VLS Model for Content Words: An Experimental Study on Engineering Students in India

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ABSTRACT

The resurgence of interest in vocabulary learning in the past two decades and research in Vocabulary Learning Strategies (VLS) since Schmitt's 1997 taxonomy have yielded a few other taxonomies and strategies to enrich the vocabulary of ESL learners. However, developing a VLS taxonomy or Model in ESP context has not been focused upon though the need for it has been studied and reported. Students from vernacular medium schools in ESL and EFL countries find it difficult to learn the content in colleges due to their limited knowledge of content vocabulary. Hence a new VLS Model for content words has been designed to render linguistic assistance to them. The efficacy of the Model has been tested in the context of Engineering Science. The proposed model is unique and specific for deriving strategies to learn content vocabulary in all branches of Science and Engineering. There is scope for diachronic, synchronic, and scientific study of words through Cognitive and Metacognitive strategies. Activities generated on this Model combine decontextualized Discovery strategy and contextualized Consolidation strategy. Eighty engineering college students in India took part in the study. The experimental group which received intervention based on the VLS Model outperformed the control group in the posttest. Hence this Model is advocated for enhancing the knowledge and use of ESP vocabulary and for helping learners understand their disciplinary field. It is believed that through appropriate VLS, the learners can be empowered to be autonomous in reading.

Keywords: VLS Model; Content words; ESP; Engineering Science; L2 learners

INTRODUCTION

Can you find the perimeter of a circle with the formula $\pi.d$?
No, with this formula I can find only the circumference.

This answer from a student in India during the pilot study raises many questions about the ways in which vocabulary is learnt in classrooms in ESP context. In the mental lexicon of the L2 learner, words, especially content words, are recorded only as orthographic equivalents of mathematical formulae or scientific notations. The student who has given the above answer will surely score well in mathematics, provided that the wordings in the question are not changed; he doesn't know that the *perimeter* of a circle is called *circumference*. Herbert Hirsh (2003) finds the phrase *Us engineers don't need no English* common in Engineering circles as in the field of Science and Engineering, it is considered important to have good content knowledge rather than good language skills. Hence in developing countries like India, where focus is on the teaching of technological subjects, language study has steadily been relegated to the sidelines and the outcome is alarming. According to the The India

Skills Report (2014) only 17% engineering graduates are employable as they lack content knowledge as well as language skills needed for placement in any industry.

Content learning is not exclusive of language learning; Language Learning Strategies (LLS) can facilitate and enhance content learning. Vocabulary Learning Strategies (VLS) are part of LLS and strengthening content vocabulary by the use of cognitive strategies is bound to have a positive impact on content learning and academic and technical communication. Hence, a discrete Model of VLS for ESP (Engineering Science in the context of this study) was developed and the strategies derived from the Model were tested in an experimental study at an engineering college in India. The results are encouraging and the Model can be applied in all disciplines of Science, be it General Science, Medical Science or Engineering Science.

LITERATURE REVIEW

Chamot (2005, p.112) describes learning strategies as procedures that facilitate learning a task. Language Learning Strategies (LLS) are those learning techniques, actions, problem-solving or learning skills (Oxford and Crookall, 1989) that can lead to effective learning and enhanced proficiency in a second language. Language learners can become autonomous by the use of LLS (Zarei & Elekaie, 2012). Vocabulary learning strategies (VLS) are a sub set of LLSs which are defined by Gu (2003) as those behavior and actions used by language learners to use and to know vocabulary items. There are many other definitions of VLS but research has shown that students from different cultural, linguistic, and educational backgrounds do not benefit from the same strategies (Gu, 2003; Tran, 2011) as the same strategies cannot be used for enriching vocabulary for general communication, academic communication and technical communication. English for Specific Purpose deals with low frequency words or words with special meanings in academic context; hence, different VLS are required to promote the comprehension of words and text. Brown (2012) developed a VLS training programme for first year medical students and Little and Kobayashi (2015) explored the VLS preferences of Japanese Life Science majors for learning general science vocabulary in English. In addition, it has been brought to light that the use of strategies differs among students pursuing different academic disciplines. The students of English major are found to use strategies more often than science students (Bernardo & Gonzales, 2009; Peacock & Ho, 2003). That is why various researchers have attempted to identify and classify the strategies used by language learners in various disciplines and as a result, different taxonomies and classifications of VLS have been made available in the field of vocabulary learning and teaching (Klapper, 2008; Nation, 2001; Rubin & Thompson, 1994; Schmitt, 1997).

Among the existing taxonomies, Schmitt's (1997) taxonomy is accepted as the most comprehensive one because it is specifically prepared for vocabulary learning, with little overlap between the classifications of the strategies (Akbari & Tahririan, 2009). Researchers in the area of VLS have chosen the relevant strategies from the available taxonomies for the purpose of their study, be it the study of Medicine (Abdullah, 2013; Sinadinović, 2013; Brahler & Walker, 2007; Seddigh & Shokrpur, 2012, etc.) or General Science (Little and Kobayashi, 2015).

