

AN INVESTIGATION OF EFL NURSING STUDENTS' VOCABULARY LEARNING STRATEGIES (VLS) FOR MEDICAL TERMINOLOGY ACQUISITION

Joan Wan-Ting Huang

ABSTRACT

This research sought to investigate EFL nursing students' use of vocabulary learning strategies to learn medical terminology and further assess strategies used in relation to learning outcomes measured by two types of vocabulary knowledge: meaning recall (passive recall) and meaning recognition (passive recognition). The participants, 138 EFL nursing students in Taiwan, completed a meaning recall test and a meaning recognition test in week 8 of the semester, and they then took the English proficiency test (TOEIC Bridge) and filled out a vocabulary learning strategies survey in the following week. Both vocabulary outcomes had moderate correlations with English proficiency. Strategy use patterns appeared for the nursing students' medical terminology acquisition. They focused on looking up for corresponding meaning in L1 using a search engine, then learning orthographical and phonological forms to facilitate retention. A Pearson Correlation Analysis revealed that inferring word meaning, utilizing mnemonic devices for retention, and managing vocabulary learning were significantly and positively correlated with both vocabulary scores. In contrast, social strategies were the least conducive to achievement.

Key Words: vocabulary learning strategies, EFL nursing students, medical terminology, receptive vocabulary knowledge

INTRODUCTION

In the past, researchers have laid the pedagogical emphasis on learning and teaching discipline-specific vocabulary. First and foremost, the acquisition of specialized vocabulary plays a central role in gaining disciplinary knowledge. Woodward-Kron (2008) examined undergraduate education students' use of specialist jargon of child development in their writing assignments. The findings revealed that students needed to demonstrate their understanding of abstract concepts by adopting a sophisticated use of specialist language and terminology. The importance of technical vocabulary for any academic discipline is also supported by corpus-based studies, indicating technical vocabulary accounts for a coverage of 20% to 30% in specialized texts (Nation, 2013). Lei and Liu (2016) reported that academic medical words account for 31.75% and 30.44 % in medical journal articles and medical English textbooks, respectively. With that said, a good grasp of technical vocabulary is essential for specialist knowledge acquisition and reading comprehension of specialized English texts for ESP students. However, to date, terminology learning has not received as much attention as it should have (Alcina, 2011).

The current study intends to delve into how EFL nursing students acquire medical terminology, a prerequisite in both professional and academic domains in the nursing field. English medical terminology, widely used for both oral and written forms of clinical communication in Taiwan, serves as a foundation for health professionals to construct English medical discourse competence. Lu's (2016) qualitative study on the nursing community in Taiwan reported code-switching into English as a common oral communication strategy among doctors and nurses of the same first language (Chinese) when medical terms are mentioned. Nurses believe that code-switching into English can not only prevent patients' confidential and sensitive information from being disclosed but can also help them assert their professional identities in order to fit into their clinical communities. Furthermore, a significant amount of the use of English medical terminology is also observed in all forms of written communication such as admission notes, medical charts, change-of-shift reports, medical diagnoses, and orders (Bosher & Stocker, 2015; Chen & Chiou, 2010; Lu, 2020).

As essential as learning technical words is for EFL nursing preprofessionals, learning medical terminology of Latin or Greek origin could impose an extraneous cognitive load (Woodward-Kron,

2008). According to Hsu (2013), 75% of medical terms are either borrowings or neologisms of Latin or Greek origin. The learning task can be even more challenging for EFL students due to their limited exposure to the target language. Thus, strategic learning is particularly crucial for EFL nursing students in facilitating the acquisition of medical terminology. Gu (2019) pointed out that vocabulary strategy learning “is normally triggered by a difficult or new vocabulary task” (p.271), and through the application of vocabulary learning strategies (VLS) learners “can play a much more active role in managing and controlling the learning process, thereby maximising the outcomes of learning” (Gu, 2010a, p.1).

Despite a vast body of research into learners’ VLS for learning more general vocabulary, studies on examining strategies for learning discipline-specific technical vocabulary are few and far between (Gu, 2019). Furthermore, little attention has been paid to how EFL nursing students learn their discipline-specific language. Boshier and Stocker (2015) indicated two possible reasons: first, within the field of English for Specific Purposes (ESP), not until very recently has English for Nursing Purposes (ENP) begun to receive more attention because it has long been considered as a part of English for Medical Purposes (EMP); second, the lion’s share of attention in ENP research focuses on international nursing students studying or working in English-speaking countries. This study, therefore, aims to address these gaps so as to contribute to a better understanding of EFL nursing students’ VLS use in acquiring medical terminology and its relationship to their learning outcomes.

Vocabulary Learning Strategies (VLS)

The notion of learning strategies was first introduced into L2 in the late 1970s (Dornyei & Ryan, 2015). According to Oxford (1999), learning strategy refers to “specific actions, behaviors, steps or techniques that students use to improve their progress in developing skills in a second or foreign language” (p. 518).

