.3)	Consolidation
Remember the affixes and roots	54 (85.7)	Consolidation
Analyze the root word and any affixes	53 (84.1)	Meaning Discovery
Analyze any available pictures or gestures	53 (84.1)	Meaning Discovery
Least used strategies		
Ask a teacher for a translation	6 (9.5)	Meaning Discovery
Ask a teacher for an example sentence	6 (9.5)	Meaning Discovery
Ask a teacher to check flashcards or word lists for accuracy	6 (9.5)	Consolidation
Use flashcards to find the meaning	5 (7.9)	Meaning Discovery
Use semantic maps like word webs	5 (7.9)	Consolidation

Meanwhile, the top three strategies adopted by students with a GPA between 3.0 and 4.0 were comparing to a similar known English word (96.8%), guessing from context clues (93.7%) and using an online dictionary (93.7%), whereas they made the least use of strategies such as using flashcards to find the meaning strategy (7.9%) and using semantic maps, including word webs (7.9%).

TABLE 5
Most Used and Least Used VLS among Students below GPA 3.0

Vocabulary Learning Strategies	Frequency (%)	Kind
Most used strategies		
Compare to a similar known English word	17 (89.5)	Meaning Discovery
Guess from context clues	17 (89.5)	Meaning Discovery
Use an online dictionary	17 (89.5)	Meaning Discovery
Use verbal repetition	17 (89.5)	Consolidation
Use a bilingual dictionary	16 (84.2)	Meaning Discovery
Study the sound of the word	16 (84.2)	Consolidation
Study the configuration of the new word	15 (78.9)	Consolidation
Use written repetition	15 (78.9)	Consolidation
Analyze any available pictures or gestures	14 (73.7)	Meaning Discovery
Study the spelling of the word	14 (73.7)	Consolidation
Least used strategies		
Ask a teacher for a translation	0 (0.0)	Meaning Discovery
Ask a teacher to check flashcards or word lists for accuracy	0 (0.0)	Consolidation
Use semantic maps like word webs	0 (0.0)	Consolidation
Use semantic feature grids when studying	0 (0.0)	Consolidation
Use flashcards	0 (0.0)	Consolidation

Students with a GPA of 3.0 or lower used four strategies most often with the same degree of frequency, 89.5%. They consisted of comparing to a similar known English word, guessing from context clues, using an online dictionary, and using verbal repetition strategies. Interestingly, they had never used five

strategies at all: asking a teacher for a translation, asking a teacher to check flashcards or word lists for accuracy, using semantic maps such as word webs, using semantic feature grids when studying, and using flashcards.

Based on the above results, Chi-square tests were performed to check whether there was a statistical significance in the difference of VLS use according to their GPA. Consequently, only seven strategies, which are only 10 percent of the entire 66 strategies, were shown to be statically different. This result indicated that the medical students' use of VLS was somewhat consistent, regardless of GPA. Table 6 represents strategies that showed a significant difference among three groups of students with a different GPA.

TABLE 6
VLS with Statistically Significant Difference among Different Groups by GPA

	GPA			
	Above 4.0 (Total: 27) Frequency (%)	4.0 ~ 3.0 (Total: 63) Frequency (%)	Below 3.0 (Total: 19) Frequency (%)	Chi-square (p-value)
Meaning discovery strategies				
Discover the meaning through group work activity	6 (22.2)	24 (38.1)	2 (10.5)	6.231 (.044)
Consolidation strategies				
Imagine the word's meaning	22 (81.5)	50 (79.4)	10 (52.6)	6.251 (.042)
Take notes in class	24 (88.9)	55 (87.3)	12 (63.2)	6.932 (.031)
Group words together spatially on a page	20 (74.1)	50 (79.4)	9 (47.4)	7.538 (.023)
Paraphrase the word's meaning	3 (11.1)	21 (33.3)	2 (10.5)	7.389 (.025)
Use cognates in study	8 (29.6)	37 (58.7)	8 (42.1)	6.798 (.033)
Use physical action when learning words	15 (55.6)	49 (77.8)	10 (52.6)	6.739 (.034)

