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Task Development for an Online English Technical Vocabulary Self-Learning System for Engineering Students

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Abstract

Teaching technical vocabulary is considered one of essential aspects of the English for academic science and technology (EAST) program and, therefore, various vocabulary lists have been created to date. However, very few EAST vocabulary self-learning systems suitable for Japanese university students have been developed. This study examines thetechnical vocabulary learning strategies used by 76 researchers and 172 graduate students majoring in engineering. The purpose of this study is to clarify their vocabulary learning strategy use patterns, select vocabulary learning tasks based on their preferences, and incorporate the learning tasks to the new online technical vocabulary self-learning system we developed. The results of the study suggest that making sentences, writing repetition, oral repetition, semantic grouping, and testing tasks should be incorporated into the system.

Keywords: *English for specific purposes, technical vocabulary, online vocabulary learning system*

Introduction

The importance of teaching English for specific purposes (ESP) has been extensively acknowledged in the field of English language education for tertiary level students, as well as vocational students. Since most of the journal articles published worldwide is written in English, particularly in the field of science and technology (Sano, 2002; van Weijen, 2012), engineering students in non-English-speaking countries are often required to learn English (Cao, 2014; Fard-Kashani, Jahromi, Javadi, & Fallahi, 2015). Currently, English for academic science and technology (EAST), which is one of the branches of ESP, is attracting the attention of ESP practitioners and researchers worldwide.

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Teaching specialized vocabulary is considered one of the essential parts of an ESP class (Swales, 1900). Although some lexical items are well known to other communities, they areused in a special or technical way in the target community. Some include highly terminological vocabulary that has never been heard by other community members. Swales (1990) argues that without using such specific lexes, discourse community members cannot establish communication on their topic of specialization. ESP learners are expected to acquire lexes specific to the target genre to become a member of the community.

Typically, researchers majoring in ESP and corpus linguistics analyze their EAST corporate develop EAST wordlists for learners and engineers (e.g., Chujo, Utiyama, & Nakamura, 2007; Ishikawa, 2011, 2017; Ishikawa & Koyama, 2007; Sasao, Kato, Eugene, & Levin, 2015; Ward, 1999). This study uses the wordlist compiled by Ishikawa (2017a), which is one of the largest wordlists that are accessible on the Internet based on an analysis of the EAST corpus of journal articles, and develops an online vocabulary self-learning system to enable Japanese engineering students and workers to learn the words on the list. Here, the discussion focuses on the type of learning exercises that should be incorporated into the system to memorize the EAST words. Accordingly, we examine the learning strategies that are believed to be effective by engineering students and researchers and discuss how they are realized in the system as learning exercises.

Literature Review

Vocabulary Learning Strategy Inventories

Previous research has described various learning strategies used by second language (L2) learners. The manner in which a learner chooses learning strategies is affected by several factors, such as the degree of awareness, learning experiences, needs, attitude, nationality, age, sex, and proficiency level (e.g., Oxford, 1990; Schmitt, 1997). In addition, Schmitt (1997) suggested that the selection of vocabulary learning strategies (VLSs) is related to the frequency of the word to be learned.

To date, numerous VLS inventories have been developed and used in studies to describe learners' VLSs. Some studies use about 25 items (e.g., Horino & Ichikawa, 1997), whereas some use approximately 50 items (Schmitt, 1997; Mizumoto, Someya, & Yamanishi, 2014; Ishikawa & Ito, 2017) and some use nearly 100 items (Gu & Johnson, 1996). Schmitt & Schmitt (1993) organized the VLSs described by earlier studies into two main categories, "Initial learning of a new word's meaning" and "studying and remembering the word's meaning once it is known" (p. 28), although some items are connected to each other and can intrinsically overlap. The former category involves the "determination strategies"used to discover the meaning of a new wordby an individual learner (1) on their own or (2) with the help of others. The latter group comprises four "consolidation strategies": (1) "social strategies" to consolidate the word knowledge with others; (2) "memory strategies", known as "mnemonics," to retain and retrieve the information of the word; (3) "cognitive strategies" for repetition or mechanical rehearsal; and (4) metacognitive strategies for planning, monitoring, and evaluating the way to learn the word (Schmitt, 2000, p. 135).