Stemming from learning strategies, VLS has received a considerable amount of research interest. The initial attempts were made by different researchers to propose various VLS taxonomies. Oxford (1990) proposed a framework including six classifications for learning strategies: cognitive, metacognitive, mnemonic, compensatory, affective, and social strategies. According to Schmitt (1997), the framework, however, was inadequate in categorizing

vocabulary-specific strategies. Thus, he proposed a modified framework containing 58 strategies by first making a distinction between discovery and consolidation strategies. The former refers to strategies used to identify word meaning, whereas the latter refers to ones used to retain vocabulary knowledge for long-term use.

The development of VLS inventories has contributed to deepening our understanding of vocabulary development on a wide array of relevant issues. One important line of research is to address the degree of relatedness between learners' VLS use and their test performance, which typically is measured by either proficiency tests (Çelik & Toptaş, 2010; Kafipour & Naveh, 2011; Mizumoto & Takeuchi, 2008), vocabulary tests (Fan, 2003; Gu, 2010b; Nassaji, 2006; Yeh & Wang, 2004; Zhang & Lu, 2015), or both (Fan, 2020; Gu & Johnson, 1996). In Mizumoto and Takeuchi's (2008) study, Structural Equation Modelling (SEM) revealed that VLS most strongly predicted TOEIC scores compared to the other three variables (i.e., extrinsic motivation, intrinsic motivation, and extracurricular study time). Gu and Johnson (1996) applied both the vocabulary size test (VST) and the College English Test (CET Band 2) as two dependent variables and explored whether they correlated with Chinese learners' VLS use. The results indicated that metacognitive strategies best predicted general English proficiency. In Gu and Johnson's (1996) study, contextual guessing, skillful use of dictionaries (using dictionaries for learning purposes as opposed to comprehension only), notetaking, paying attention to word formation, contextual encoding, and activation of newly learned words also turned out to be positive predictors for both English proficiency and vocabulary size.

Some scholars further examined the relations between VLS and different aspects of lexical knowledge by administering various instruments such as the Vocabulary Levels Test, Lexical Frequency Profile, and Word-Associate Test, measuring learners' passive vocabulary size, active vocabulary use, and depth of vocabulary knowledge, respectively. According to Gu (2010b), VLS was positively related to passive vocabulary size but not with active vocabulary use. Visual repetition was the only strategy negatively correlated with vocabulary breadth knowledge. This is consistent with Zhang and Lu's (2015) finding that there exists a negative relationship between repetition strategies and vocabulary breadth knowledge. Surprisingly, using images for memorizing words didn't show any predictive power over vocabulary breadth and depth knowledge. On the contrary, they reported that mnemonic strategies

of learning word forms and associating words were predictive of vocabulary breadth knowledge and that learning word forms especially helped learners establish strong form-meaning links. Fan (2020) found that attention and guessing were positively associated with vocabulary breadth and depth knowledge, but socializing was negatively associated with the two.

Researchers (Gu, 2003, 2019; Schmitt, 1997) also stressed that some caution should be taken with analyzing as to which strategies work better or worse than others. With this said, the effectiveness of strategies might be dependent on various contextual factors, such as proficiency levels, gender, discipline, learning tasks, learning environments, or even culture. Since the present paper aims to shed light on nursing students' VLS use in learning medical terminology, which is rather discipline- and context-specific, a review of the existing research into strategies in the context of learning nursing English follows below because the above discussion might not be adequate to provide ample evidence or a complete picture.

Learning Strategies in an ENP Context

The following two studies review EFL nursing majors' learning strategies for medical English. Chen and Chiou's (2010) correlational study investigated whether variables such as learning strategies, measured by Oxford's Strategy Inventory for Language Learning (SILL) (1990), learning motivation, general English proficiency, and gender would contribute to nursing students' medical English achievement. The findings revealed that learning motivation, gender, and general English proficiency were positive predictors of medical English achievement. Nonetheless, only compensation strategies among the six strategy categories had predictive power over achievements. Another important finding was that those who were highly motivated showed a tendency to use a wider spectrum of strategies. Yang (2005) reported on an investigation on VLS for learning medical terminology with 89 nursing majors from a Taiwanese college using Schmitt's (1997) VLSS. The findings indicated that written repetition and verbal repetition were the most frequently used strategies among both high- and low-level students, grouped based on their Medical Terminology midterm scores. Additionally, neither high- nor low-level learners preferred social strategies.

