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A Longitudinal Analysis of Growth in Vocabulary Size and Strategy Use: Focusing on Japanese EFL Senior High School Students*

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The purpose of this study is to determine whether a vocabulary size test is a valid and reliable measure of longitudinal growth in vocabulary size (VS), and to investigate the relationship between growth in VS and use of vocabulary learning strategies (VLS). Kasahara's (2006) revised version of Mochizuki's (1998) Vocabulary Size Test (VST) was administered to 209 Japanese senior high school students at three time points during their course of study. In addition, a VLS questionnaire based on Schmitt's (1997) taxonomy was administered and used to investigate the relationship between vocabulary growth and patterns of strategy use. Cronbach alpha for the three administrations of the VST ranged from .79 to .85, indicating adequate reliability of the VST. A cluster analysis of strategy use yielded three distinct patterns: low, medium, and high frequency use of strategies. A two-way mixed ANOVA with year as the within-subjects factor and strategy cluster as the between-subjects factor found a significant mean effect for year and strategy use, but no effect for the interaction. The large effect size for year supports the claim that the revised VST is a valid measure of vocabulary size for Japanese high school students. The relationship between VS and strategy use confirms the potential of the revised VST for investigating theoretical and pedagogical factors affecting vocabulary growth.

Keywords: longitudinal study, vocabulary size, vocabulary learning strategies, cluster analysis

1 Introduction

Vocabulary knowledge is known to play a key role in individuals' proficiency in reading, writing, listening, and speaking in both their first and second languages. In 2018, Japan's Ministry of Education, Culture, Sports, Science

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and Technology (MEXT) announced the total number of English words to be taught would increase from 3,000 to approximately 4,000 to 5,000 in 2020. Figure 1 shows that the new Course of Study would require the instruction of 600 to 700 words in elementary school, 1,600 to 1,800 in junior high school, and 1,800 to 2,500 in senior high school as compared to 1,200 in junior high and 1,800 in senior high school before.

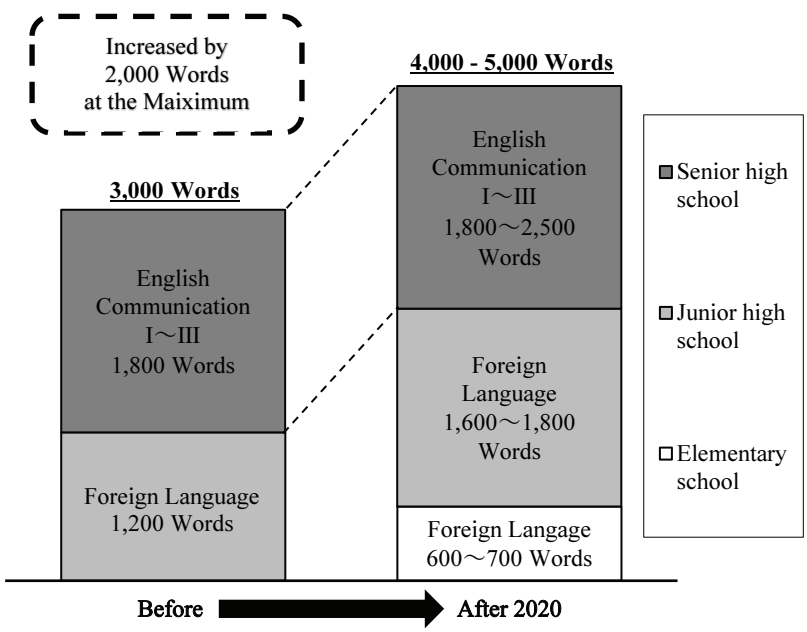

Figure 1. The number of required English words before and after revision (after MEXT, 2018)

The major difference in the new revised Course of Study is that elementary school children now start English as a foreign language activity in their third and fourth year and study English formally as a school subject in their fifth and sixth year. The total amount of words to be taught has been increased by a maximum of 2,000 words throughout their time at school. This change in the number of words required for the students reflects the perceived value in communication of having a wide range of vocabulary, which means that improving students' knowledge of vocabulary is one of the primary goals in each stage of learning. For this reason, knowing how to learn vocabulary is essential for learners and finding how to teach this building block of language effectively is also worthwhile for teachers to enhance not only language proficiency in general but also students' motivation to learn English and the promotion of autonomous vocabulary learning. Hence, a primary goal of this

study is to investigate longitudinal growth in vocabulary size, patterns in vocabulary learning strategy use, and their potential relationship.

2 Literature Review

Researchers and theoreticians have pointed out the fact that vocabulary knowledge is multi-faceted and can be classified into several components (e.g., Harley, 1996; Henriksen, 1999; Meara, 2005; Nation, 2020; Read, 2000; Schmitt, 2010; Webb & Nation, 2017). Of the several dimensions of lexical knowledge, two perspectives are often used; the size and the depth of vocabulary knowledge (Anderson & Freebody, 1981). Size or breadth of vocabulary is concerned with the quantitative aspect of vocabulary knowledge; in essence, the number of words learners know (e.g., Nassaji, 2004; Nation, 2001). On the other hand, depth of vocabulary knowledge is a quality measure (e.g., Meara, 1996; Nassaji, 2004; Read, 1993) which is defined as "how well a learner knows individual words or how well words are organized in the learner's mental lexicon" (Staehr, 2009, p. 579).

Both vocabulary size (VS) and depth are essential for language use. However, size has been considered the primary aspect of vocabulary knowledge because of its importance in the form-meaning link for vocabulary use (e.g., Laufer et al., 2004; Meara, 2002; Schmitt, 2010). For example, Meara (2002) believes that the basic dimension of lexical competence is VS and learners with a large VS are more proficient than learners with a smaller VS in a wide range of language skills. A larger VS gives foreign language learners a greater potential to understand the language that they encounter (Webb & Paribakht, 2015), and knowing more words may also enhance their ability to infer the meaning of any unknown words they encounter (Liu & Nation, 1985). Given the importance of VS, display of L2 target form-meaning knowledge can be interpreted as having the ability to understand or use words in the four skills. Therefore, much recent work on vocabulary testing has focused on estimating how many words learners know (Qian & Lin, 2020; Read, 2000; Schmitt, 2014). Read (2000, p. 115) acknowledges that "despite the fact that the size tests may seem superficial, they can give a more representative picture of the overall state of the learner's vocabulary than an in-depth probe of a limited number of words."

