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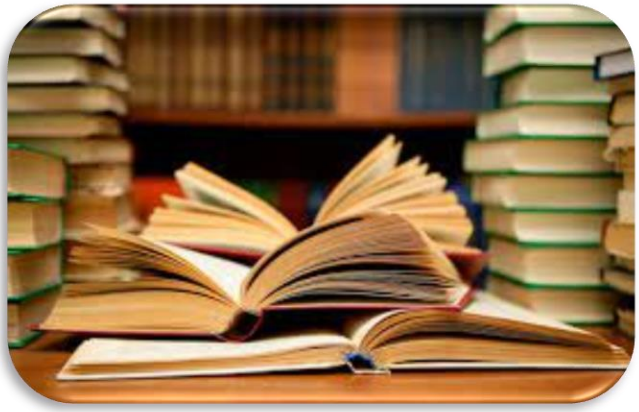

The Frayer Model Effectiveness in the LSP Vocabulary Development: The Case of English for Iranian Computer Sciences Majors

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ABSTRACT

This study was intended to investigate the application of the Frayer model to teaching vocabulary to language for specific purposes students. It employed quasi-experimental control group posttest-only design. As its requirement, two intact classes of Iranian undergraduate computer sciences majors—having taken language for specific purposes course—were selected in a convenience sampling fashion (#62 students). They were assigned to two groups: control and experimental. In a twelve-week treatment period, the experimental group was taught some words present in content area texts using the Frayer model charts along with other words using textbook procedure. To be more precise, they were trained how to organize their understanding of words graphically—the words chosen from their English for specific purposes textbook, i.e., English for computer engineering. In contrast to the experimental group, the control group received instruction in vocabulary learning following just textbook procedure. At the end of the term, an identical vocabulary achievement posttest was administered to both groups. The probable effectiveness of the Frayer model application in learning vocabulary words was statistically computed through independent samples *t*-test procedure. The results showed that Frayer model had significantly affected the experimental English for specific purposes students' vocabulary gain. As a result, they outperformed the normal English for specific purposes students in vocabulary learning. It is implied that the practitioners in this area can transgress the textual mode routines of vocabulary learning: they can take advantages of graphically organizing tools such as the Frayer model for the enhancement of vocabulary learning.

Keywords: English for Specific Purposes, Frayer model, Graphic Organizer, Language for Specific Purposes, Vocabulary Learning

اثرگذاري مدل فراير بر رشد واژگان زبان براي اهداف ويژه: مورد زبان انگليسي براي دانشجويان ايراني رشته علوم كامپيوتر

اين مطالعه با هدف تحقيق در مورد استفاده مدل فراير در تدريس واژگان به دانشجويان مهندسي كامپيوتري كه درس زبان (انگليسي) براي اهداف ويژه يا همان زبان تخصصي علوم كامپيوتر را دريافت كرده بودند انجام شد. طرح تحقيق آن شبه‌آزمايشي مقايسه‌ايي با گروه كنترل و سنجه پس‌آزمون بود. براساس الزامات اين طرح، دو كلاس موجود از دانشجويان مقطع كارشناسي فوق‌الذكر (مجموعاً به تعداد 62 نفر) بدون دخل و تصرف برگزيده شدند. سپس يک كلاس گروه كنترل و كلاس ديگر گروه آزمايش در نظر گرفته شدند. در يک دوره تدريس دوازده هفته‌اي، به گروه آزمايش برخي واژگان برگرفته از متون كتاب زبان تخصصي رشته مهندسي كامپيوتر با استفاده از رسم‌هاي گرافيكي مدل فراير آموزش داده شد به موازات آموزش ديگر واژگان با رويه خود كتاب. به روايتي دقيق‌تر، به آنها آموزش داده شد چگونه يادگيري و فهم خود از واژگان را بصورت گرافيكي سامان ببخشند. در مقابل به گروه كنترل تمامي كلمات با رويه كتاب آموزش داده شد. در پايان ترم، از هر دو گروه يک پس‌آزمون واحد دانش اكتسابي واژگان گرفته شد. سپس اثر احتمالي استفاده مدل فراير با روش آماري نمونه‌هاي مستقل تي-تست محاسبه شد. نتايج اين محاسبات نشان داد كه مدل فراير تاثير قابل‌توجهي بر يادگيري واژگان توسط گروه آزمايش داشته است. يعني اين گروه عملكرد بهتري نسبت به گروه كنترل داشته است. بر اين اساس، مي‌توان نتيجه گرفت كه مدرسين فعال در اين حوزه مي‌توانند، به همراه يا با عبور از رويه‌هاي كتابي، از ابزارهاي سامان‌بخش گرافيكي مثل مدل فراير براي رشد يادگيري واژگان استفاده كنند.