Though Schmitt's taxonomy (1997) has been a comprehensive resource for all researchers and ELT practitioners, the choice of strategies is determined by the learners' needs and their background. The strategies cannot be the same for native and non-native speakers of English. Even in many ESL countries, the actual status of English is that of EFL as the educational policies of the governments favour L1 as the medium of instruction in schools. India is a multilingual country with 780 languages spoken by its people and 42 languages being used as the medium of instruction at the primary and secondary level of education. When English becomes the only medium of instruction at the tertiary level of professional education, the insufficient content vocabulary impedes the learners' acquisition of knowledge in their discipline. Hence there is a dire need to build their content vocabulary explicitly within a short time. However, there has been no comprehensive Model of VLS that can help the learners and teachers in ESP, particularly in India. Hence a VLS model has been developed for content words and its efficacy has been tested in the field of Engineering Science.

VOCABULARY LEARNING STRATEGIES MODEL

The proposed VLS model was developed from the earlier models of language learning and vocabulary learning. Vocabulary learning strategies cannot be developed in isolation because vocabulary learning strategies are intertwined with language learning strategies. Although in 1975 Rubin had already directed attention towards learning strategies, up till 1997, there was no clear and complete taxonomy of VLS. VLS then was mentioned only as a part of language learning strategies. In 1997, however, Schmitt proposed an exhaustive list of VLS with reference to Oxford's (1990) classification scheme of language learning strategies. He expanded Oxford's classification by adding one more strategy and grouping them under two categories of Discovery and Consolidation. Figure 1 depicts the classification scheme put forward by Schmitt.

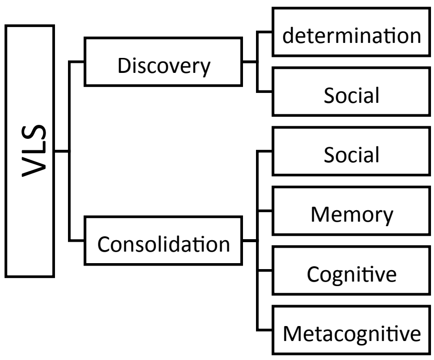

FIGURE 1. Schmitt's Taxonomy of Vocabulary Learning Strategy (VLS)

Schmitt's taxonomy (1997) has served as the base for later research on VLS due to its exhaustiveness, with 55 strategies arranged under the sub categories. The model prepared for the present study is built on this general framework with modifications done to suit the requirements of the ESP learners and the objective of the study. Figure 2 represents the VLS Model created for the purpose of teaching the content words in Engineering Science. This model can also be used for other branches of science.

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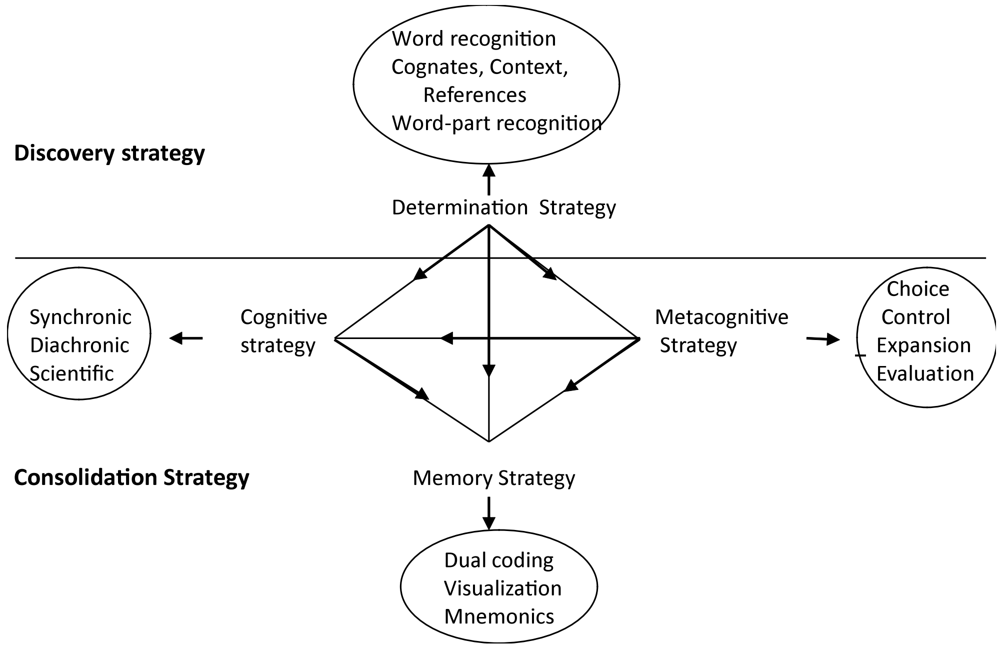

FIGURE 2. VLS Model for Content Words in ESP - Engineering Science

RATIONALE BEHIND THE DESIGN OF THE MODEL

The existing taxonomy of learning strategies and the previous models of VLS take into consideration general vocabulary learning of either the ESL or the EFL learners. However, the present study aims at learning of content words chosen from academic corpus in the context of ESP. The words in this context are technical and semi technical in nature; they fall in mid or low frequency bands. Since these words are almost never used in social discourse, the Social strategy which is mentioned as a Consolidation strategy in Schmitt's taxonomy is not included in the model. Amirian and Heshmatifar (2013) endorse this view by saying that in ESP context, students resist asking others' assistance for knowing the meaning of new words and vocabulary learning is considered an individual or asocial process.