2.1 Development of vocabulary size tests

Several types of vocabulary size tests (VSTs) are currently in use, including the Vocabulary Levels Test (Nation, 1990; Schmitt, 2000), the Eurocentres Vocabulary Size Test (Meara & Jones, 1990), and Nation and Beglar (2007)'s Vocabulary Size Test. The items in these tests are representative words drawn from frequency-of-use bands such as the first thousand most encountered

words, the second thousand, the third thousand, etc. Furthermore, these tests are based on the assumption that the recognition of word families[1] is the most useful unit for quantifying receptive vocabulary knowledge (Webb & Nation, 2017).

On the other hand, in the Japanese EFL context, the counting of word items (lemma[2]) has been more widely used instead of word families because Japanese learners of English tend to lack knowledge of derived forms. In other words, evidence of knowledge of one word within a word family is no guarantee that other words within that word family will be known or recognized. Consequently, the lemma has come to be considered to be more useful as a unit for counting the VS for beginners, who have yet to learn derivations (Aizawa, 1998). Considering this, Aizawa and Iso (2008), Aizawa and Mochizuki (2010), and Mochizuki (1998) sought to develop a VST with high reliability and validity that would estimate VS based on representative base-word items drawn from the 1,000– to 7,000–word bands. In their VSTs, test takers must choose the English equivalents of two Japanese words from six alternatives. Mochizuki's VST has been widely used in Japanese junior and senior high school settings and several attempts have been made to estimate students' size of vocabulary or investigate how it developed across their high school career (e.g., Akase & Uenishi, 2015; Kosuge, 2003; Katagiri, 2009; Yashima, 2002). This VST was further revised by Kasahara (2006), who used FACETS (Linacre, 2006), a Rasch analysis software package, to identify and replace test items that were too easy or did not match the Rasch measurement model. Kasahara replaced items that were not functioning efficiently with words from the JACET 8000 list, which might better reflect words that are encountered in the Japanese school curriculum.

2.2 Classifications of vocabulary learning strategies

Since the mid-1980s, many researchers and EFL educators have become interested in finding effective ways to improve and facilitate vocabulary learning. One avenue of research has involved the classification and measurement of vocabulary learning strategies (VLS) defined as "actions that learners take to help themselves understand and remember vocabulary" (Cameron, 2001, p. 92). A number of VLS taxonomies with a focus on vocabulary acquisition have been proposed including those by Gu and Johnson (1996), Lawson and Hogben (1996), Mizumoto (2010), Nation (2001),

[1] Word families are usually held to include the base word (e.g., 'add'), all of its inflections ('adds', 'adding', 'added') and its common derivatives ('addition', 'additions', 'additional', 'additionally', etc.).

[2] The term lemma is more restricted and includes only the base word and its inflections. Lemmas are made up of a headword (e.g., 'add') and its inflections ('adds', 'adding', 'added').

Sanaoui (1995), and Schmitt (1997, 2000). Of these, Schmitt's VLS taxonomy and associated questionnaire has proven to be both clear and extensive. The questionnaire employs 58 items and classifies VLS under six categories, although Schmitt acknowledges that it is sometimes difficult to decide where to draw the line between different strategies. As shown in Figure 2, Schmitt suggested two major classes of L2 VLS: discovery strategies and consolidation strategies. Discovery strategies are further subdivided into determination and social strategies, whereas consolidation strategies are categorized into social, memory, cognitive, and metacognitive strategies. Determination strategies are used when identifying a new word's meaning without resource to another person's expertise, such as guessing from context. Social strategies[3] involve understanding meaning by consulting or working with others, such as studying and practicing meaning in a group. Memory strategies includes traditional mnemonic techniques, such as connecting a word to its synonyms and antonyms. Cognitive strategies use mechanical means to memorize words, such as written or verbal repetition. Metacognitive strategies are used by learners to plan, monitor, or evaluate the best way to study, such as continuing to study words over time.

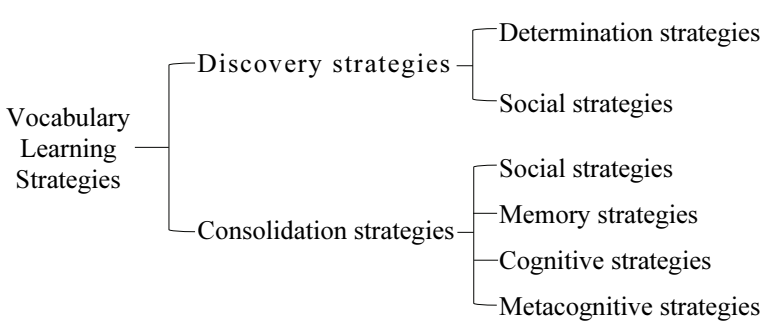

Figure 2. Schmitt's taxonomy of vocabulary leaning strategies

The main findings of previous studies of VLS research can be summarized as follows: (1) more proficient learners employ a variety of VLS more frequently than less successful counterparts (e.g., Ahmed, 1989; Fan, 2003; Kojic–Sabo & Lightbown, 1999; Lawson & Hogben, 1995; Maeda et al., 2003); (2) as learners become proficient, their use of strategies change from simple repetition to more elaborate imagery and association or organization strategies (e.g., Akase, 2015; Akase & Uenishi, 2011; Horino & Ichikawa,

[3] The function of social strategies is two-folded: (1) to understand a word by interacting with other people and (2) to study and practice the meaning of words in a group. The former is related to discovery and the latter to consolidation strategies. In the inventory, both functions are combined in a single subscale labeled social strategies.

1997; Kudo, 1999; Saida, 2006; Schmitt, 1997); (3) the appropriate, structured, and orchestrated use of VLS contribute to success in vocabulary learning and higher proficiency (e.g., Gu, 2018; Gu & Johnson, 1996; Mizumoto, 2010; Sanaoui, 1995; Wei, 2007); (4) metacognitive strategies play an important role in better vocabulary learning (e.g., Gu, 2003; Gu & Johnson, 1996; Mizumoto & Takeuchi, 2009; Nacera, 2010; Nyikos & Fan, 2007), and (5) Individual differences such as motivation, gender, age, and learning environments have an impact on the choice and use of VLS (e.g., Catalán, 2003; Cohen & Dörnyei, 2002; Nakamura, 2002; Oxford et al., 1998; Schmitt, 1997; Tseng & Schmitt, 2008). In general, learners' VLS are a multidimensional construct and are intertwined with other factors. Hence, as Gu (2003, p. 1) stated, "the choice, use, and effectiveness of VLS depend on the task, the learner, and the learning context."