Vocabulary Knowledge

Regarding vocabulary knowledge, it is generally divided into passive (receptive) and active (productive) knowledge (Laufer & Goldstein, 2004; Nation, 2001). According to Nation (2001), passive knowledge is needed for listening and reading, involving learners to comprehend the input, whereas productive knowledge is needed for speaking and writing, entailing recalling a word to express a meaning. Laufer and Goldstein (2004) further distinguished four degrees of vocabulary knowledge based on two dichotomous distinctions: active vs. passive and recall vs. recognition, illustrating how a word item can be tested on four modalities: passive recognition (to recognize a word's meaning), passive recall (to produce a word's meaning when the form is provided), active recognition (to recognize the form of a word), and active recall (to produce the word form when its meaning is given). However, Schmitt (2010) argued that the term "form" should be used instead of "active", and "meaning" instead of "passive" as the descriptions are more transparent and thus easy to decipher the type of knowledge being elicited (i.e., form and meaning). For example, passive recognition and passive recall should be replaced with meaning recognition and meaning recall, respectively. These two aspects of form-meaning linking knowledge of medical terms will be further explored in terms of their relationship with VLS in the current study. For consistency and transparency, Schmitt's terms (2010), namely meaning recall and meaning recognition, are used throughout the paper.

There exists scant empirical evidence about investigating EFL nursing students' VLS use to learn medical terminology. To my knowledge, there is almost no research that has explicitly shown the relationship between VLS for learning medical terminology and aspects of lexical knowledge. The two reviewed studies in an ENP context in the previous section only employed overall or part of Medical English course grades as a learning outcome variable. The limitation to such a methodological approach is that it failed to demonstrate the association between the use of different strategies and lexical knowledge in terms of a form-meaning relationship. Thus, there is a need to better understand which strategies could contribute to components of vocabulary knowledge acquired, measured by meaning recall and meaning recall tests in the study. The current study was undertaken to fill these gaps in the literature by pursuing the following research questions:

1. What VLS do EFL nursing students report using to learn medical terminology?
2. How is lexical knowledge measured by meaning recall and meaning recognition related to English proficiency and VLS?

METHODOLOGY

The study used a quantitative method approach to explore VLS use for learning medical terms of EFL junior nursing majors at a junior college in Taiwan. Primary data sources, including vocabulary tests measuring form-meaning link knowledge, an English proficiency test, and a questionnaire, were collected from three intact nursing classes enrolled in the required course of Medical Terminology. Data collection took place in the middle of the semester to ensure participants had already had enough input to take vocabulary tests and fill in questionnaires related to VLS for learning medical terms.

Both vocabulary tests were administered to the three intact classes in paper-pencil formats in week 8, one week prior to the midterm exam. The meaning recall test was administered before the meaning recognition test. The reason to follow such an order was to ensure that the participants did not get hints from one test for the other. Based on the prescribed schedule at college, the English proficiency test was given in week 9 (midterm-week) as was the questionnaire.

Participants

Participants (17–18 years old) were 152 nursing majors. These students are all native speakers of Chinese who have learned English for 8–10 years. The majority of students' general English proficiency was at A2 level or below as established by the CEFR. They were recruited from three intact classes, taking Medical Terminology as a required course offered in the third year of the five-year nursing program during the data collection process. Medical Terminology is taught for two hours every week by two nursing instructors, aiming to introduce students to commonly used medical terms for different body systems. The instructional textbook and materials unified for all nursing classes were designed by one nursing instructor who has been

teaching the course Medical Terminology for more than ten years. By the time the participants took the course, they had taken core courses for a total of 27 credits in the nursing curriculum such as Human Anatomy, Introduction to Nursing, Fundamental Nursing, Physical Examination and Assessment, and Medical-surgical Nursing so they had acquired discipline-specific knowledge needed for an understanding of medical terms. It is noted that all these courses are taught in Chinese so students were not familiar with the English equivalent of medical terms before they took Medical Terminology.

Vocabulary Tests

The vocabulary test designed for the current paper mainly assessed learners' receptive retrieval, an indicator of learners' ability to comprehend the meaning of the target words. The nursing instructors thought the most important skill to aim for during instruction was for the participants to recognize medical terminology when presented because nurses might have more frequent encounters of medical terminology involved with inputs (listening, reading) rather than outputs (speaking, writing) in clinical settings in Taiwan. Another reason is that the participants were considered novice learners of learning medical terminology so their productive knowledge might not be available in the first place. Thus, a meaning recognition test and a meaning recall test were developed for the present study following Laufer and Goldstein's (2004) test modalities for measuring these two degrees of vocabulary knowledge. The medical terminology test was based on the scope of the midterm exam of the course Medical Terminology designated by the nursing instructors, covering the first four units of the textbook: cardiovascular system, respiratory system, nervous system, and digestive system. The vocabulary test contained 20 items in total, with five medical terms taken from each unit. Although no participants were familiar with English equivalents of medical terms, a vocabulary knowledge test was given before instruction to ensure they didn't have any prior knowledge of the target words.