واژگان كليدي: انگليسي براي اهداف ويژه، زبان براي اهداف ويژه، سامان‌بخش گرافيكي، مدل فراير، يادگيري واژگان

INTRODUCTION

The use of graphic organizers in education in general and language education in particular has been endorsed. "A two-dimensional visual framework that presents conceptual relationships," Vaughn, Bos and Schumm (2007:12) defined a graphic organizer as. It enables the arrangement of a great deal of information so that the learner can define concepts and recognize connections between them. The architecture of an organizer consists of boxes and or circles with connecting lines that can visually represent the links among ideas and how words can be classified and described. As such, it can contribute to the classification and description of vocabulary words.

On the one hand, vocabulary is an important component of language since there is a consensus that lexical competence is at the heart of communicative competence and learners must systematically gain an efficient knowledge of vocabulary (Ghezelseflou & Seyyedrezaei, 2015; Decarrico, 2001). It is part and parcel of four skills of listening, speaking, reading and writing. Therefore, learning vocabulary is one of the main challenges foreign language learners encounter during the process of learning a new language (Hatch & Brown, 1995).

Learning vocabulary via instruction takes a lot of time and effort so it can exhaust students. Iranian EFL learners are motivated to make use of some boring traditional vocabulary learning strategies such memorizing long lists of words in order to perform well on general English language tests. Chances are that it makes them disappointed with their attempts to learn language. Furthermore, the majority of EFL learners complain that their lexical knowledge ceases to exist as there is no context of use to practice their knowledge out of class time.

So far, many studies have been carried out to find a better way for teaching L2 vocabulary. However, they have almost failed. One of the problems is that evaluating lexical repertoire is a hard task (Nation, 2001). Therefore, there is a need for principled innovative strategies for vocabulary learning. It is very important to find out through which strategies an EFL learner can foster his/her vocabulary knowledge and from his/her perspective which strategies can be more beneficial to them.

One way to rise to the challenge of learning vocabulary is to raise students' awareness of the role of context in language—either L1 or L2—vocabulary learning. This can be realized through training students to represent lexical items within specific visualized contexts (Hatch & Brown, 1995). Many vocabulary acquisition researchers have argued that acquiring a word requires countless encounters with the word in different contexts (Horst, Cobb, & Meara, 1998; Nation, 1990; Schmidt, 2001). Enriching the context—either (co)textually or visually—in which language learning takes place is believed to likely have a great impact on learners' vocabulary building (Anderson & Nagy, 1991). Therefore, it should be considered as an important pedagogical procedure.

Graphic organizers are known as context enrichment tools. They have been used, as an instructional strategy, to teach vocabulary. Their typical examples are Venn diagrams, vocabulary mind maps, and the Frayer Model word charts (Schwartz & Raphael, 1985; Nessel & Graham, 2007; Buran & Filyukov, 2015). Buran and Filyukov (2015) found that mind maps help students remember new vocabulary. Wang and Dostal (2018) analyze theoretically the utility of mind map in teaching and learning English vocabulary. Putra, Padmadewi and Budiarta (2022) set to determine the effect of using Mindmeister—a mind map generation application— implementation on vocabulary development, especially young learners of sixth-grade elementary school students. The Frayer model word chart, as one type of graphic organizers, helps students to define the target concepts or vocabulary words as well as to identify and understand unfamiliar vocabulary.