Most research, however, has examined and illustrated the overall pictures of learner's strategy use through cross-sectional studies. In comparison, little is known about the process of development in the relationship between VS and VLS and what and how certain types of strategies are employed depending on learners' levels of proficiency. Since the number of words to be taught has been recommended as part of the promotion of communicative competence, the importance of testing students' VS while exploring their use of VLS can be understood as factors that will enhance their overall language proficiency. The currently widely used VST for Japanese learners of English employs word item counting which can be applied to MEXT Course of Study vocabulary targets. The monitoring of VS can lead to reflective teaching for teachers, which in turn serves as effective teaching practice. Therefore, the current study aims to establish whether Kasahara's revised version of the Mochizuki's VST can detect a relationship between patterns of VLS preference and vocabulary growth over an extended period was researched. The research questions of the study are as follow.

RQ1: To what extent is Kasahara's revised VST an appropriate instrument for estimating growth in senior high school students' VS across a three-year course of study?
RQ2: Will the revised VST and a questionnaire based on Schmitt's taxonomy of VLS enable the detection of a relationship between patterns of VLS use and growth in VS?

3 Method

3.1 Participants

A total of 209 middle-ranking senior high school students in Nagano prefecture, Japan, were recruited for the study: 71 students were enrolled in the

commercial course and 138 in the general course. They ranged in age from 16 at the beginning of the study to 18 at the end. As first-year students, students in both courses took English I as a mandatory subject. In the second year, English II was taken as a mandatory course, but the general course students also had elective options such as Writing and Comprehensive English. In the third year, both the commercial students and the general course students took a mandatory reading class, while the general course students could take electives such as Advanced Reading, Writing, and English Comprehension. These students were university-bound, moderately motivated and some of them sought qualifications such as the EIKEN test in practical proficiency.

Students' career choices after graduation were collected in April, 2013. Table 1 shows a cross tabulation comparing courses with their choices and Figure 3 illustrates the ratio of chosen paths for each course after graduation.

Table 1. Cross Tabulation of Students' Courses and their Career Choices

		UNIV	JC	VOC	EMP
Commercial	(N = 71)	11	12	27	21
General	(N = 138)	71	13	45	9
Total	(N = 209)	82	25	72	30

Note. Each abbreviation is as follows: UNIV: University, JC: Junior college, VOC: Vocational school, EMP: Employment

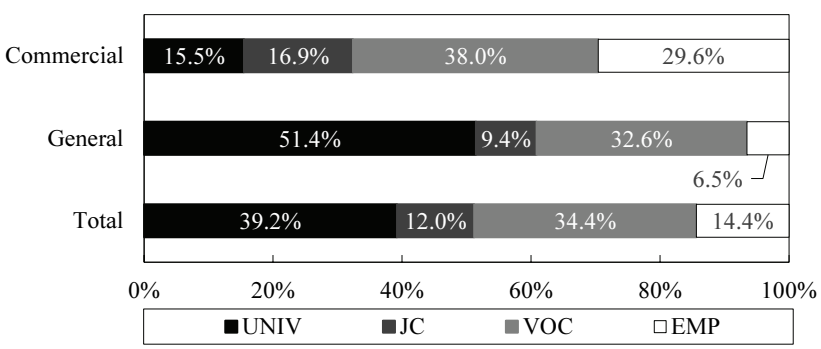

Figure 3. Career choice ratio of chosen paths for each course of students

While the majority of commercial course students chose to proceed to vocational schools and employment, more than 50 percent of general course students continued on to university. The students tended to decide their next step as they were close to graduating from high school and their course of action was basically determined by the end of July in their third year. The students' career choices were diverse, which affected the way they invest their time to study English. They also varied in the type and amount of classroom hours in English they experienced and differed in the level of commitment to study. These factors are likely to have affected their vocabulary knowledge

motivation to increase their vocabulary. This variation in vocabulary proficiency and motivation provided a suitable setting for assessing the use of the VST.

3.2 Instruments and procedures

3.2.1 Vocabulary size test (VST)

Kasahara's (2006) modified version of Mochizuki's (1998) VST was used for the current study without modification and was administered at three time points, in November of 2010, 2011, and 2012. Although Kasahara (2006) did not include the 1,000–word level in his validation study with university students, it was included in the present study in order to get an accurate estimate of overall VS and because it could not be assumed that first-year high school students would know most of the words at the 1,000–word level. The form of the test used in the present study included the 1,000–word level for junior high school students together with the 2,000, 3,000, and 4,000–word levels for high school students. The test did not include the 5,000 to 7,000–word levels for university students, both to reduce the testing time and because few of these lower frequency words are encountered in the high school curriculum.

The VST item format consists of two Japanese words followed by six English words from which students must choose the appropriate translations. While the format tests only the most basic level of receptive vocabulary knowledge, it is efficient and avoids problems encountered with English-only tests, such as when students recognize an English word but do not understand the English synonyms or definitions which are offered as options. Each of the four level bands used in this study contains 30 items, for a total of 120 items. A complete copy of the VST is shown in Appendix A.

VS was estimated separately for each level band by multiplying the percent of items answered correctly by 1000, with the total VS then estimated by summing the results for the four level bands. At the time of the study, only one form of the VST existed and this was used at each time point. In order to minimize a possible testing effect, students were informed of their estimated VS after the test was marked, but tests were not returned so that they could not study items they had missed.

3.2.2 Vocabulary learning strategies questionnaire (VLSQ)

Schmitt's (1997) VLS taxonomy is viewed as rich and sensitive to the variety of VLS and allows comparisons with other studies. The present study is based on this inventory as a measure of strategy use. Schmitt's (1997) VLSQ was originally comprised of 58 items to which learners responded on a 5-point Likert scale ranging from (1) never true of me to (5) always true of me. In the VLSQ, the discovery and consolidation functions of social strategies are combined in a single subscale.

For this study, seven items were removed from the questionnaire because the strategies are uncommon or unknown in the Japanese EFL context. In addition, the 5-point Likert scale was changed to a 6-point scale ranging from (1) never true of me to (6) always true of me in order to avoid an easy "middle ground" option. Finally, the remaining 51 items were translated into Japanese by the author and then double-checked for accuracy by a Japanese university professor of English. A pilot test was then conducted with a different cohort of students to check any unforeseen problems. A sample of items from each strategy category is shown in Appendix B. The VLSQ was administered in November of each school year, from 2010 to 2012. However, only the results from the 3rd administration were used for this analysis. The rationale for doing this was the belief that students' VLS will change over their three years of high school, but stabilize as they mature and learn which strategies work best for them.