Looking at Table 6, students in the middle and upper GPA groups with a 3.0 or higher made more use of three strategies, such as imagining the word's meaning (memory strategy), taking notes in class (cognitive strategy), and grouping words together spatially on a page (memory strategy), compared to the lower group of students with GPA below 3.0. This result means that middle and upper groups of students made better use of memory and cognitive strategies. Nevertheless, the middle group of students with GPA between 3.0 and 4.0 made more frequent use of four strategies—discovering the meaning through group work activity (social strategy), paraphrasing the word's meaning (memory strategy), using cognates in a study (memory strategy), and using physical action when learning words (memory strategy)—than higher and lower groups of students in terms of GPA.

Discussion

This study examined the differences in the VLS pattern shown by medical students in learning medical terminology and general English words. The result showed there was not much difference in learning two types of vocabulary sets. In particular, medical students adopted the strategy of using an online dictionary most often in both cases, which was similar to the results of many previous studies (Boonnoon, 2019; Hashemi & Hadavi, 2015; Wu, 2005). Thai students majoring in economics, engineering, agriculture, and health sciences used the dictionary strategy most often (Boonnoon, 2019). Similarly, EFL high school and

college students in Wu's study 2005 and medical and dental students in Iran also preferred to use the dictionary strategy (Hashemi & Hadavi, 2015). The result indicated that the strategies used to discover the meaning of new words were similar, despite the variety of learners' majors and educational contexts.

The findings below are of value for further discussion. First of all, comparing a word to a similar known English word was ranked as the most used strategy in the same frequency as using an online dictionary when learning medical terminology. This result might mean that academic English terminology is too technical to learn the form as its own; thus, learners might look for assistance from their background knowledge that they already possessed to obtain new information. As for vocabulary learning, learners lean on and make use of their knowledge on easier and familiar words. Secondly, the most frequently used strategies for medical students when learning general English were using an online dictionary and guessing from the context. These strategies were consistent with those seen in previous studies (Park, 2001; Rachmawati, 2018; Seddigh & Shokrpur, 2012). In this regard, Gu and Johnson (1996) observed that proficient learners make more use of guessing and dictionary strategies than other strategies. Fan (2003) also noted that frequent dictionary use is observed among strong learners. It is evident that medical students in Korea, who belong to 0.01 percent of the population in their performance on the college entrance exam, showed the same behavior as proficient English learners in other studies.

For the second research question, a significant difference in the frequency of VLS use was found between general English words and medical terminology for 32 strategies, which is about half of the total of 66 strategies. Among the 32 strategies, only six strategies, one for meaning discovery and five for consolidation, were used more frequently when learning medical terminology than when learning general English words. In general strategies adopted by medical students were more frequently used when learning general words. The investigation of the six strategies used more often for medical terminology revealed that analyzing any available pictures or gestures was the only strategy used for meaning discovery. Given that medical terminology entails anatomical pictures and terms, medical students may take advantage of any available images. Furthermore, when they consolidate and remember the meaning of medical words, they more often used the following five strategies than when they did general English words—grouping words together spatially on a page, underlining the initial letter of the new word, studying the configuration of the new word, using physical action when learning words, and taking notes in class. Except for taking notes in class, the four strategies were all memory strategies and appeared to be associated with sensory and analytical activity. That is, they seemed to exert their full effort to master medical terminology; they drew words in groups on a piece of paper, underlined initial spellings, took words apart, and acted out word meanings. Even advanced learners had to mobilize all senses and exert all possible memory-related cognitive actions to master severely technical and unfamiliar words. The results were in line with those of previous studies, which showed the effectiveness of affixes and roots analysis for teaching medical terminology (Fang, 1985) and keyword mnemonic strategies for the acquisition and retention of medical terminology (Troutt, 1987). Furthermore, medical students actively participated in class to master medical terminology. It turned out that they took notes during class to master medical terms more often than to master general English words. That is, they studied very hard to master medical terminology learned in their major in and outside the classroom.