The cognitive strategies adopted in this Model are the use of etymology, semantics, and affixes. Semantic mapping leads to deep vocabulary knowledge (Akil & Rosida, 2018; Nilforoushan, 2012; Amer, 2002) as words are learnt in association instead of isolation. Similarly the strategies based on imagery strengthens memory (Zahedi, 2012) as proposed in the Dual Code Theory by Paivio (1986). Psycholinguistics offers an explanation for the effectiveness of these strategies by explaining that the Depth of Processing (Craik & Lockhart, 1972) enhances deep memory and enables delayed retrieval. Smith and Jarrold (2014) studied the effects of grouping, semantic relation, and imagery in individuals with specific verbal Short Term Memory (STM) deficit and observed significant memory recall benefits after the intervention.

In the proposed Model the etymological study gives ample scope for visualization due to the diachronic study of the words. The use of affixes is mentioned as a discrete strategy because all the affixes in science are not linguistic elements. The scientific affixes follow the rules of nomenclature established by IUPAC (International Union of Pure and Applied Chemistry). For example the suffix '*–ane*' does not have a meaning but is used for naming an element if all of the carbon-carbon bonds are single bonds (formula C_nH_{2n+2}) and the prefix *'meth-'* is used if the number of carbon atom is one. Thus the addition of scientific perspective to the diachronic and the synchronic perspectives makes the Model highly relevant in ESP. All these strategies do not function in a linear way as it could be seen in

Figure 2. Also, the strategies mentioned are not mutually exclusive as Schmitt (1997, p.204) himself noted that "it is very difficult to draw a border line between different strategies and their variations". It could also be seen that any Discovery Strategy leads to Consolidation strategy ultimately.

FUNCTION OF THE MODEL

The Model supports explicit vocabulary learning as the context is ESP and the learners are at the tertiary level of education. At this level 'List learning' and 'Data Driven learning' (DDL) are widely used to enrich the vocabulary of the learners to help them attain the university threshold level of vocabulary knowledge and meet the demands posed by complex text books. The list-learning of words offers little scope for contextual guesses. Guessing from the context is still considered as the most effective means of vocabulary learning that will help to improve proficiency in language. However, in academic or technical language, guessing from the context is possible only if the learners have an understanding of the conceptual structure of the topic or that they are familiar with at least 95% of the running words in the text (Liu and Nation, 1985, cited Nation 2001). Hence words are presented through semicontextualised activities (e.g. word association, visual and aural imagery, semantic mapping etc.) to initiate word recognition or word-part (root, base, prefix, suffix) recognition. Once the shared word-parts are identified, their meanings are elicited and confirmed with activities involving etymological analysis, semantic analysis, or scientific analysis. The cognitive strategies help in expanding the learners' repertoire of words as more words are added to the groups. Caution should be applied while introducing and expanding words. For example, the prefix *re-* means 'again' but not for the words '*read'* or *'ready'* which have old English and Proto-Germanic roots respectively. The outcome of the tasks is evaluated by self or the instructor. The entire process involves analysis, inference, interpretation, confirmation, organization, repetition, and reinforcement; all of which give ample scope for dual coding, visualization, and mnemonic technics. Such an elaborate rehearsal, as per Levels of Processing Model of Memory (Craik & Lockhart, 1972), registers the information in the long term or deeper zone of memory ready to be retrieved during comprehension of text materials. Based on the model, tasks and materials can be designed for teaching content words.

DESIGN OF TASKS BASED ON THE MODEL

The tasks are designed under five categories, namely, i) etymology, ii) semantics, iii) prefixes, iv) suffixes, and v) scientific. These strategies enhance memory through imagery, association, and grouping. For each unit, a set of words from a pre-drawn list is taken. The strategy is chosen and the outcome is estimated. It is only an estimation as there is a possibility of exceeding the outcome because the students would sometimes come out with extraordinary responses. The phases of the strategy are uniform for all the units but the sub strategies would vary according to the strategy chosen. The instruction process is a five-step process adopted from CALLA (Cognitive Academic Language Learning Approaches) which is being used in the United States of America and many other countries.

STEP 1. PREPARATION

This is a brainstorming phase to elicit the prior knowledge of the learners about the words to be introduced in the class and the strategy they use to decode the meaning of the words to identify the gap that needs to be addressed. The objectives are also explained to the learners in this phase.

STEP 2. PRESENTATION

In this phase the new words are presented in a manner to captivate the interest of the students. Depending on the strategy chosen, pictures, graphic organizers, mind maps, fish bone diagrams, or authentic texts are used to support the strategy introduced to decode word meanings. Contextual and semi contextual clues are also presented to understand the use of the words and their lemmas. The students are prepared for the next phase by giving enough explanations and examples.

STEP 3. PRACTICE

This is a learner-centred phase where the students are engaged in hands-on activity to practice the new strategy taught in the previous phase. They are allowed to seek help for clarification from the instructor who is also the facilitator or the peer group and look up for more information in reference materials available. Some of the resource sites suggested to the students are i) normal dictionary, ii) technical dictionary, iii) science dictionary, iv) etymology dictionary, and v) 'Concordance' (online tool) to learn how the word is used in the text. The students learn to deduct meaning, organize words, visualize, or use imagery, dual code the information, and practice pronunciation.

STEP 4. EVALUATION

This is a phase of self-evaluation for the students who verify their responses to check their understanding of the strategy. They apply the strategy to elaborate their knowledge and expand their word-stock.