Table 2 shows a summary of the measures used in the study. For the VST, a total estimated VS was calculated based on the four level bands, as described above. Because the number of items for the VLSQ subscales varies considerably, an average score ranging from 1 to 6 was calculated for each subscale.

Table 2. Summary of Measures Used in this Study

Measure	Items	Possible range
Vocabulary size test (1,000– to 4,000–word level)	120	0–4,000
Determination strategies (DET)	7	1–6
Social strategies (SOC)	6	1–6
Memory strategies (MEM)	20	1–6
Cognitive strategies (COG)	10	1–6
Metacognitive strategies (MET)	8	1–6

3.2.3 Analyses

Descriptive statistics were first calculated for both the VST and the VLSQ in order to judge their reliability and suitability for parametric analyses. Reliability was estimated using Cronbach's alpha for the three administrations of the VST and for the five subscales of the VLSQ.

Using SPSS version 25, a cluster analysis employing Ward's method with the squared Euclidean distance technique was performed on the VLSQ data in order to identify patterns of strategy use among the participants. Specifically, it was hypothesized that learners might vary not only in their frequency of strategy use, but also in their preference for certain types of strategies over others. For example, it seemed feasible that some learners might prefer social strategies to more introspective strategies such as cognitive and metacognitive and that these profiles might be related to growth in VS.

Following the cluster analysis of the VLSQ, a two-way mixed ANOVA was performed with estimated VS at the three time points as a repeated

measures factor and strategy use profile as determined by the cluster analysis as a between-subject factor. The repeated measures main effect was used to confirm whether the VST can robustly measure growth in VS over a three-year high school course of study. The main effect for strategy use profile, together with post hoc analyses was used to determine whether strategy use is related to VS at the three time points. Finally, the interaction between the repeated measure and strategy use profile was used to investigate whether patterns of strategy use are related to the rate of vocabulary growth over time.

4 Results

4.1 Descriptive statistics

Descriptive statistics for 209 participants in this study at the three administrations of the VST are reported in Table 3. Mean scores indicate that estimated VS grew steadily from Year 1 to Year 3 with substantial variation within the sample indicated by the standard deviations. Reliability was acceptable for each administration. Skewness and kurtosis were within the values of -1.5 and +1.5 suggested by Tabachnick and Fidell (2013) as indicative or normality, except for Year 1, which had kurtosis of 2.04. An examination of the distribution plots, however, indicated that all distributions were near normal and were judged adequate for parametric analyses.

Table 3. Descriptive Statistics of the VST

	M	*SD*	Min	Max	Skewness	Kurtosis	*α*
Year 1	2022.81	443.25	300.00	3366.67	-0.92	2.04	.79
Year 2	2390.75	393.62	1133.33	3600.00	-0.20	0.34	.80
Year 3	2619.62	445.63	1266.67	3733.33	-0.35	0.60	.85

Note. $N = 209$

Table 4 reports descriptive statistics and reliability for the five subscales of the VLSQ. Mean scores for the five subscales were similar, centering around

Table 4. Descriptive Statistics of the VLSQ Subscales

	Items	*M*	*SD*	*α*
DET	7	3.63	0.74	.62
SOC	6	3.02	0.88	.68
MEM	20	3.23	0.73	.88
COG	10	3.00	0.82	.75
MET	8	3.08	0.82	.69

Note. $N = 209$. DET = Determination strategies, SOC = Social strategies, MEM = Memory strategies, COG = Cognitive strategies, MET = Metacognitive strategies

3, indicating a slight trend toward not using VLS. Only DET, with a mean of 3.6 was above the center point on the 6-point Likert scale. Although the MEM and COG subscales had good reliability, the DET, SOC, and MET subscales had only marginally adequate reliability, probably due to the small number of items that comprised those scales.

4.2 Cluster analysis

Examination of the dendrogram in SPSS cluster analysis suggested three major clusters as optimal for classifying participants according to patterns of strategy use. It was originally hypothesized that strategy use profiles might emerge based on preferences for one strategy type over another, but for the most part, that proved not to be the case. Table 5 shows the mean and standard deviation of the strategy clusters for each of the five VLSQ subscales and for comparison, a global mean score for all 51 items. In each of the three clusters, mean scores are similar across strategy type, with DET somewhat higher than the others. Perhaps it is notable that Cluster 1 are particularly low users of COG. The three clusters are distinguished by their overall differences in frequency of strategy use and it would seem most appropriate to label the profiles as low, medium, and high frequency users of VLS.

To validate this grouping based on their use of VLS, a one-way ANOVA was conducted, which demonstrated that there were significant differences among the scores in each cluster. With the exception of SOC, the assumption of equality of variances was not met, so Brown-Forsythe tests were used for the other subscales: DET (F (2, 70.73) = 56.89, $p < .001$, $\eta^2 = .43$); SOC (F (2, 206) = 62.19, $p < .001$, $\eta^2 = .38$); MEM (F (2, 91.86) = 151.93, $p < .001$, $\eta^2 = .64$); COG (F (2, 162.57) = 157.06, $p < .001$, $\eta^2 = .59$); MET (F (2, 165.63) = 121.72, $p < .001$, $\eta^2 = .52$). The effect sizes of each group of VLS were large. For the post hoc Tukey HSD tests, Cluster 1, Cluster 2, and Cluster 3 were thus interpreted as low, medium, and high frequency users of VLS, respectively as shown by Figure 4.

Table 5. Mean Scores for the Five VLSQ of the Three Strategy Clusters

	Cluster 1 (N = 36)	Cluster 2 (N = 92)	Cluster 3 (N = 81)	Significant in post hoc test
DET	2.99 (0.85)	3.36 (0.51)	4.22 (0.44)	1 < 2< 3
SOC	2.06 (0.72)	2.89 (0.66)	3.58 (0.72)	1 < 2< 3
MEM	2.23 (0.58)	3.06 (0.37)	3.87 (0.44)	1 < 2< 3
COG	1.79 (0.45)	2.93 (0.44)	3.61 (0.64)	1 < 2< 3
MET	2.10 (0.51)	2.90 (0.62)	3.74 (0.53)	1 < 2< 3

Note. Mean (Standard Deviation); For all significant pairs in post hoc test, $p < .001$