The meaning recognition test

The recognition test is composed of 20 multiple-choice items. The participants were presented with a target word in its L2 form and they needed to identify the equivalent Chinese translation among four options. Considering that participants' blind guessing might affect the test results, the fifth response "not sure" was added to the options for all test items, with such an answer treated as an incorrect answer. Each correct answer was worth five points. Thus, the highest possible score for this section was 100 points. An example of a test item is presented as follows:

Cardiomegaly

- A. 心搏過緩 B. 心悸 C. 心臟肥大 D. 心絞痛 E. 不確定 (not sure)

The meaning recall test

Different from the meaning recognition tests, the learners had to supply L1 items (i.e., Chinese translation) as opposed to choosing L1 items from options. Participants were provided with an L2 form as a cue to write down its Chinese translation equivalent. Again, five points were given for each correct answer. Thus, the possible maximum score for both passive recall tests was 100 points. An example of a test item is presented as follows:

Cardiomegaly _____ (Answer: 心臟肥大)

English Proficiency Test

The participants' English proficiencies were measured using a sample TOEIC Bridge reading test administered every semester by the junior college during the midterm exam week. The purpose for the college to administer such tests regularly is twofold: to evaluate curriculum effectiveness and to track learners' progress. The TOEIC Bridge test, developed to serve as a "bridge" to the TOEIC test, is intended for test-takers with beginning to low-intermediate English language proficiency in the context of everyday life. Thus, the test is

deemed suitable for targeted participants of English proficiency labeled as A1-A2 level in the CEFR in the current study. Previous studies also provided validity evidence indicating the appropriateness of employing the TOEIC Bridge test at educational institutions as a measurement of students' English proficiency (Sinharay et al., 2009; Zhang et al., 2013).

The English proficiency test consisted of 50 multiple-choice questions with two sections, including 20 grammar and 30 reading comprehension items. The test mainly assesses students' knowledge of grammatical structures and their ability to read and understand reading passages. With two points for each item, the highest possible score for the English proficiency test was 100 points.

The Vocabulary Learning Strategies Survey (VLSS)

The current study adopted Schmitt's Vocabulary Learning Strategies Survey (VLSS) because it has been the most widely used instrument to ascertain respondents' VLS use. This allows for a direct comparison with data from previous studies based on Schmitt's inventory. Apart from identifying learners' VLS for learning medical terms, the VLSS also aims to help us comprehend which strategies contribute to learning outcomes of the two aspects of lexical knowledge.

The original version of the survey divided 58 strategies into five categories: determination, social, cognitive, memory, and metacognitive strategies. According to Schmitt's distinction (1997), determination and part of social strategies were referred to as discovery strategies, whereas social, memory, cognitive, and metacognitive strategies are considered consolidation strategies, as presented in Table 1. The questionnaire was first translated into Chinese, on which all strategies specified for learning medical terminology were explained, and some were clarified in examples. The questionnaire was piloted to a small group of nursing students who had taken Medical Terminology in the previous semester. This was to ensure no items would cause misunderstanding and could be fully understood by the target participants. The researcher also went through the questionnaire item by item with the pilot participants to ensure the stated strategies were applicable to learning medical terms and to see if there was any particularly crucial strategy missing.

Based on the feedback collected from the pilot tests, some modifications were made. For example, the respondents indicated that

they looked up medical terminology using the Google search engine and an online medical dictionary. Neither strategy was included as a strategy item on the original questionnaire. Thus, the two items “use of medical dictionary” and “use of Google” were added to the category of determination strategies. Two items that involved the use of cognates were deleted because Chinese is not an Indo-European language so a form-meaning connection might not be transferable from English to Chinese (Schmitt, 1997). The item “Interact with native speakers” was slightly modified to “Interact with health professionals.” Three strategies “Scales for gradable adjectives,” “Peg method,” and “Loci method” were also deleted because strategy statements were not familiar to the pilot participants or did not seem to apply to a context of learning medical terms. Thus, the finalized version consisted of 55 items which were rated on a 5-point Likert scale, ranging from 1, I have never used it, to 5, I always use it.

Table 1

Schmitt’s (1997) Taxonomy of Vocabulary Learning Strategies

Discovery strategies	Consolidation strategies
<u>Determination strategies:</u> discover new word’s meaning by guessing and using reference materials.	<u>Social strategies:</u> learn or practice vocabulary by engaging in group work or interaction with people
<u>Social strategies:</u> discovering new word’s meaning by asking someone who knows.	<u>Memory strategies:</u> application of mnemonic devices, using picture/imagery, rhyming, related words, word’s orthographical or phonological form, physical action. <u>Cognitive strategies:</u> repetition, and use of mechanical means <u>Metacognitive strategies:</u> control and evaluate one’s own learning

Data Analysis

On completing the data collection, participants who did not complete either the questionnaire or vocabulary tests were eliminated, so a total of 138 surveys were collected for the data analysis.

Descriptive analysis was obtained to see overall VLS patterns and the variation in the frequency of VLS use by categories and individual items. Furthermore, a correlation analysis was performed to further analyze passive lexical knowledge of medical terms in relation to English proficiency and strategy use.