Regarding VLS use by different GPA groups based on the previous semester, we found that the five strategies were ranked in the top ten as most frequently used in all the three groups of students at different GPA levels—using an online dictionary, studying the sound of the word, comparing to a similar known English word, using verbal repetition and guessing from context clues. The findings were consistent with those of Yang (2005), who addressed Taiwanese nursing students' VLS to learn medical terms and discovered that they generally preferred written repetition, verbal repetition, and bilingual dictionary strategies. Considering that the strategy of use of online dictionaries was newly added in our study, the latter two strategies were confirmed in our study by all groups of Korean medical students. Furthermore, written repetition was listed as one of the top-ten frequently used strategies by students with a GPA of 3.0 or below. Another common finding shown among the Yang's (2005) nursing and the medical students of our study is the very rare use of social strategies to discover new meanings, regardless of GPA. It is clear

that medical students did not depend on a social network, such as their classmates and instructors, to acquire new words.

To further explore the differences of VLS use by different academic achievement groups in a major, only seven, ten percent of the entire 66 strategies, showed statistical difference in the VLS use among three groups of their GPA: 4.0 or higher, 3.0 to 4.0, and below 3.0. Except for the social strategy of discovering meaning through group work activity, six were related to the consolidation of word meaning. The seven strategies were more frequently used among the two higher groups than the low-achieving group, and the middle group of learners were the most frequent VLS users, followed by the highest GPA group, although the two groups were not much different. Specifically, the middle and upper GPA groups with a 3.0 or higher made more use of three strategies, such as imagining the word's meaning (memory strategy), taking notes in class (cognitive strategy), and grouping words together spatially on a page (memory strategy), than the lowest GPA group. Furthermore, the middle group more often employed four strategies than the higher and lower groups—discovering the meaning through group work activity (social strategy), paraphrasing the word's meaning (memory strategy), using cognates (memory strategy), and using physical action when learning words (memory strategy). The results indicated that the higher GPA student groups made better use of memory and cognitive strategies, which means that higher-achieving students are active learners in all circumstances, taking notes during their medical class, imagining word meaning in their cognition, and using space to draw words in meaning groups outside the classroom.

Conclusion

Overall, there was not much difference in the most used VLS strategies in learning general English words and learning medical terminology in medical students. Yet, the strategies the medical students used more frequently to learn medical terminology than general English words require special attention. They depended more on physical pictures and actions to discover word meaning, and used sensory and analytical strategies more frequently to master medical terminology. The results cast very important implications for teaching English for medical purposes (EMP). Keeping in mind what strategies medical students make more use of to learn medical terminology than to learn general English words, English teachers in medical courses need to focus on teaching them explicitly in the strategy-based instruction. It is notable that the strategies of comparing to a similar known English word and using an online dictionary were ranked in the list of the top five both for learning general English words and medical terminology. The two were added in Laffey (2000) based on the observation of Korean learners of English in the study of Laffey's (2017), considering the shift of learner behavior associated with the current technology. It means that the VLS taxonomy should be further re-examined by including the contemporary learner behavior and characteristics and validated for future researchers.

Finally, the study had some limitations. It focused only on the frequency of strategies adopted by learners but did not examine the helpfulness. Further research is needed to clarify a strategy's degree of helpfulness so as to compare other studies on this aspect. The data for this study were collected from only one university, which may be influenced by the curriculum and educational context. Additional research on EMP requires wider data sampling from different regions and countries. It would be also valuable to investigate how medical students would be affected by their general English proficiency on their acquisition of medical terminology. If possible, future researchers may explore effective strategies for this particular group of learners, who need to master a heavily technical and academic vocabulary.