On the other hand, academics are unanimous that (L2) lexical knowledge is undoubtedly crucial to the learning of academic content. For instance, Lane and Allen (2010:364) state, "Vocabulary knowledge is one of the best predictors of performance and school achievement". It is words that are the main carrier of information and conceptual knowledge. In spite of the emphasis on learning vocabulary words for

academic achievement, only some students built a good size of vocabulary (Lawson & Hogben, 1996). Students who lack higher order vocabulary skills will encounter difficulties in reading and comprehension in terms of fluency and accuracy.

Treating words both as lexical items and as information vehicles is a perplexing problem. Content majors are usually bombarded with a plethora of unfamiliar words in each session—words from which students must extract meaning as they read. As such, vocabulary study before, during, and after reading should be integrated into the curriculum (Robb, 2000). Teachers must train their students in making use of strategies to enhance understanding of word meaning (Armbruster, Lehr & Osborne, 2001). One of the facilitative strategies seems to be the Frayer model word charts.

The current study attempts to investigate the effect of the Frayer model on English vocabulary building of Iranian computer sciences majors. It commenced the investigation by raising following question.

Does the use of Frayer model have any effect on English vocabulary development of Iranian computer sciences majors as it is achieved through the language for specific purposes?

Seeking for a convincing answer, this study set out to implement the Frayer model to broaden students' vocabulary as its treatment strategy because it is claimed to be capable of encouraging students to learn more than just when they are motivated to look up the definitions of words in the dictionary. This strategy helps them learn salient and subtle ties and nuances of particular words, which are backed by the visual representation of the information in Frayer model chart. In addition, it helps them to apply this information to generating examples and non-examples as they activate prior background knowledge.

LITERATURE REVIEW

Although grammar and vocabulary are complementary, Wilkins (1972:14) asserts that "without grammar very little can be conveyed, but without vocabulary nothing can be conveyed." Lewis (1993) also stated that language constitutes words linked by rules of language rather than grammatical rules fleshed out with words. Sapir (1921:1), in reference to vocabulary, put "the true, significant elements of language are... either words, significant parts of words, or word groupings." Chomsky's (1981) modular Universal Grammar assigns a key role to lexicon. It is lexicon that projects some specific attributes on to the verbs. In other words, it imposes some constraints on the usage of verbs.

Some researchers claim that vocabulary acquisition has always been a controversial issue. For instance, Pavicic (2008) argued that although many studies on vocabulary acquisition have been conducted by linguists, psychologists and theorists of L1/L2 acquisition, no generally accepted theory of vocabulary acquisition has ever been developed.

Despite the consensus on the significance of vocabulary knowledge for reading comprehension (Anderson & Freebody, 1981), researchers have failed to reach working definitions of what fully knowing a word means and of what kind of knowledge this is. Cronbach (1942) broke down vocabulary to the knowledge of word meaning and the level of one's access to this knowledge, but this definition does not take into account other aspects of lexical knowledge such as pronunciation, spelling, and morpho-syntactic properties (as cited in Qian, 2002). It was Richards (1976) who offered the first inclusive definition of vocabulary knowledge which included not only the morphological and syntactic properties but also other aspects, such as word frequency. His definition yet failed to take into consideration the pronunciation and spelling aspects. Later, Nation (1990), however, added the missing parts to his model of vocabulary knowledge.