RESULTS AND DISCUSSION

The five categories of VLSS were checked for their internal reliability by using Cronbach's alpha coefficient, as reported in Table 2. The overall Cronbach's alpha for the scale is .938, indicating highly acceptable reliability. Participants' average scores on the meaning recognition and the meaning recall tasks were 63.91 (SD = 19.31) and 39.49 (SD = 23.97), respectively. The mean for the total vocabulary scores, adding up both meaning recall and meaning recognition scores, was 103.41 (SD = 39.93 out of a maximum of 200 points, while that for the English proficiency test was 58.46 (SD = 15.21).

Table 2

Internal Consistency Reliability

Subscale	Cronbach's alpha
Determination strategies	alpha = .760
Social strategies	alpha = .763
Memory strategies	alpha = .895
Cognitive strategies	alpha = .754
Metacognitive strategies	alpha = .725
Total score	alpha = .938

Research Question 1: What VLS Do EFL Nursing Students Report Using to Learn Medical Terminology?

To answer Research Question 1, mean scores of the entire VLSS, five categories of VLSS, and individual strategy items were calculated to investigate EFL nursing students' medical terminology

learning strategies. The average mean in strategy use frequency for the 55 strategies ranged between 1.75 and 4.33. As indicated in Table 3, the participants reported a medium frequency (3 = sometimes, 4 = often) of the mean strategy use on overall and five categories of VLSS. They also reported using determination strategies most frequently and then in descending order, cognitive, memory, social, and metacognitive strategies. When comparing individual strategy items, Table 4 shows the ten most frequently used strategies. It was found that these top ten strategies were well-balanced, with half of them in the category of discovery strategies, and the other half consolidation strategies.

Table 3

Mean and Ranking profile for five categories of VLSS

	Sum	Mean	<i>SD</i>	Ranking
DET	434	3.14	.623	1
COG	423	3.06	.698	2
MEM	419	3.04	.658	3
SOC	404	2.93	.712	4
MET	387	2.80	.898	5
Overall	417	3.02	.566	

Table 4

Top Ten Most Frequently Used VLS

Type	Item	Description	Mean	SD	Ranking
Discovery	DET7	Use of google	4.33	0.88	1
Consolidation	COG2	Written repetition	4.20	1.01	2
Consolidation	MEM12	Study the sound of a word	4.09	1.00	3
Consolidation	COG1	Verbal repetition	4.06	1.12	4
Consolidation	MEM11	Study the spelling of a word	3.94	1.15	5
Discovery	DET2	Analyze affixes and roots	3.92	1.04	6
Consolidation	MEM14	Image word form	3.91	1.04	7
Discovery	DET4	Guess from textual context	3.88	0.96	8
Discovery	DET3	Analyze any available pictures or gestures	3.86	0.95	9
Discovery	SOC1	Ask teacher for an L1 translation	3.83	1.11	10

Item use of Google (DET 7), a discovery strategy, ranked at the top of the list with the highest mean of 4.33. The other four frequently-used discovery strategies included: analyzing affixes and roots (DET 2, $M = 3.92$), guessing from textual context (DET 4, $M = 3.88$), analyzing any available pictures or gestures (DET 3, $M = 3.86$), and asking a teacher for an L1 translation (SOC 1, $M = 3.83$). The findings revealed that participants discovered a new word's meaning mostly through the use of the Google search engine, appearing to be the most favored reference tool over a medical dictionary (DET 8, M

= 2.29), bilingual dictionary (DET 5, $M = 2.19$), and monolingual dictionary (DET 6, $M = 1.78$). In looking at the consolidation strategies, all of them, to a certain extent, are associated with learning orthographical and phonological forms of medical terms.

As regards discovery strategies, the use of search engines was found to be a major reference tool used by nursing students to look up medical terminology. The data indicated that search engines were more extensively used than specialized or general dictionaries for lexicographic purposes in specialized settings. These findings corroborate some of those found in Gromann & Schnitzer's (2016) study that investigated 430 business majors' resource selection process and consultation behaviors in specialized settings. Similarly, their findings also revealed a low percentage of consultation to specialized dictionaries (less than 10%) and extensive reference to non-lexicographic resources, such as search engines, social media, and online translators. In the current study, the rare use of specialized resources by nursing students could be due to that learners were not aware of the resources, or simply felt that a search engine query was convenient and adequate enough to search for the equivalent meaning of medical terminology in L1.