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Appendix

VLS Frequency for Medical Terminology and General English

	Frequency Medical Term (in %)	General English (in %)	McNemar test (p-value)
Meaning discovery strategies			
Analyze the part of speech	51.4	76.1	.000
Analyze the root word and any affixes	82.6	78.9	.523
Compare to a similar word in your native language	45.9	55.0	.087
Compare to a similar known English word	93.6	89.9	.424
Analyze any available pictures or gestures	79.8	65.1	.011
Guess from context clues	89.9	92.7	.607
Use a bilingual dictionary	82.6	77.1	.327
Use a monolingual English dictionary	50.5	56.9	.265
Use an electronic dictionary	34.9	55.0	.000
Use a smartphone dictionary app	50.5	61.5	.012
Use an online dictionary	93.6	95.4	.754
Use an online translator	65.1	70.6	.286
Use a word list to find the meaning	12.8	41.3	.000
Use flashcards to find the meaning	4.6	15.6	.002
Keep reading, hoping the meaning will become clear	40.4	65.1	.000
Ask a teacher for a translation	8.3	21.1	.001
Ask a teacher for a paraphrase or synonym	11.9	15.6	.454
Ask a teacher for an example sentence	8.3	21.1	.004
Ask a classmate or friend the meaning	61.5	59.6	.860
Discover the meaning through group work activity	29.4	37.6	.078
Consolidation strategies			
Study and practice the meaning in a group	36.7	34.9	.845
Ask a teacher to check flashcards or word lists for accuracy	5.5	6.4	1.000
Interact with a native speaker	13.8	33.9	.000
Study the word with a picture of the meaning	59.6	64.2	.511
Imagine the word's meaning	75.2	83.5	.078
Connect the word to a personal experience of yours	70.6	83.5	.007
Associate the word with its coordinates	52.3	53.2	1.000
Connect the word to its synonyms and antonyms	57.8	72.5	.007
Use semantic maps like word webs	5.5	9.2	.388
Use "scales" for gradable adjectives	36.7	54.1	.001
Use the Peg Method to remember words	18.3	14.7	.344
Use the Loci Method to remember words	28.4	30.3	.845
Group words together to study them	51.4	53.2	.864
Group words together spatially on a page	72.5	25.7	.000
Use new words in sentences	29.4	50.5	.001
Group words together within a storyline	47.7	46.8	1.000
Study the spelling of the word	81.7	86.2	.302
Study the sound of the word	89.0	90.8	.727
Say the new word aloud when studying	71.6	74.3	.678
Imagine the word form/spelling	63.3	74.3	.023
Underline the initial letter of the new word	44.0	27.5	.002
Study the configuration of the new word	85.3	74.3	.017
Use the Keyword Method to remember words	76.1	66.1	.090
Remember the affixes and roots	78.9	73.4	.327
Remember the part of speech	38.5	62.4	.000
Paraphrase the word's meaning	23.9	41.3	.001
Use cognates	48.6	53.2	.442
Learn the words of an idiom or phrase together	26.6	60.6	.000
Use physical action when learning words	67.9	45.0	.000
Use semantic feature grids when studying	13.8	10.1	.424
Use verbal repetition	89.9	85.3	.267
Use written repetition	80.7	83.5	.664
Use word lists	40.4	55.0	.017
Use flashcards	7.3	21.1	.001

Take notes in class	83.5	69.7	.006
Use the vocabulary section in your textbook	39.4	53.2	.024
Listen to a recording of the word	30.3	38.5	.064
Put English labels on physical objects	8.3	7.3	1.000
Keep a vocabulary notebook	32.1	59.6	.000
Use English-language media	18.3	43.1	.000
Test yourself with word tests	40.4	56.0	.003
Use spaced word practice	32.1	45.9	.004
Skip or pass the new word	29.4	38.5	.064
Continue to study the word over time	81.7	76.1	.307
Use a smartphone language learning app	16.5	33.9	.001
Use an online language learning program	13.8	31.2	.001
Total	3,112.3	3,505.2	