STEP 5. EXPANSION

In this phase what is learnt inside the classroom is taken out to other classes and real life. Since all the words learnt are content words, they would be of immense help in their Science classes. The students think about the new strategy, integrate with what they already know and make real life applications. It develops their academic language and subject knowledge.

A sample unit plan for one of the tasks is given in Appendix A.

METHODOLOGY

SAMPLING

The VLS Model was tested for its efficacy in an experimental study conducted on the students of an engineering college in Chennai, India. The sampling was of convenience as two groups of first year students from two classes were chosen. The random allocation helped to avoid bias and limit the effects of participant variables. According to the students' profile collected from the admission office, all the students were of the same age group and had completed twelve years of schooling. 78 students had one of the Dravidian languages (i.e., Tamil, Telugu, Kannada and Malayalam) as their L1 whereas two had Hindi (an Indo-Aryan language) as their L1. The L1 profile helped in deciding against using cognates as a strategy because Dravidian languages share little similarity with languages that belong to the family of Indo-European languages. Admission to engineering colleges in India is done based on the marks of the students in the entrance examination and the rankings of the colleges. Colleges are given ranks by the All India Council for Technical Education after assessment and students are allotted to colleges from a central pool. This means that all the students in a college would have met the same admission criteria. Hence the students in the two groups were considered homogenous though the homogeneity was established statistically after the pretest. Only after checking the results of the '*t*-test' to establish the similarity, the experimental intervention was carried out. Similarly, α reliability was found out for the pretests. 80 students participated in the study and half of the students were exposed to the intervention. Pretests were held in the month of July and posttests at the end of three months. The experimental group was given an intervention of 30 sessions of half-an-hour each for a period of three months.

EXPERIMENTAL STUDY

The design of the test chosen for the study comprised vocabulary tests to measure the two dimensions of breadth and depth of vocabulary knowledge. The target words were taken from the pre-drawn list of Engineering Science words (ESWL) compiled by the researcher (Viswanathan & Sultana, 2018) earlier from the academic corpus of the target group and approved by two content experts at the university. In fact, for developing the first version of Word Association Test (WAT) for university ESL learners, Read (1993), too selected the 50-stimulus words from the University Word List (Xue and Nation 1984), which is a list of 836 words commonly appearing in academic texts. The words in ESWL were grouped under different frequency bands and care was taken that the number of words picked out for testing was proportional to the number of words of ESWL in each frequency band. The words were distributed between the two sections of Vocabulary Level Test (VLT) and Depth of Vocabulary Knowledge (DVK).

Any vocabulary test should test the knowledge of the words both at productive and receptive levels and to achieve this, researchers have differentiated between the breadth and depth of vocabulary knowledge (e.g., Bogaards and Laufer, 2004; Read, 2000). Vocabulary breadth refers to the number of words of which a learner has at least some superficial knowledge of the meaning (Qian and Schedl, 2004). Nassaji (2004) mentions that one widely used measure to assess the size of vocabulary is the Vocabulary Level Test (VLT) designed by Nation (2001). Nation (2008) himself asserts that the test is widely used by researchers as it is well-researched. Ten words were used in non-defining sentences and each sentence was followed by four options: one of which was the synonym of the word highlighted. The words in the options belonged to the same frequency or a lesser frequency than the target word. Each correct answer carried a score of 10.

Vocabulary depth encompasses various aspects of knowledge about words, such as form, meaning, and use in both receptive and productive senses as well as in both spoken and written modalities (Nation 2001; Schmitt 2014). The Depth of Vocabulary Knowledge (DVK) was evaluated on the pattern of Word Association Test developed by Read (1998) which was later revised by Qian (2004). The stimulus words were given in adjective forms followed by eight options in two columns. The four options in the first column measured the meaning of the word and the four options in the second column were in noun forms forming a syntagmatic relationship by collocating with the stimulus word. Four words were to be chosen as answers from among the eight options in both the columns and the scores varied from 0 to 4 for each question.

During the intervention, the learners were exposed to and trained in VLS derived from the new Model through various tasks as explained earlier in the paper. The pretests and post tests were conducted on the same day for both the experimental and the control groups.

RESULTS

The scores were analyzed using the SPSS version 23 software. The Reliability was 0.61 and 0.79 in the VLT (Vocabulary Level Test) and DVK (Depth of Vocabulary Knowledge) respectively which are acceptable values. Since the sampling was of convenience, the homogeneity between the groups had to be statistically established before further analysis. Hence, the pretest scores of both the groups were compared to find out if there was a difference among the variables of groups by an independent sample *t*-test. The values of the mean scores, standard deviation and *t*-values are listed below in Table 1 and Table 2.

TABLE 1. The pre-test scores of the control and experimental groups

Test	Groups	Number of samples	Mean	Standard deviation
Pre test scores	Control	40	65.52	12.79
	Experimental	40	63.25	12.06

TABLE 2. The Independent Samples Test scores of the CG and the EG – Pre test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Pretotal scores	Equal variances assumed	.217	.643	.818	78	.416	2.27500	2.78037	-3.2602	7.81028
	Equal variances not assumed			.818	77.73	.416	2.27500	2.78037	-3.2605	7.81058

The Mean score of the Control Group was slightly higher than the Experimental Group, as evident from the difference in the means shown in Table 1. However, this difference was not significant to the 95% confidence interval. Again, the variance in the two groups was checked to determine any similarity. Equal variances is denoted with a *p*-value (Sig) which should be greater than .05. Here, the *p*-value was 0.643 which was greater than 0.05 ($p>0.05$). The value in the column "Sig. (2-tailed)" indicates if there was a significant difference in the means of the two sample groups tested. Here, the *p*-value, 0.416 was also greater than 0.05. Thus it was concluded that there was no significant difference between the Control and the Experimental groups and this suggests that they were homogeneous.