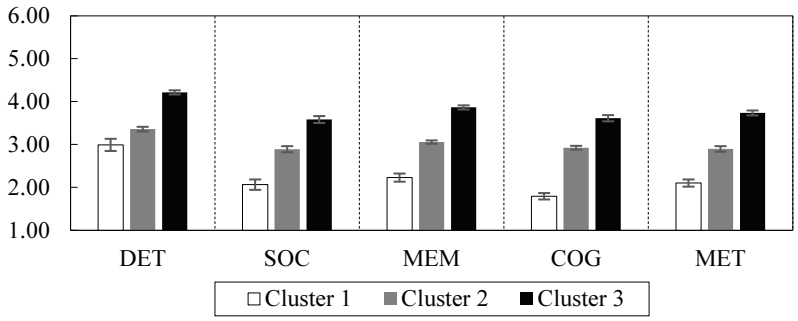

Figure 4. Cluster profiles among the three groups

4.3 Two-way mixed ANOVA

Prior to running the two-way mixed ANOVA, the assumptions of sphericity and homogeneity of variance were checked using Mauchly's test of sphericity and Levene's test of equality of variance. Mauchly's test indicated that the assumption of sphericity was violated at $p < .001$. Consequently, a Greenhouse-Geisser correction to degrees of freedom was applied for the within-subjects effects. Levene's test was non-significant for estimated VS at Year 1 and Year 2 ($p = .54$, $p = .78$, respectively) but was marginally significant at Year 3 ($p = .038$). Because the sample sizes were roughly equal and the level of significance for Year 3 marginal, however, the ANOVA without a correction for unequal variances was adopted (see Field, 2018 for a discussion of the limitations of Levene's test).

Table 6 reports results for the two-way mixed ANOVA. Main effects for both Strategy Cluster and Year were significant at $p < .001$, indicating that

Table 6. Two-way Mixed ANOVA for VS Measures and Strategy Clusters

Source	SS	*df*	*MS*	*F*	*p*	Partial η^2
			Between Subjects			
Strategy Cluster	6393392.20	2	3196696.10	8.64	<.001	.08
Residuals (BS)	76230680.11	206	370051.85			
			Within Subjects			
Year	32516857.03	1.82	17909452.89	213.22	<.001	.51
Strategy Cluster * Year	356920.24	3.63	98291.27	1.17	.32	.01
Residuals (WS)	31416423.73	374.02	83996.91			

Note. Greenhouse-Geisser correction applied to *df* for within subjects effects

frequency of strategy use was related to VS at the three time points and the VST can measure growth in VS across time. The interaction between Strategy Cluster and Year, however, was not significant, indicating that patterns of reported strategy use are not associated with the rate of growth in VS.

Post hoc tests for Strategy Cluster using Tukey's procedure indicated there was no statistical difference in VS between Cluster 1 and Cluster 2, the low and mid-frequency groups. There were, however, significant differences between Cluster 3 and Cluster 1 ($p = .02$) and Cluster 3 and Cluster 2 ($p < .001$). In contrast to Year, the partial eta squared of .08 indicated a small effect size for Strategy Cluster, with patterns of strategy use accounting for only a modest 8 percent of the variance in VS.

Post hoc Tukey's HSD was also used to test for significant changes across the three time points and yielded significant differences between Year 1 and Year 2 ($p < .001$) and Year 2 and Year 3 ($p < .001$). In addition, the partial eta squared of .51 indicated a robust effect size, with time accounting for more than 50 percent of the variance in VST.

Table 7 shows the mean and standard deviation of the strategy clusters for estimated VS. The relationship between reported strategy use and growth

Table 7. Mean Estimated VS on VST of the Three Strategy Clusters

	Cluster 1 ($N = 36$)	Cluster 2 ($N = 92$)	Cluster 3 ($N = 81$)
Year 1	1,947 (532)	1,957 (422)	2,130 (405)
Year 2	2,329 (344)	2,320 (382)	2,497 (407)
Year 3	2,556 (265)	2,498 (461)	2,784 (444)

Note. Mean (Standard Deviation)

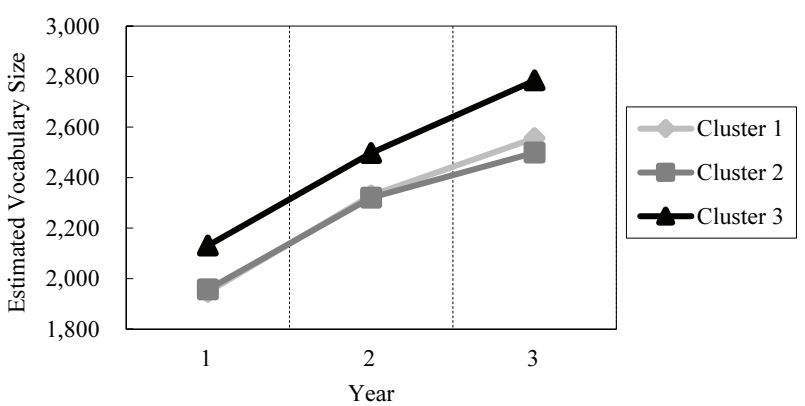

Figure 5. Estimated VS of three strategy clusters at three time points

in VS is best understood by examining Figure 5. In this figure, there was virtually no difference between the low and mid strategy clusters at each of the three time points. In contrast, Cluster 3, the high-frequency strategy users,

shows a higher VS at each time point. In addition, these students appear to maintain their trajectory of VS growth during Year 3, while the VS growth of reported low and mid-frequency strategy users tapers off.

Although the main effect for the interaction was not significant, post hoc tests using Tukey's procedure did show a significant difference between Cluster 3 and Cluster 1 at Year 3 ($p = .018$) and a significant difference between Cluster 3 and Cluster 2 at Year 3 ($p < .001$), suggesting that reported use of a greater number of strategies is a characteristic of the participants who demonstrated continued sustained growth in VS to the end of their third year.

5 Discussion

The answer to RQ 1 (To what extent is Kasahara's revised VST an appropriate instrument for estimating growth in senior high school students' VS across a three-year course of study?) is that the revised VST administered at three time points was a valid and practically useful instrument for measuring growth and VS in Japanese EFL senior high school students in this study. They demonstrated a clear pattern of VS growth in a learning situation where motivated students are expected to study hard and increase their vocabulary. On average, the VST detected a word-progress (mean growth in VS) of 368 between Year 1 and Year 2 and 229 words between Year 2 and Year 3, with a good degree of reliability. The word-progress in upper-intermediate high school students in Yashima (2002) was approximately 500 as they moved up from year to year. Similarly, in Katagiri's (2009) study with top-ranking high school students, there was a word-progress of approximately 400 words in the regular course and a 700 word-progress in English course students. Although the middle-ranking high school students in the present study did not show that level of development, the average word-progress of about 300 in each year appears to the author to be an accurate reflection of their investment in studying English. Yashima (2002) predicted that there would be lower vocabulary size in a lower or middle ranking high school. This finding provides further evidence of the validity of Kasahara's revised VST and supports Yashima's prediction of lower estimated vocabulary size in a middle-ranking high school, where the overall academic deviation value is around 50.