This paper focuses on the VLSs that Japanese adults (university students or researchers) tend to use and aims to develop a learning system that suits their needs and preferences, rather than minutely clarifying their VLSs. Therefore, we use the same list of VLS inventories as Ishikawa (2017b), which has been simplified from the longer list of VLS inventories that was used by Ishikawa & Ito (2017). It includes the items of both determination and consolidation strategies mentioned earlier by Schmitt (2000).

Successful Language Learner

Some language learners perform better than others in the same class, although all the learnersuse the same materials and attend the same lectures. Several researchers examined the relationship between the VLSs used by learners of English and their performances. Successful or good language learners tend to share particular VLS use patterns. Good learners tend to use various strategies, including "deeper" strategies and self-regulating strategies, since they are very conscious of learning (Schmitt, 2000). After reviewing the literature, Takeuchi (2003) argued that learning strategies that are shared among good learners in ESL situations and those shared in EFL situations are verydifferent.

Based on the VLS use of Japanese learners, Schmitt (1997) examined 600 learners from four different age groups (junior high school, high school, university, and adult learners) and showed that Japanese learners follow particular strategy use patterns as a whole and the patterns can change as learners grow older or become more proficient. Although the Japanese prefer written repetition, its use decreases with the increase in age of learners mature. Compared to other groups, the university student group and adult learners group tend to use a dictionary more often to discover the meanings of words and use mechanical repetition less often (pp. 223-224).

The study by Schmitt (1997) suggests that the VLS use preferred by the Japanese may be affected by either their age or proficiency level or both. Further, the study reveals the changing patterns Japanese learners' tendencies for selecting VLS to some extent; however, it does not consider the learners' needs or the type of English that they are learning. Junior and senior high school students may learn general English to pass their entrance examinations, university students may learn literary English to study Shakespeare an texts, and adult learners may learn business English to communicate with foreign clients or business partners. It is not clear whether the results of the study can be applied to the VLS use of EAST learners, who are the members of a specific academic community and use engineering English for a specific purpose. Therefore, this study examines the VLS use of Japanese learners, who use EAST to read and write articles in the engineering field.

Research Design

Research Aims and Questions

To provide vocabulary learning tasks appropriate for Japanese engineering students to learn the technical vocabulary, this study examines the VLS that they prefer to use for technical

vocabulary learning. Assuming that VLS preference patterns change as learners mature and become more proficient in using EAST, as suggested by Schmitt (1977), this study examines theVLS preference patterns of ordinary language learners (OLL) and successful language learners (SLL). In this study, graduate students majoring in engineering will be defined as the OLL of EAST, and faculty members of engineering, such as professors, associate professors, and assistant professors, will be referred to as the SLL of EAST. Faculty members are supposed to use EAST to do their research work, reading and writing article journals, giving lectures or presentations, and having discussions in English. It means that theyhave succeeded in language learning.
The present study examines following research questions:

1. Which VLS does both OLL and SLL tend to use?
2. Which VLS that OLL tend to avoid does SLL prefer to use?
3. Which VLS that SLLtend to avoid does OLLprefer to use?

The VLSs that are being used by OLL and SLL can be basically classified into four groups, as shown in Table 1.

Table 1
Four Types of Strategies

	SLL use less	SLL use more
OLL use more	OLL > SLL	Both
OLL use less	Neither	SLL > OLL

We need to consider how to deal with a variety of VLSs based on who use them.
(1) Tasks based on the VLS that both OLL and SLL tend to use should be incorporated into the system (RQ1).
(2) Suppose that the VLS changes in patterns from OLL patterns to SLL patterns as learners grow or become more proficient,it might be better for OLL to trythe tasks based on the VLS preferred by SLL but not by OLL (RQ2), in addition to the tasks based on their preference VLS. They may get aware of their learning strategies when they use the VLS which they have never used before and they can proceed to the next learning stage to become SLL. Such tasks should be incorporated into the system; fewer tasks for lower-intermediate learners and more tasks for intermediate and advanced learners should be incorporated.
(3) Tasks based on learners' preference VLS should be basically incorporated. The system should allow the learners to perform the tasks based on their preference VLS (RQ1, RQ3). Contrarily, it might be better for advanced learners to choose not to perform the tasks based on the VLS preferred by OLL and not by SLL (RQ3).