In contrast, when a similar independent *t*-test was conducted to compare the post test scores of the two groups, significant difference was found between the two, with a high *t*-value and low *p*-value, as shown in Tables 3 and 4.

TABLE 3. The post-test scores of the Control and Experimental groups

Test	Groups	Number of samples	Mean	Standard deviation
Post test scores	Control	40	72.37	12.88
	Experimental	40	81.57	10.23

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TABLE 4. The independent t- test scores of the Control and the Experimental groups – Post-test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Posttotal scores	Equal variances assumed	1.137	.290	3.537	78	.001	9.20000	2.60142	4.02096	14.37
	Equal variances not assumed			3.537	74.19	.001	9.20000	2.60142	4.01678	14.38

According to the values in Table 4, the *p*-value (2 tailed) 0.001 was less than 0.05 and *t*-value was 3.53. This suggests that there was significant difference between the Control and the Experimental groups.

A paired samples *t*-test was conducted when one group of participants is measured on two different conditions at two different times (like pre-test and post-test: Time 1 and Time 2). The post-test scores of the Control Group and the Experimental Group were compared with their pre-test scores to find the difference. Figure 3 shows the Mean difference in the scores of the Control group and the Experimental Group according to the paired samples *t*-test. The *t*-value was 12.59 for the experimental group.

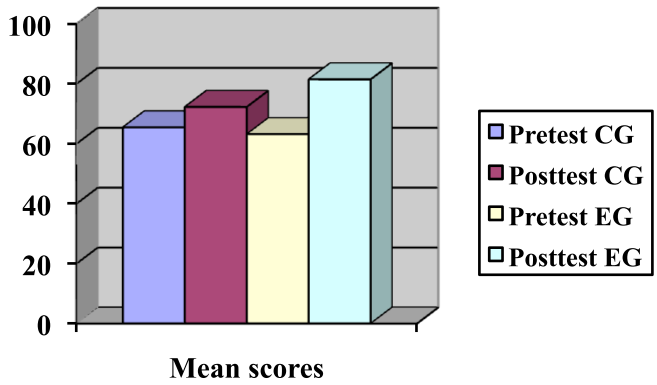

FIGURE 3. Mean difference in post test scores of CG and EG

Figure 4 shows the Mean difference in VLT and DVK scores of the posttest and pretest of the Experimental group according to the paired samples *t*-test. The *t*-value for VLT was 7.98 and DVK was 15.44.

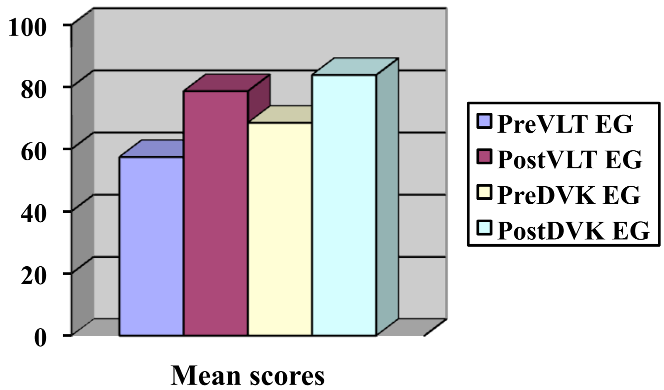

FIGURE 4. Mean difference in VLT and DVK scores of the EG

Once the statistical significance of difference was determined, the next step was to find the effect size. Effect size is an indicator of how strong or how important the results are. One common method of indicating effect size is to express the difference in means in terms of standard deviations. Cohen's *d* is generally used to find the effect size. The formula is Cohen's $d = (M_2 - M_1) / SD_{pooled}$ where $SD_{pooled} = \sqrt{((SD_1^2 + SD_2^2) / 2)}$.

Cohen gives the following guidelines for interpreting the effect size *d*:

- $d = 0.2$ is a small effect size
- $d = 0.5$ is a medium effect size
- $d = 0.8$ is a large effect size

Cohen's *d in* the present study was 0.859 indicating a large effect size. The reason for the increase in scores was the effective intervention aimed at building the vocabulary of the students through CVL.

DISCUSSION

There are four major findings of the study. First, the efficacy of the VLS Model for content words in (Engineering) Science has been proved. Second, the exclusion of social strategies in content word learning is validated. Third, there is ample scope for deep processing or elaborate rehearsal which is vital for improving productive vocabulary. Fourth, the inclusion of scientific affixes in language teaching has added a new dimension to integrated learning.