RQ 2 (Will the revised VST and a questionnaire based on Schmitt's taxonomy of VLS enable the detection of a relationship between patterns of VLS use and growth in VS?) can be answered by the fact that the revised VST showed a significant relationship to VLS use. A cluster analysis was conducted on the VLSQ responses, dividing them into three major groups. The students in Cluster 1 ($N = 36$) can be referred to as the low strategy users, centering at 2.23 on a scale of 1–6. Their overall use of strategies was lower than that of the other two groups, especially their use of COG. The students in Cluster 2 ($N = 92$) were medium or moderate strategy users with an average of 3.03 on a

scale of 1–6. On the other hand, those in Cluster 3 ($N = 81$) were high or active strategy users who employed a well-balanced range of strategies, 3.80 on average. In each of the clusters, DET was the most frequently used strategy and MEM was the secondly most frequently used strategy, although the three clusters employed them with different frequencies.

Regarding the relationship between students' use of VLS and VS, the main effect for strategy cluster in the two-way ANOVA demonstrates that frequency of strategy use is associated with the acquisition of new words. However, the post hoc analyses, which found a significant difference for the high use group only, suggest that substantial use of strategies is required to make a difference. Low versus medium frequency of strategy use (Cluster 1 versus Cluster 2) was not associated with VS at any time point. In addition, low effect size may mean that use of VLS is only one of many factors that drive vocabulary acquisition. While the findings suggest that some explicit instruction in strategy use and encouragement to use strategies could support vocabulary learning, other factors such as motivation, career goals, and aptitude are also likely to be important.

As for a relationship between patterns of VLS and rate of growth in VS, interaction between strategy cluster and year, which implies that the rate of growth in VS is not influenced by patterns of VLS. However, the failure to find a significant main effect for the interaction is likely due to the fact that all three groups grew in VS across the three time points. As shown in Figure 5, while the high VLS group was consistently ahead of the other two groups in VS, the rate of growth for all three groups was quite similar between Year 1 and Year 2. It is only in Year 3 that there appears to be a difference in growth between the high VLS group and the other two groups. The post hoc analysis, which found a significant difference between the high VLS (Cluster 3) and mid VLS groups (Cluster 2), supports this, but must be interpreted cautiously as the main effect of the interaction was not significant. Nevertheless, we might tentatively conclude that the continued frequent use of VLS supported the high use group in continuing to raise their VS during Year 3.

The findings of this research provide more support for previous research findings generally in favor of the claim that the more frequently learners employ a variety of VLS, the higher the levels of proficiency they can achieve (e.g., Ahmed, 1989; Fan, 2003; Kojic-Sabo & Lightbown, 1999; Lawson & Hogben, 1996; Maeda et al., 2003). Gu and Johnson (1996) showed that as much as 20 percent of the variance in either VS or English proficiency could be explained by VLS use, including vocabulary-related beliefs about vocabulary learning. Although the effect size for strategy use was not strong, this study confirmed a significant main effect for strategy use in estimated VS at the three time points with a modest 8 percent of the variance. Previous research also showed that successful vocabulary learners employ a wider variety of VLS in appropriate, structured, and orchestrated manners (e.g., Gu, 2018; Gu & Johnson, 1996; Mizumoto, 2010; Sanaoui, 1995; Wei, 2007). The

high-use learners in Cluster 3 had a wide variety of VLS options to choose from, which enabled them to have an "appropriate choice and deployment of strategies (Gu, 2018, p. 326)" in learning vocabulary.

The current study identified three clusters that were best described as low, medium, and high frequency users of VLS. Cluster analysis was initially chosen to investigate whether profiles of strategy use based on relative balance of use might exist, such as emphasis on social strategies versus emphasis on determination strategies. However, the cluster analysis indicated that strategy use tended to be balanced across type. The study reported here also showed that high frequency strategy learners maintained a high frequency of use in all types of VLS, which supported their acquisition of vocabulary during the three years of their high school careers and may have supported a continuing high rate of vocabulary growth during their third year.

Finally, from a qualitative point of view, the author served as an English teacher for for all six classes for three years and as a homeroom teacher for one of the classes. During informal advisory sessions with students, it was often observed that high VLS users tended to be university- or junior college-bound students who were eager to learn about how to increase their knowledge of vocabulary. This might further corroborate the fact that they employed a wide variety of VLS in and out of the classroom. On the other hand, low and mid VLS users tended to be vocational school- or employment-bound students, who were less eager to learn English and more focused on subjects directly related to their major. The level of commitment to studying English might also be related to the importance of students envisioned future career: if students have a vision of using English after graduation, they tend to maintain their motivation accordingly (Akase & Uenishi, 2015).

6 Conclusion

The findings obtained from this empirical study indicated that Kasahara's revised version of the Mochizuki VST was tenable for analysis of longitudinal measurement of the size of students' vocabulary with high reliability and validity. Longitudinal measurements using the test demonstrated that overall students made progress in their receptive vocabulary across time. Cluster analysis using VLSQ further validated the potential for using the VST for conducting research in a high school setting and led to better understanding of differences in growth in VS. The study found significant differences in vocabulary size only among the students who demonstrated highly frequent or active use of strategies (Cluster 3), suggesting that low and medium levels of use might not be sufficient to support the expansion of their vocabulary.

The findings of the study imply that teachers should pay more attention to the period between Year 2 and Year 3, when the students may stand at the crossroads of the development of their VS, and teach and provide an overview

of well-balanced VLS, as opposed to a particular type of VLS. As for the limitations of the study, even though the corrected tests were not returned to the students, a practice effect is still possible: motivated students might have been led to learn certain words because they appeared on the test.

If so, estimates of growth in VS could be somewhat overestimated. Future research might use different forms of the VST and employ Rasch analysis to more rigorously investigate the difficulty and unidimensionality of the test forms. The precise measures provided by such tests would permit more rigorous investigations of the relationship between VS and other individual differences such as self-efficacy, attitudes, and motivation.