Overall, the findings suggested that learners mainly exerted their efforts looking for a corresponding meaning in Chinese using a search engine, then learning the spelling and pronunciation of words to facilitate retention. The learners' attention was focused on learning words at a more surface level, not so much on "learning to use words syntactically and pragmatically" (Gu & Johnson, 1996, p. 659). Part of this may be due to the nature of learning tasks and pedagogical practices. Empirical evidence has shown that instructional approaches and pedagogical activities greatly affect learners' strategy use (Ghalebi et al., 2020; Lai, 2009; Yeh & Wang, 2004). As distinct from more general L2 vocabulary, most medical terms are low-frequency words, rarely encountered in general readings or natural language acquisition contexts. Given that students have developed a certain level of schemata in subject-specific content from the previous core nursing curriculum, it was observed that the nursing instructors' pedagogical attention concentrated mainly on helping students map the form of words to a meaning that already existed in their L1. A variety of reinforcement exercises was given to students to write down L1 equivalents, match definitions, and practice word pronunciation in class. Typical pedagogical practices rarely involved reading texts or any sort of contextualized activities. The adopted teaching method of decontextualized word learning by nursing

instructors could be attributed to students' low mastery of L2 and a very large number of medical terms to be covered within a limited time frame. Although substantial evidence has advocated learning vocabulary through reading (Lesaux et al., 2010), some researchers have also argued that the learning rate of a form-meaning link can be rather slow from reading an L2 text (Ballance & Cobb, 2019), and the approach is only effective when learners have reached a certain threshold of L2 skills (Elgort et al., 2015; Gu & Johnson, 1996).

The subjects reported determination strategies the most frequently used and metacognitive strategies the least frequently used. The preference ordering of strategy category is similar to that of Turkish undergraduates in Ghalebi et al.'s (2020) study, which sought to compare differences in VLS use between undergraduates and postgraduates. Ghalebi et al. (2020) found that educational level was a significant factor in determining English language learners' VLS. The study revealed that postgraduates preferred higher-order metacognitive strategies, whereas undergraduates employed mostly superficial determination strategies on discovering the meaning of new words. According to Grabe and Stoller, metacognitive knowledge "permits us to reflect on our planning, goal setting, processing of tasks, monitoring of progress, recognition of problems and repair of problems" (2002, p. 46). This might imply that learners at lower educational levels (i.e., junior college students; BA students) have not yet developed sufficient metacognitive awareness during the language learning process due to their limited experience in studying at the tertiary level. According to previous studies, age and proficiency also play a part in learners' selection of strategies. The claim can be supported by Schmitt's (1997) study that Japanese learners reported more use of higher-order strategies as they matured and by both Ni et al.'s (2008) and Lai's (2009) study that metacognitive strategies were applied more by proficient learners. Thus, all the aforementioned factors (educational level, age, and proficiency) might explain the participants' rare use of metacognitive strategies.

Research Question 2: How Is Lexical Knowledge Measured by Meaning Recall and Meaning Recognition Related to English Proficiency and VLS?

Another important aim of the study was to assess two types of lexical knowledge in relation to English proficiency and strategy use. Note that VLSS was specified for analyzing learners' VLS for learning medical terms. Thus, the data would not be suited for interpreting correlations between proficiency and VLS. As shown in Table 5, Pearson correlation coefficients between variables were calculated. The results indicated that meaning recall and meaning recognition were strongly related ($r = 0.70, p < 0.01$), and both have moderate correlation coefficients of .48 ($p < 0.01$) and .44 ($p < 0.01$) with participants' English proficiency, respectively. Meaning recall revealed significant correlations with four out of five categories of strategy use, except for social strategies, whereas meaning recognition was positively and significantly correlated with three categories: detective, memory, and metacognitive strategies.

The data were further analyzed by examining individual items showing significant (either positive or negative) correlations with two vocabulary variables. As shown in Table 6, a great deal of overlap of strategy items significantly correlated with both vocabulary variables also supported the high correlations between these two types of passive vocabulary knowledge. Nineteen strategy items demonstrated significant and positive correlations with the two vocabulary variables, including three determination strategies, 12 memory strategies, one cognitive strategy, and three metacognitive strategies. The three determination variables (DET2, DET3, DET4) were related to guessing strategies, indicating learners utilized linguistic and contextual cues (i.e. affixes, pictures, gestures) to find the meaning of medical terms. All the memory strategies were associated with mnemonic devices for later retrievals, such as using imagery, associations, grouping, a word's orthographical and phonological forms, and paraphrasing. The three metacognitive strategies referred to learners' conscious perspectives of monitoring and evaluating their learning process and accomplishments regularly. The only cognitive strategy item demonstrating significant and positive correlation to both outcome variables was the use of vocabulary sections in textbooks (COG 6). Taken together, the significant and positive correlations among variables suggest that inferring word meaning with cues (determination strategies), utilizing mnemonic devices (memory strategies), and managing vocabulary learning (metacognitive strategies) could contribute to technical vocabulary

learning gains. In contrast, skipping or passing a new word (MET 4) was the only item negatively and significantly correlated with the two outcome variables.