The increment in the scores of posttest in the Experimental group is statistically significant in comparison to the Control Group. In the Experimental Group, the mean score of DVK is higher than that of VLT, but the increase in relation to the pretest is more in VLT than DVK. Generally, the social strategies are considered important in improving language proficiency, but in content vocabulary learning, for better comprehension of academic texts, social strategies take a backseat. Here, the act of learners asking for or discussing the possible meaning of a given word during activity is not taken as a social strategy. Explicit and decontextualized word learning is always considered a 'shallow' strategy and that is why Segler et al. (2001) say that none of the proposed taxonomies includes the depth-of-processing (DOP) factor. Craik (2002) proposed that "deep" processing is associated with higher levels of retention and clarified that deep processing requires more attention and not more time. According to him, stronger memories occur as a result of a deep memory trace which happens through 'elaborative rehearsal' that takes place in the mind at the time of learning. The elaborate process of learning through strategies mentioned in this Model requires either a diachronic perspective or structural elaboration to unravel the meaning of a word. It complements the teaching of synchronic aspect of word knowledge that is normally practiced in classrooms. The 'word processing' or 'elaborative rehearsal' does not provide only the lexical knowledge but also the key to comprehend the text in which the word occurs. Perfetti (2014) endorses this view when he says that within the Reading System Framework, there is a close interaction between the word identification system and the comprehension system that is mediated by lexical knowledge.

Though there are numerous VLS aimed at enriching the vocabulary of ESL learners, they cannot be applied to specialized fields like EEP (English for Engineering Purpose), EMP (English for medical Purpose), EBP (English for Business Purpose), EVP (English for Vocational Purpose) etc. The Model discussed in the paper fulfils the requirement of all disciplines of Science as most of the scientific words have classical roots and scientific nomenclature governed by the rules of IUPAC. The words in specialist word lists like ESWL used in the experimental study are technical and semi technical having classical roots. Hence, the use of etymology and semantics as vocabulary building strategies for students of Science and Engineering has proven to be tremendously beneficial. On the one hand the diachronic perspective of word origin and changes over time gives ample scope for creating visual imageries; on the other hand word associations expand the vocabulary.

VLS has made the learners aware of the strategies they employed, and has thus, triggered the development of their metacognitive skills. As a result, the learners became more engaged in reading Science passages provided at the intervention and could focus more on comprehending as they became 'experts' in decoding the word meanings. There was also a positive feedback from the professors of Engineering Chemistry and Engineering Physics about the intervention provided in the English classes. The professor of Chemistry cited an example from his teaching of 'Classification of colloids', which was taken from the chapter on Surface Chemistry. He argued that the students' understanding of the term *lyophilic colloids* was due to the strategy introduced by the English teacher rather than the definition given in the book.

> **Lyophilic colloids**:- Colloidal sols directly formed by mixing substances like gum, gelatine, starch, rubber, etc., with a suitable liquid (the dispersion medium) are called lyophilic sols. (Chemistry Part I, NCERT Publication, p. 134)

It was quite interesting to note that the control group had also shown an improvement as the *p*-value was less than .01 for all the tests. This indicates that the normal classroom practices were not totally ineffective. However, the improvement was only marginal compared to the significant improvement in the experimental group. The intervention based on VLS was part of the regular teaching hours and there was no extra teaching hours for the experimental group. Hence it could be said that the synchronic aspect of word knowledge had been strengthened by the diachronic and scientific aspects of word knowledge leading to effective vocabulary learning in ESP classrooms. The study also favours explicit vocabulary teaching which is considered more effective in promoting reading comprehension in ESP (Kusumawati & Widiati, 2017). Thus this study recommends the use of the new VLS model for content words in ESP for effective learning of vocabulary that would inevitably lead to enhanced comprehension of academic material.

CONCLUSION

The present study has dealt with the innovation of the VLS Model for content words in the context of the academic requirements of students in universities and colleges. The efficacy of the Model depends on the disciplines in which it is used. While science and science-related disciplines have many words with classical roots, other disciplines such as those related to management or commerce have very few words with classical roots. The efficacy of the Model also depends upon the L1 of the students. Hence the study needs to be done among different groups of students with different L1 for better results. For example, in the proposed VLS Model, the Discovery strategies include word recognition, cognates, context, references and word part recognition. Among them cognates are helpful only to the students whose mother tongues belong either to Indo European or Indo Aryan languages. Even in the present study, cognates were not included as all but two students in the experimental group had one of the Dravidian languages as their L1.

The presentation of new strategies through various tasks has fostered effective vocabulary learning and helped the students to become autonomous learners (Amiryousefi, 2015) as the learners at tertiary level need to be independent in conducting self-directed learning (Sulaiman et al., 2018). The current study has also bridged the gap between research and classroom practice by devising strategies and learning modules out of the theoretical Model. The step-by-step account of designing the learning modules, as well as keeping the

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content learning in focus, is helpful to language teachers in ESP, who have the responsibility of providing linguistic assistance to facilitate content learning. In addition, the current study can also help the ESP curriculum designers who may wish to embed the study of etymology, semantics and morphology in the regular content and researchers who want to expand and implement the Model in other disciplines.

English is the lingua franca of modern era and it will remain so for a long time. Hence, it is an ethical obligation of institutions of higher education in ESL and EFL countries to understand the specific needs of the students and help them in their academic pursuits. The framework of the VLS Model for content words provides ways to derive explicit and effective vocabulary learning strategies to acquire enough lexical knowledge needed for reading and comprehending academic texts.

REFERENCES

Abdullah, G. M. A. (2013). Strategies and approaches for teaching and learning of medical terminology. *International Journal of English and Education. Vol. 2*(2), 225-241.