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Appendix A

Kasahara's (2006) Revised Vocabulary Size Test

Select English word which represents the meaning of each Japanese one from (1) to (6) and write the number on the answer column.

(1,000–Word Level)

1. 小麦粉を焼いた菓子			2. 集まり，会		
(1) birthday	(2) cookie	(3) fork	(4) party	(5) star	(6) sweater
3. 玉ねぎ			4. ぶどう		
(1) grape	(2) lettuce	(3) onion	(4) pear	(5) rose	(6) tree
5. 丸い入れ物			6. クッションのある長いす		
(1) bath	(2) lamp	(3) phone	(4) pot	(5) sofa	(6) stove
7. 40			8. 100		
(1) forty	(2) hundred	(3) month	(4) six	(5) twelve	(6) year
9. 町			10. 橋		
(1) bridge	(2) garage	(3) place	(4) scene	(5) square	(6) town
11. 食事			12. 1つ，1個，1片		
(1) air	(2) meal	(3) piece	(4) sign	(5) sound	(6) while
13. 男の人			14. 象		
(1) change	(2) elephant	(3) man	(4) rabbit	(5) wolf	(6) woman
15. 顔			16. 手ぬぐい		
(1) face	(2) finger	(3) hair	(4) leg	(5) shoe	(6) towel
17. 不可解なこと，不思議なこと			18. 試験		
(1) act	(2) butterfly	(3) exam	(4) mystery	(5) tennis	(6) trouble
19. 点，地点			20. 太陽		
(1) dam	(2) magazine	(3) pajamas	(4) point	(5) sun	(6) war
21. 持っている			22. しなければならない		
(1) do	(2) get	(3) give	(4) have	(5) must	(6) raise
23. 聞く			24. 続ける		
(1) add	(2) continue	(3) die	(4) listen	(5) mean	(6) understand
25. すてきな，すばらしい			26. 大きい		
(1) cool	(2) hot	(3) large	(4) least	(5) nice	(6) quiet
27. 偉大な，りっぱな			28. 早く		
(1) complete	(2) early	(3) great	(4) most	(5) never	(6) usually
29. 彼女のもの			30. 私の		
(1) below	(2) hers	(3) my	(4) past	(5) which	(6) whom

(2,000–Word Level)

1. 旗			2. 丸くて大きい緑色野菜		
(1) cabbage	(2) campus	(3) flag	(4) railway	(5) tin	(6) tournament
3. 信じること・信念			4. 盤上で白黒の駒を動かして，勝敗を競うゲーム		
(1) attention	(2) belief	(3) chess	(4) hook	(5) pride	(6) union
5. 限界，制限			6. 指導員，指導・助言を与える人		
(1) bottom	(2) coach	(3) flight	(4) limit	(5) proof	(6) quantity
7. 通路，通行			8. 意見，眺め		
(1) climate	(2) factory	(3) law	(4) link	(5) passage	(6) view
9. 勝利			10. 力・強さ		
(1) bridge	(2) garage	(3) place	(4) scene	(5) square	(6) town
11. 洪水			12. 設備，備品		
(1) account	(2) courage	(3) equipment	(4) factor	(5) flood	(6) luck
13. しつけ，訓練			14. 海岸		
(1) benefit	(2) coast	(3) discipline	(4) division	(5) soap	(6) truth
15. 修理する，修繕する			16. ロづけする		
(1) advise	(2) establish	(3) kiss	(4) repair	(5) request	(6) settle
17. 発見する，見つけ出す			18. 救う，救出する		
(1) attract	(2) discover	(3) observe	(4) pour	(5) recognize	(6) save
19. 直す，繕う			20. 競争する		
(1) complete	(2) defend	(3) delay	(4) mend	(5) occur	(6) trace
21. 憎む			22. 解決する		
(1) appoint	(2) forgive	(3) hate	(4) pray	(5) solve	(6) spread
23. 余分な			24. 自動的な，自動の		
(1) automatic	(2) extra	(3) honest	(4) legal	(5) sharp	(6) smooth
25. 費用のかかる，高価な			26. 簡単な，単純な		
(1) awake	(2) exact	(3) expensive	(4) loud	(5) patient	(6) simple
27. 心地よく感じる，気楽な			28. 生の，加工していない		
(1) comfortable	(2) equal	(3) independent	(4) raw	(5) social	(6) steady
29. 分かれた，分離した			30. 緊急の，差し迫った		
(1) bright	(2) frequent	(3) initial	(4) safe	(5) separate	(6) urgent

(3,000–Word Level)

1. 巻き毛			2. 肉，肉体		
(1) beach	(2) curl	(3) economy	(4) flesh	(5) glory	(6) worker
3. 手のひら			4. 重さの単位		
(1) baggage	(2) circuit	(3) fool	(4) palm	(5) poet	(6) ton
5. 旅行者			6. 比較		
(1) access	(2) bounce	(3) comparison	(4) sunshine	(5) tourist	(6) wound
7. 豆			8. 天火（調理器具）		
(1) bean	(2) fisherman	(3) ceiling	(4) margin	(5) oven	(6) ray
9. 船			10. かすみ，もや		
(1) barn	(2) existence	(3) heap	(4) manufacturer	(5) mist	(6) vessel
11. 儀式			12. 緊急事態		
(1) apparatus	(2) boundary	(3) ceremony	(4) emergency	(5) horizon	(6) sympathy
13. 民主主義			14. 是認，賛成		
(1) approval	(2) contract	(3) democracy	(4) institution	(5) recall	(6) wheat
15. 心理学			16. 説明		
(1) billion	(2) bundle	(3) explanation	(4) flavor	(5) lighting	(6) psychology
17. 食事をする			18. 切り倒す		
(1) admit	(2) deny	(3) dine	(4) fell	(5) inquire	(6) rescue

19. 改訂する			20. 腐る，朽ちる		
(1) decay	(2) distribute	(3) fasten	(4) fold	(5) isolate	(6) revise
21. 投資する			22. しきりに勧める		
(1) admire	(2) cease	(3) celebrate	(4) construct	(5) invest	(6) urge
23. 気がついて			24. まっすぐに立っている		
(1) absent	(2) aware	(3) central	(4) drunk	(5) historical	(6) upright
25. 等しい，全く同様の			26. 毎年の，年間の		
(1) annual	(2) constant	(3) deaf	(4) identical	(5) modest	(6) recent
27. 可能性のある			28. 機械の，機械的な		
(1) confident	(2) mechanical	(3) odd	(4) potential	(5) splendid	(6) unusual
29. 実際に			30. とにかく		
(1) actually	(2) anyhow	(3) completely	(4) indeed	(5) somewhere	(6) whenever