According to him, one's knowledge of a word should involve not only receptive but also productive knowledge. That means all aspects of what is involved in knowing a word such as forms, meaning and usage. In a similar vein, Read (2000) separated vocabulary knowledge into receptive and productive knowledge. Accordingly, the former refers to the knowledge to understand a word, which is often used

in listening and reading whereas the latter to the knowledge to produce a word as one speaks and writes (Schmitt, 2000). Nation (2001) also distinguished between receptive and productive vocabulary knowledge. Receptive vocabulary consists of words comprehensible for the learners in listening and reading. They are not used by the learners in speaking or writing. They help the individual understand the forms of the words and retrieve their meanings. Productive vocabulary knowledge allows learners to retain the appropriate form of the word meaning in order to express through written or spoken channel (Laufer & Goldstein, 2004). Therefore, lexical knowledge involves passive recognition and active production, and an understanding of spoken and written forms, and collocations (Nation, 1990; Teichroew, 1982). L2 readers need to develop both receptive and productive vocabulary knowledge and to increase their vocabulary size. A number of studies argue that lexical deficiencies of language learners frequently lead to communication breakdowns. In the same vein, communication will break down if people do not use the right words (Allen, 1983). Vocabulary errors in communication can be more disruptive than grammatical ones (Gass et al., 1998).

The difference between receptive and productive knowledge of words is significant in second language learning though not in first language (Laufer & Paribakht, 1998). It is associated with factors such as the learner's level of language proficiencies, the number of vocabulary items that can be retained or can be used in each knowledge dimension, learning durations and contexts, and word frequencies. Thus, there is no clear-cut boundary between receptive and productive vocabulary knowledge. Although the relationships between receptive and productive vocabulary knowledge can be predicted, correlations between these two types of vocabulary knowledge are not constant. It is not certain that an increase in receptive vocabulary knowledge will result in an increase in productive vocabulary (Laufer, 1994).

As regards receptive and productive vocabulary knowledge, a less conclusive moderate correlation was found between depth of vocabulary knowledge and speaking ability (Ishizuka, 2000). Furthermore, his vocabulary depth can be categorized as receptive vocabulary knowledge since test takers who were provided with words selected the right words in the test. However, productive vocabulary knowledge seems to influence speaking ability more than receptive vocabulary knowledge does.

Another study investigated the relationship between changes in vocabulary learning strategies and developmental change of vocabulary knowledge. Gu (2010) found a significant relationship between changes in vocabulary learning strategies and the changes in receptive and active vocabulary knowledge. Moreover, a significant positive relationship between using vocabulary learning strategies and receptive vocabulary size as well as a significant negative relationship between vocabulary learning strategy use and productive vocabulary knowledge were revealed.

As to the acquisition of receptive and productive vocabulary knowledge, it is done both intentionally and incidentally. The learner's focus, while encountering new words incidentally in media use or conversations, is on inferring or comprehending meaning rather than explicitly learning definitions or other formal features or uses of previously unknown vocabulary items. However, studies that make use of immediate and delayed recall tests have shown that incidentally acquired vocabulary is lost over time (Knight, 1994; Rott, 1999). Schmitt (2000) argued that vocabulary knowledge is a consciousness process probably interacting with all other domains of target language. Intentional learning of vocabulary words may involve some graphic organizers.

According to Loretta (2008), graphic organizers are of eight categories in reference to their purposes for learning: K-W-L chart, history frames, zooming in and zooming out—concepts, zooming in and zooming out—people, inquiry chart, Venn diagram, column notes, and word map. K-W-L chart is a graphic organizer which is condensed out of what I know, what I want to know, and what I learned statements. It is an activity teacher use to introduce a new topic. The history frame is the same as familiar story map which is used to provide elements of a historical event as those of a story and break the information down to highlight the people and places involved and any other pertinent information.