Method

We requested the faculty members of engineering and graduate students to answer a questionnaire survey using a 5-point Likert scale via the Internet in February 2018; consequently, we received responses from 81 faculty members and 198 graduate students. This study analyzes the responses from faculty members who teach engineering subjects and use English for their research at least once a week. Excluding members who rarely use English for working research or who teach arts, mathematics, or other subjects, we can assume that the faculty members were SLL of EAST. The number of SLL responders is 76. This study also analyzes the responses from graduate students who are majoring in engineering and whose first language (L1) is Japanese. We excluded the responses of graduate students whose L1 is a language other than Japanese; who are majoring in mathematics, economics, or some other discipline; or who rarely use English for their research. The number of OLL responders included in the data is 172. Further, Table 2 provides details of the responders.

Table 2
Details of OLL and SLL

	Female	Male
OLL	28	144
SLL	5	71

It is noted that the age of SLL ranges from 30 to more than 60 years, and the numbers of members in each group are12 (thirties), 23 (forties), 32 (fifties), and 9 (more than 60). Among the OLL, 155 are pursuing the master's program,11 are enrolled in the doctoral program, and the remaining 6 are studying in a laboratory asauditing or research students.

Question Items

The questionnaire given to the participants comprises six parts, with 60 question items in total. The present study deals withthe VLS part, which is one of the sixparts that includes 11 question items. The following explanation precedes the question items: "How did you learn technical vocabulary? Considering your experiences, do you think the following learning strategiesare effective to learn technical words?" All the items are preceded by the phrase "When I memorize technical words…":

1.I use a vocabulary book or a wordlist (wordlist, hereafter).
2. I use a dictionary to understand the definition and usage (dictionary use, hereafter).
3. I make up a sentence by myself using the word (sentence use, hereafter).
4. I test myself regularly to checkif I can remember the word (test, hereafter).
5. I read and listen to a lot of English (read-listen, hereafter).
6. I say the word aloud repeatedly (oral repetition, hereafter).
7. I write the word repeatedly (write repetition, hereafter).

8. I use “keyword method” (keyword, hereafter).
9. I also memorize synonyms or antonyms (semantic group, hereafter).
10. I also memorize the derivatives (derivative group, hereafter).
11. I memorize the word with my friends (social, hereafter).

Results and Discussion

To answer RQ1, we calculated the average score of each VLS and sorted the 11 VLSs in the ascending order. Table 3 depicts the top 5 and bottom 5 items for Japanese engineering students and researchers.

Table 3
Top 5 and Bottom 5 VLS Items for Engineering Students and Researchers

Top 5	Average	SD	SE
Read-listen	4.11	0.92	0.06
Sentence use	3.83	1.03	0.07
Oral repetition	3.79	1.02	0.06
Dictionary use	3.46	1.03	0.07
Write repetition	3.38	1.10	0.07

Bottom 5	Average	SD	SE
Keyword	2.29	1.10	0.07
Wordlist	2.47	1.06	0.07
Social	2.75	1.10	0.07
Test	3.30	1.05	0.07
Derivative group	4.16	0.93	0.07

Note. N = 248. SD standard deviation; SE standard error.

It is noted that preference for the read-listen strategies (M= 4.11) canexplain two different phenomena. It may indicate that many EAST learners are not conscious of their vocabulary learning and do not have particular strategies to learn technical words. Further, it may imply that EAST learners and researchers are highly motivated to adoptthe input-seeking strategies, one of which previous studies described as the VLS that good learners of general English tend to use (e.g., Mizumoto, 2010). They tend to read academic English in the engineering field everyday and learn technical words by incidental learning. In the former situation, the online system should include functions to enhance learners’ consciousness of vocabulary learning, explaining about VLS explicitly. In the latter situation, we can consider that they need input information. Using the second preference strategy, to learn technical words in making sentences using words (M= 3.83), it would be better to incorporate many English sentences or phrases including the target words into the vocabulary learning system.