Akbari, Z. & Tahririan, M. H. (2009). Vocabulary learning strategies in an ESP context: The case of para/medical English in Iran. *The Asian EFL Journal Quarterly. Vol. 11*(1), 39-61.

Akil, M. A. & Rosida, A. (2018). The application of semantic feature analysis as a strategy to enrich students' vocabulary. *Journal of Advanced English Studies. Vol. 1*(2), 12-20.

Amer, A. (2002). Advanced vocabulary instruction in EFL. *The Internet TESL Journal. Vol. 3*(11).

Amirian, S. M. R. & Heshmatifar, Z. (2013). A survey on vocabulary learning strategies: A case of Iranian EFL university students. *Journal of Language Teaching and Research. Vol. 4*(3), 636-641.

Amiryousefi, M. (2015). Iranian EFL teachers and learners' beliefs about vocabulary learning and teaching. *SAGE Open* https://doi.org/10.1177/2158244015581382

Bernardo, A.S. & Gonzales, H.T. (2009). Vocabulary learning strategies of Filipino college students across five disciplines. *TESOL Journal. Vol. 1,* 17-27.

Bogaards, P. & Laufer, B. (2004). *Vocabulary in a Second Language*. Amsterdam: John Benjamins Publishing Company.

Brahler, C. J. & Walker, D. (2008). Learning scientific and medical terminology with a mnemonic strategy using an illogical association technique. *Advances in Physiology and Education. Vol. 12*, 219–224.

Brown, P. S. (2012). Innovating a vocabulary learning strategies program. In Muller, T., Herder, S., Adamson, J. & Brown, P. S. (Eds.), *Innovating EFL Teaching in Asia,* Hampshire, UK: Palgrave Macmillan

Chamot, A. (2005). Language learning strategy instruction: Current issues and research. *Annual Review of Applied Linguistics. Vol. 25*, 112-130. https://doi.org/10.1017/S0267190505000061

Craik F. I. M. (2002). Levels of processing: Past, present and future? *Memory. Vol. 10* (5/6), 305-318.

Craik, F. & Lockhart, R. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning & Verbal Behavior. Vol. 11*, 671-684.

Gu, P. Y. (2003). Fine brush and freehand: The vocabulary-learning art of two successful Chinese EFL learners. *TESOL Quarterly. Vol. 37*, 73-104.

Hirsh, H. L. (2003). *Essential Communication Strategies for Scientists, Engineers and Technology Professionals*. New York: Wiley-IEEE Press, xi-15.

Klapper, J. (2008). *Deliberate and incidental: Vocabulary learning strategies in independent second language learning*. In Hurd, S., Lewis, T. (Eds.), Language Learning Strategies in Independent Settings (pp. 159-178). Bristol, UK: Multilingual Matters.

Kusumawati, E. & Utami, W. (2017). The effects of vocabulary instructions on students'reading comprehension across cognitive styles in ESP. *Journal of education and Practice. Vol. 8*(2).

Little, A. & Kobayashi, K. (2015). Vocabulary learning strategies of Japanese life science students. *TESOL Journal. Vol. 6*(1), 81-111.

Nassaji, H. (2004). The relationship between depth of vocabulary knowledge and L2 learners' lexical inferencing strategy use and success. *Canadian Modern Language Review . Vol. 61*, 107-134.

Nation, I. S. P. (2001). *Learning Vocabulary in Another Language*. Cambridge: Cambridge University Press.

Nation, I. S. P. (2008). *Teaching Vocabulary: Strategies and Techniques*. Boston, MA: Heinle Cengage Learning.

Nilforoushan, S. (2012). The effect of teaching vocabulary through semantic mapping on EFL learners' awareness of the affective dimensions of deep vocabulary knowledge. *English Language Teaching. Vol. 5*(10). doi: 10.5539/elt.v5n10p164

Oxford, R. & Crookall, D. (1989). Research on language learning strategies: Methods, findings, and instructional issues. *Modern Language Journal. Vol. 73*(4), 404-419. http://dx.doi.org/10.2307/326876

Oxford, R. (1990). *Language Learning Strategies. What Every Teacher Should Know*. Boston: Heinle: Heinle Publishers.

Paivio, A. (1986). *Mental Representations.* New York: Oxford University Press.

Peacock, M. & Ho, B. (2003), Student language learning strategies across eight disciplines. *International Journal of Applied Linguistics. Vol. 13*, 179–200. https://doi.org/10.1111/1473-4192.00043

Perfetti, C. & Joseph Stafura (2014). Word Knowledge in a Theory of Reading Comprehension. *Scientific Studies of Reading. Vol. 18*(1), 22-37. DOI:10.1080/10888438.2013.827687

Qian, D. D. & Schedl, M. (2004). Evaluation of an in-depth vocabulary knowledge measure for assessing reading performance. *Language Testing. Vol. 21*, 28–52. DOI:10.1191/0265532204lt273oa

Read, J. (1993). The development of a new measure of L2 vocabulary knowledge. *Language Testing. Vol. 10*, 355–371. https://doi.org/10.1177%2F026553229301000308

Read, J. (1998). Validating a test to measure depth of vocabulary knowledge. In Kunnan, A. (Ed.). *Validation in Language Assessment* (pp. 41-60). Mahwah. NJ: Lawrence Erlbaum.