Table 5

Correlations among Recall, Recognition, English proficiency, and Vocabulary strategies

	Recall	Recogni tion	DET	SOC	MEM	COG	MET
Recall	----	-----	-----	-----	-----	-----	-----
Recogni tion	.70**	-----	-----	-----	-----	-----	-----
Proficie ncy	.48**	.44**	-----	-----	-----	-----	-----
DET	.34**	.22**	-----	-----	-----	-----	-----
SOC	-.03	-.03	.30**	-----	-----	-----	-----
MEM	.30**	.27**	.66**	.54**	-----	-----	-----
COG	.19*	.16	.46**	.37**	.66**	-----	-----
MET	.25**	.21*	.48**	.46**	.71**	.67**	-----

Note. DET = Determination; SOC = Social; MEM-Memory; COG = Cognitive; MET = Metacognitive.

**Correlation is significant at the 0.01 level (two-tailed).

*Correlation is significant at the 0.05 level (two-tailed).

The results showed that meaning recall showed a higher correlation (.48) with English proficiency than meaning recognition (.44). This lends support to Laufer’s finding that meaning recall was a better predictor of classroom success in L2 performance. Additionally, meaning recall was correlated with greater use of strategies by categories than meaning recognition. This attested to Laufer’s hierarchy of difficulty in lexical knowledge, indicating that

meaning recall is more difficult than meaning recognition. This also explains learners, thus, probably need to draw on a wider repertoire of strategies for meaning recall than meaning recognition.

Table 6

Strategies that Significantly Correlated with 2 Vocabulary Variables

Strategy Item	Meaning recall	Meaning recognition
DET2 Analyse affixes and roots	.407**	.283**
DET3 Analyse any available pictures or gestures	.296**	.172*
DET4 Guess from textual context	.289**	.234**
DET5 Bilingual dictionary	.173*	.150
MEM2 Image word's meaning	.299**	.262**
MEM3 Connect word to a personal experience	.339**	.242**
MEM4 Associate the word with its coordinates	.360**	.228**
MEM5 Connect the word to its synonyms and antonyms	.329**	.177*
MEM7 Group words together to study them	.307**	.216*
MEM9 Use new word in sentence	.196*	.170*
MEM11 Study the spelling of a word	.218*	.251**
MEM12 Study the sound of a word	.269**	.247**
MEM14 Image word form	.279**	.262**
MEM18 Affixes and roots (remembering)	.252**	.183*
MEM19 Part of speech (remembering)	.250**	.238**
MEM20 Paraphrase the word's meaning	.242**	.230**
COG6 Use the vocabulary section in your textbook	.230**	.167*
MET2 Testing oneself with word tests	.313**	.267**
MET3 Use spaced word practice	.331**	.277**
MET4 Skip or pass new word	-.194*	-.240**
MET5 Continue to study word over time	.234**	.209*

**Correlation is significant at the 0.01 level (two-tailed).

*Correlation is significant at the 0.05 level (two-tailed).

A great number of memory strategies showed significant and positive correlations with two technical vocabulary variables.

According to Schmitt's (1997) classification for the inventory, memory strategies were mostly mnemonic techniques for transferring information into long-term memory, whereas cognitive strategies were involved with mechanical repetition for remembering. The current findings suggested that effective memorization was more than repetition, which is associated with cognitive strategies in the current study. Similarly, Zhang & Lu (2015) reported repetition strategies were not significant predictors for vocabulary breadth or depth knowledge. According to Gu & Johnson (1996), visual repetition was even a negative predictor of both general proficiency and vocabulary size. As opposed to rote repetition, mnemonic strategies are "more desirable" as they result in deeper processing of words (Fan, 2003, p.224). Extensive research also provided evidence of enhancing vocabulary acquisition and retention with the utilization of various mnemonic devices, such as the keyword method (Shapiro & Waters, 2005), word stems (Wei, 2015), etymological information (Boers et al., 2007), paired associations (Dunlosky et al., 2013), word forms (Kida, 2010), to name a few.

The current evidence also showed inferring word meaning skillfully was positively correlated with learning passive knowledge of medical terms. The result that analyzing affixes and roots (DET 2) demonstrated the highest correlation with meaning recall also showed this strategy is especially important to perform accurate lexical inferencing of medical terms. In the case of learning medical terminology of Greco-Latin origin, knowledge of word parts (roots, prefixes, suffixes) is attested to be crucial to help learners derive the appropriate meaning (Liu & Lei, 2019). Most medical terms are composed of three basic parts: word roots, prefixes, and suffixes. For instance, the term pericarditis, meaning inflammation around the heart, can be anatomized into peri- (prefix for around), cardi (root word for heart), and -itis (suffix for inflammation). Various combinations of these components determine the meaning. Thus, students needed to acquaint themselves with rules of combining word parts and corresponding meanings of word parts so that they could define meanings through analyzing word elements. This also shows that learning medical terms required students to take in a huge amount of information and commit learned knowledge to memory. This might explain rehearsing intermittently over extended periods was equally important for effective learning of medical terms. A general assumption is that constant form-meaning rehearsals increase encounters of learned words, thus leading to better retention (Ballance & Cobb, 2019).