Table 3 shows that EAST learners and researchers prefer to use a dictionary to discover the meanings of words and memorize them by reading the usage explanation given in the dictionary (M= 3.46). Further, they preferto use mechanical repetition; in particular, they tend to use oral

repetition (M = 3.79) more than writing repetition (M= 3.38). After one-way analysis of variance (ANOVA) showed that there are statistically significant differences among the five VLSs, the Sidak test was adapted to indicate that the differences between read-listen >sentence use and oral repetition >dictionary use and write repetition are statistically significant ($p< 0.01$). They seem to be more related to informative or mechanical activities compared to the VLSs included in the bottom 5. Since keyword, social, and test strategies seem more imaginative and creative, learners should work by themselves to advance their own learning.

To answer RQ2, we figured out the differences in the average scores of 11 VLSs by SLL and OLL. Although the difference between the total score of the 11 VLSs of SLL and OLL is not significant, there might be some VLSs that are preferred by SLL and some that are preferred by OLL. It is noted that four VLSs were preferred by SLL. We sorted the VLSs in the ascending order of SLL scores, and Table 4 depicts the VLSs with the averages of SLL and OLL.

Table 4
VLSs Preferred by SLL

VLS	OLL Average	SLL Average	Difference	SE
Sentence use	3.76	4.00	0.24**	0.07
Dictionary use	3.35	3.71	0.36**	0.07
Write repetition	3.35	3.45	0.09	0.07
Keyword	2.26	2.38	0.13	0.07

Note. ** $p< 0.01$

SLL believe that they can learn technical words by making sentences using the target word and using a dictionary. Both the sentence use and dictionary use strategies are preferred by SLL, rather than by OLL. It may be one reason that SLL often write journal papers in English but OLL rarely do. The results of one-way ANOVA with post hoc Tukey-Kramer test showed significant differences in the averages of sentence use and dictionary use by SLL and OLL. Therefore, providing sentence making tasks and providing dictionary information for OLL may enhance OLL'sconsciousness of vocabulary learning and change their VLS use patterns.

It is noted that seven VLSs are preferred by OLL, rather than by SLL. After sorting them in the ascending order of the averages of OLL, we depictthe top four VLSs in Table 5. After one-way ANOVA, we conducted the Tukey-Kramer test, and it indicated that the differences in read-listen, oral repetition, semantic grouping, and test strategies are significant.

Table 5
VLSsPreferred by OLL

	OLL	SLL		
	Average	Average	Difference	SE
Read-listen	4.16	4.00	0.16**	0.05
Oral rep	3.84	3.68	0.16**	0.05
Semantic group	3.45	3.18	0.26**	0.05
Test	3.44	2.97	0.47**	0.05

Note. ** p< 0.01

In our discussion on the preference for the read-listen strategy, we mentioned two possible reasons. The result reveals that OLL, rather than SLL, tend to use the VLS; therefore, we can conclude that tasks for making OLL aware of VLSs should be incorporated into the system. The result also shows that oral repetition, semantic grouping, and testing are preferred by OLL, rather than SLL. Tasks based on the VLSs preferred by OLL must be incorporated into the online vocabulary learning system. The selection of a VLS is a personal choice. Some of the OLL use their own VLSs and donot use other VLSs. For such individuals, we can show them some information about the VLSs that SSL tend to use and provide some tasks based on them.In addition, tasks that allow OLL to conduct oral rehearsal, semantic grouping, and testing themselves must be incorporated, as well as tasks based on SLL preference.

Conclusions

This study surveyed the VLSs used by the faculty members of engineering and graduate students and compared their VLS use patterns. The results revealed some VLS use patterns 1) common to both engineering students and researchers; 2) preferred by graduate students, rather than researchers; and 3) preferred by engineering researchers, rather than engineering students. The study supported previous study on EGP learners (Schmitt, 1997) and found that VLS use patterns may be affected by the EAST learner's age or learning level or both. The online technical vocabulary learning system should havea lot of usage information including dictionary information on technical vocabulary and various tasks based on VLSs such as making sentences task, writing task, oral repetition task, semantic grouping task, and testing task.Assuming that the VLS use patterns ofOLL are transforming into SLL patterns, tasks enhancing OLL's awareness of VLSs may help the OLL to proceed to the next learning stage.

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