(4,000–Word Level)

1. 顕微鏡			2. 望遠鏡		
(1) cube	(2) kilometer	(3) license	(4) microscope	(5) studio	(6) telescope
3. 化学者			4. 消費者		
(1) chemist	(2) consumer	(3) emperor	(4) membership	(5) sergeant	(6) sovereign
5. 交響曲			6. 美術館		
(1) charity	(2) distribution	(3) faculty	(4) gallery	(5) session	(6) symphony
7. 認めること，承認			8. 祝宴，宴会		
(1) admission	(2) bull	(3) feast	(4) geometry	(5) hedge	(6) succession
9. 案内所，事務所			10. 小さな包み		
(1) bureau	(2) certificate	(3) evolution	(4) lane	(5) packet	(6) poll
11. 赤道			12. 同意，承諾		
(1) bullet	(2) consent	(3) equator	(4) facility	(5) lap	(6) poll
13. 船			14. 特権，特典		
(1) cereal	(2) craft	(3) deposit	(4) pastry	(5) privilege	(6) opponent
15. 移行，移り変わり			16. 群れ		
(1) complaint	(2) cone	(3) flock	(4) leadership	(5) temptation	(6) transition
17. ドシンと当たる，ぶつかる			18. 広くする		
(1) bump	(2) confront	(3) graduate	(4) promote	(5) scan	(6) widen
19. 促す，刺激する			20. 固執する，貫く		
(1) arouse	(2) clash	(3) invade	(4) persist	(5) prompt	(6) soak
21. 仲直りさせる			22. 変える，修正する		
(1) conclude	(2) modify	(3) murmur	(4) reconcile	(5) stagger	(6) weave
23. 購入する，買う			24. 再び始める		
(1) alternate	(2) collapse	(3) fetch	(4) pat	(5) purchase	(6) resume
25. 論理的な			26. 中立の		
(1) dense	(2) logical	(3) neutral	(4) partial	(5) residential	(6) spiritual
27. 単数の			28. ことばの，言語の		
(1) administrative	(2) atomic	(3) concrete	(4) frank	(5) linguistic	(6) singular
29. ただ…だけ，単に			30. その結果として，したがって		
(1) consequently	(2) nearby	(3) necessarily	(4) occasionally	(5) solely	(6) technically

Appendix B
Vocabulary Learning Strategies Questionnaire

What strategy do you use to learn English words and phrases? The following sentences describe some of the learning strategies. Please circle the number that you think is most applicable.

1. strongly disagree	2. disagree	3. partly disagree
4. partly agree	5. agree	6. strongly agree

(Determination strategies)

1. I think about the part of speech of the new word (e.g., noun, verb, adj., adv., etc.).
2. I analyze word parts in order to guess the meaning of a word (e.g., happiness > happy + ness).
3. I look for similarities in sound and meaning between words in my mother tongue and foreign words (e.g., 台風 (*taifu)* → typhoon).
4. I try to guess the meaning of a new word from the context.
5. I think about the meanings of words by looking at pictures and photos when reading a text, or by looking at the surroundings and people's facial expressions when listening to a text.
6. I use a bilingual dictionary when I find a new English word that I do not know.
7. I use a monolingual dictionary when I find a new English word that I do not know.

(Social strategies)

8. I ask the teacher to explain the meaning of a word.
9. I ask someone other than teacher what a word means.
10. If I don't understand a word, I discuss its meaning with a group of friends.
11. I talk to a native speaker to learn the meaning and usage of a word.
12. I study the meaning and usage of a word with others.
13. I ask another person to test me on words.

(Memory strategies)

14. I connect the meaning with an image to remember words. (e.g., when memorizing the word "mountain," I try to picture a real mountain in my mind as I study.)
15. I associate a word with pictures, drawings or illustrations to remember it.
16. I associate new words with the ones I already know (e.g., when learning "monkey," I relate it to other words such as banana, sweet, yellow, jungle, etc.)
17. I look up the synonyms and antonyms of the word that I want to remember and memorize them together (e.g., for the word "important", I remember the synonyms "significant" and "necessary," or the antonym "unimportant.").
18. I memorize words with similar spellings at the same time.
19. I connect a word to my experience to help remember it (e.g., I am "shy", but "cheerful".).
20. I group words together to remember them (e.g., fruits = apple, orange, strawberry, pear, etc.).
21. I use rhyme to remember a word. (e.g., take = mot<u>teiku</u>, tot<u>teiku</u>, tsure<u>teiku</u>).
22. I read and leaf through a dictionary to learn new words.

23. I use new words in a sentence to remember them.
24. I study the spelling of a word.
25. I study the sound of a word.
26. I study a word I want to remember by saying it aloud.
27. I make a mental image of the spelling of a word I want to remember.
28. If a word is long, I remember it by analyzing word parts (e.g., unthinkable = un(not) + think + able).
29. I remember a word with other expressions or paraphrases (e.g., shout = to talk very loudly).
30. I memorize words using actions. (e.g., when learning the word "seize," I use my hands to grip something.).
31. I connect words to physical objects to remember them.
32. When I encounter new words in a conversation or textbook, I try to use them immediately.
33. I consciously study the part of speech of new words (e.g., noun, verb, adj., adv., etc.).

(Cognitive strategies)

34. I repeat the word aloud many times to remember it.
35. I write the word many times to remember it.
36. I study lists of words, such as found in a vocabulary book, repeatedly.
37. I make flashcards to practice words (e.g., write English words on one side and the Japanese meanings on the back).
38. I make vocabulary notebooks, add information to them, and use them as a reference.
39. I study the words, text, and example sentences from the textbook by listening to the CD.
40. I actively use the word practice questions in the textbook.
41. I use colors and highlighters to mark new words in a text.
42. When I learn new words in class, I write them down in my notebook immediately.
43. I record new words by myself and then listen to them.

(Metacognitive strategies)

44. I remember new words by checking which lesson and page they appear in the textbook.
45. I focus on new words that appear in non-school materials, such as movies, music, books, magazines, TV, radio, Internet, games, etc.
46. I continue to study and review new words I want to remember at intervals of time.
47. I skip or ignore unfamiliar words and continue reading, as long as I understand the content of the text.
48. I take whatever time is necessary to learn each new word individually.
49. I test myself on new words to check if I remember them.
50. I make my own word study plan before learning new vocabulary.
51. I review the words I have learned regularly outside of class or school.

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