Schmitt (1997) emphasized that learners, with limited study time, could not cover all words so they need to prioritize the most useful word items. However, the findings showed negative correlational results between skipping or passing a new word (MET 4), and learning results could be due to that medical word lists appearing in the teacher-made textbooks were rigorously examined and selected by nursing instructors already so they were all deemed frequent and practical medical terms to learn. In general, social strategies also showed negative correlations with two vocabulary outcomes. This could be due to that VLS attested beneficial to learning outcomes such as word inferencing and use of mnemonic strategies; metacognitive awareness seemed to involve more of the parts of individual practices, and to a lesser extent any form of collaboration. The data seemed to indicate solitary learning without distraction from others facilitated more effective learning of medical terms than learning in a group. Similar findings were also reported by Fan (2020), proclaiming social strategies had negative predictive power over vocabulary breadth and depth knowledge.

CONCLUSION

This study profiled the strategies of EFL nursing students for learning medical terminology. The participants reported using a search engine extensively as a discovery strategy to look up a corresponding meaning in Chinese. On the other hand, the most frequently used consolidation strategies were related to learning orthographical and phonological forms of medical terminology. Furthermore, two dimensions of form-meaning link knowledge of medical terms, namely meaning recall and meaning recognition, were examined in relation to participants' VLS use and English proficiency. The significant moderate correlations between two lexical variables and English proficiency suggested that English proficiency might play a role in learners' development of medical terms. Moreover, the current evidence also showed lexical inferencing, employment of mnemonic devices for linking form and meaning, and evaluative reflections on vocabulary learning could contribute positively to the development of the passive knowledge of medical terms.

Learning technical vocabulary in an ESP context can be challenging for all-disciplinary students. The challenge of learning

medical terminology of extensive Greco-Latin origins in L2 can be further compounded for EFL learners without language background of Romance languages (Coxhead, 2019). Based on the findings, the current paper has proposed some pedagogical implications for medical terminology instructions. First, the findings revealed that self-management and constant reflection of the learning process were crucial for vocabulary development. However, most participants lacked such metacognitive awareness, notwithstanding which tends to improve within time and proficiency development. Thus, for younger learners, teachers need to engage learners in evaluative reflection exercises to facilitate metacognitive awareness development. Second, mnemonic strategies and lexical inferencing demonstrated significant correlations with medical terminology learning. Nursing educators could incorporate instructions on contextual guessing strategies for discovering a word's meaning and mnemonic strategies for consolidating form-meaning connections. These strategies should be demonstrated and followed by guided practices so learners can learn to apply them. According to Mizumoto and Takeuchi (2009), after explicit VLS instruction, learners applied strategies in a wider repertoire and higher frequency and were more intrinsically motivated.

The finding also indicated that learning medical terminology in isolation resulted in nursing students resorting to the use of surface strategies, such as checking definitions and learning word forms. Researchers have also warned against over-reliance on decontextualized vocabulary learning. As cautioned by Barcroft (2019), learners who limit themselves to only word-level input would fail to develop “an array of other types of knowledge and development of other types of abilities” (p.485), or “a threshold level of L2 skill” (Gu & Johnson, 1996, p.669). Based on previous analysis of English needs of Taiwanese nurses in clinical settings, nurses need to integrate their medical terminology knowledge beyond word levels, and into discourse levels, for example, to communicate effectively with foreign patients and caregivers (Lu, 2018), to read English research papers in the specialist language (Lai, 2016), and to exchange information with international healthcare professionals (Bosher & Stocker, 2015). Empirical evidence reported that Taiwanese nurses suffered from insufficiency in English skills, thereby resulting in poor quality of patient care and dissatisfaction of patients (Lu et al., 2009; Lu, 2018). It is urged that effective strategy instruction should complement contextualized learning, incorporating task-based or communicative activities.

Inferences drawn from the results of this study might be limited. One major limitation might be the participants' homogeneity. Participants were mostly low proficient English learners, the generalizability of the data might fall short of truly presenting a fuller picture. Another is a common drawback of using self-reported data to ascertain learners' VLS, which may inflate the range of strategy use and differ from real practice, as Dörnyei (2007, p. 115) cautioned, "necessary simplicity of the questions [...] usually provide a rather thin description of the target phenomena." Thus, future research that examines learners' VLS could supplement questionnaire surveys with qualitative data to provide a deeper and richer understanding into the subject matter. The third limitation is that the current paper only evaluated two degrees of vocabulary knowledge given that the instruction focused more on meanings of medical terminology and to a lesser extent on forms. According to Laufer and Goldstein (2004), there are four degrees of vocabulary knowledge in terms of form-meaning connections, future studies could, thus, further investigate the relationship between learners' VLS and active knowledge of medical terminology bypassed by the present study.

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CORRESPONDENCE

*Joan Wan-Ting Huang, Department of Applied Foreign Languages,
MacKay Junior College of Medicine, Nursing, and Management,
Taipei, Taiwan
Email address: s279@mail.mkc.edu.tw*

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