Read, J. (2000). *Assessing Vocabulary.* Cambridge, England: Cambridge University Press.

Rubin, J. & Thompson, I. (1994). *How to be a More Successful Language Learner: Toward Learner Autonomy*. Boston, MA: Heinle & Heinle.

Schmitt, N. (1997). Vocabulary Learning Strategies. In Schmitt, N., & McCarthy, M. (Eds.). *Vocabulary: Description, Acquisition and Pedagogy*. Cambridge: Cambridge University Press.

Schmitt, N. (2014). Size and depth of vocabulary knowledge: What the research shows. *Language Learning. Vol. 64*, 913–951. https://doi.org/10.1111/lang.12077

Seddigh, F. & Shokrpur, N. (2012). Vocabulary learning strategies of medical students at Shiraz University of Medical Sciences. *English Language Teaching Journal. Vol. 5*(2), 160–173. doi:10.5539/elt.v5n2p160

Segler, T.M. Pain, H. & Sorace, A. (2001). *Second language vocabulary acquisition and LS in ICALL environments*. [Online]. Accessed at http://homepages.inf.ed.ac.uk/s9808690/finalpaper2.pdf (30.4.2006)

Sinadinović, D. (2013). The importance of strategies in learning and acquiring medical English vocabulary. *JAHR. Vol.* 4(7), 273–291.

Smith, E. & Chris, J. (2014). Grouping, semantic relation and imagery effects in individuals with Down syndrome. *Research in Developmental Disabilities. Vol. 35*(11), 3162-3174.

Sulaiman, N. A., Salehuddin, K. & Khairuddin, R. (2018). Academic word list knowledge of Malaysian ESL undergraduates. *GEMA® Online Journal of Language Studies. Vol. 18*(4), 1-14. http://doi.org/10.17576/gema-2018-1804-01

The India Skills Report. (2014). accessed at https://wheebox.com/logo/SummarizedVersion.pdf

Tran, T. H. (2011). *EFL Teachers' Perceptions about Vocabulary Acquisition and Instruction*. (Doctoral Dissertation, Alliant International University, San Diego, CA). Retrieved from http://search.proquest.com/docview/880629010/37F7DF0A85954E24PQ/1?accountid=14594

Viswanathan, U. M. & Shahin, S. (2018). An Indian ESWL: A pedagogic tool to improve the lexical competency of students in context of horizontal diversity. *The Asian EFL Journal. Vol. 20*(4), 23-38.

Xue, G. & Nation, I. S. P. (1984). A university word list. *Language Learning and Communication. Vol. 3*, 215–229.

Zarei, A. A. & Elekaie, A. (2012). *Learner Autonomy and Language Learning Strategies: An Empirical Analysis. Saarbrücken,* Germany: Lambert Academic Publishing.

Zahedi, Y. & Abdi, M. (2012). The impact of imagery on EFL learners' vocabulary learning. *Procedia- Social and behavioral Sciences. Vol. 69,* 2264- 2272.

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APPENDIX A

SAMPLE UNIT PLAN FOR VOCABULARY LEARNING STRATEGY

<table>
<tr><td>Date:</td><td>Content: words from the ESWL</td><td>Time: 45 minutes</td><td>Class: First year (Civil)</td></tr>
<tr><td colspan="4">No. of words chosen – 8 (chromatogram, chromatography, crystallography, lithograph, photolithography, radiography, sonogram, spectrograph)</td></tr>
<tr><td colspan="4">Objective: Cognitive learning of the selected words</td></tr>
<tr><td colspan="4">Outcome: Expansion of word knowledge to 44 words</td></tr>
<tr><td colspan="4">Strategy: Etymology</td></tr>
<tr><td colspan="4">Phases of strategy
Determination – word recognition, word-part recognition
Cognitive – word-part analysis using etymology, suffixes
Metacognitive – expansion, evaluation
Memory – elaborate and deep processing</td></tr>
<tr><td colspan="4">Instruction process – Five step process</td></tr>
<tr><td colspan="4">1. Preparation
a. Brainstorm about the various ways that can help the students to deal with unknown vocabulary in a semi or decontextualized situation</td></tr>
<tr><td colspan="4">2. Presentation
a. Present ways to recognize the ‘roots’ or prefixes or suffixes shared among the given words and group them together. Use the newspaper clipping “Scan centres to maintain a record of the scans done on all ultrasonography to prevent female foeticide” to initiate word-part recognition.
b. Discuss the possible meaning of the shared word-parts (suffix) in all the words.
c. Create a Web of Words as part of Mind Mapping to connect words
d. Explain strategy benefits – knowledge of ‘root’ and ‘suffix’ helps in decoding the meaning of unfamiliar words and associating with previous knowledge of familiar words</td></tr>
<tr><td colspan="4">3. Practice
a. Pronunciation with shift in stress in derivations.
Example: [1]Chrome, Chroma[1]togram, Chromatogra[1]phy
b. Match the following (pair work)</td></tr>
<tr><td colspan="4">4. Evaluation
a. Peer correction of the worksheet
b. Get oral feedback on the usefulness of the strategy</td></tr>
<tr><td colspan="4">5. Expansion
a. Ask students to add more words to the Web of Words
b. Give another set of words with another suffix and find the meaning of the suffix and the words.</td></tr>
</table>

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