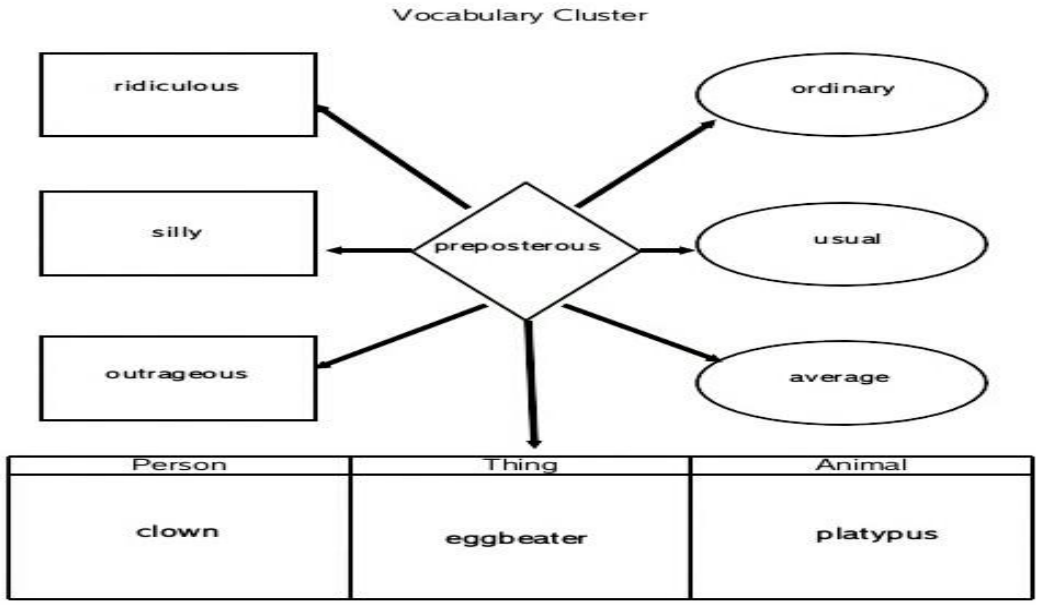
Zooming-in and -out allow students to analyze the more complex concepts or VIPs. It is a graphical tool which consists of a space—at the center designating a person or a concept—and five enclosing boxes providing spaces for the most and least important information, similar concepts/people, related events, and a different question. Venn diagram is used to compare a pair of ideas, events and sets of information. Column notes organizer is set up simply and applied flexibly. The following examples are merely a sampling of the two types and uses of graphic organizer. Finally, word map helps analyze a new or complex vocabulary word from different perspectives.

A number of studies (e.g., Bos & Anders, 1990; Palmer et al., 2014) have investigated vocabulary acquisition and word retention by means of word graphic organizers. Word graphic organizers are visual tools that help learners to identify, understand, and recall the meaning of words in text they encounter. These word maps enable the visual representation of the links between the meaning of a word and a set of related words and concepts.

To be more precise, word graphic organizers include vocabulary cluster and a variety of Frayer models. A vocabulary cluster (as shown in Figure 2.1.) is made of a diamond at the center and some rectangles and ovals enclosing it. As a worthwhile tool, it is used to teach difficult infrequent vocabulary words to whole group. One who specifies the word that will be placed in the diamond is the teacher. Then, (s)he has the students fill in rectangles with synonyms and ovals with antonyms for the word.

Figure 1

An example of word cluster

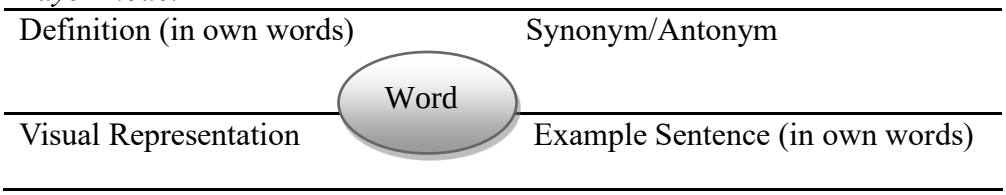


The Frayer model word chart, as another kind of graphic organizers, is a large square made up of four quadrants with a circle at the center (as shown in Figure 2.2.). Each quadrant contains a category by which the given word can be described (Greenwood, 2002; Nessel & Graham, 2007), and it is these categories that help explain which characteristics relate and which ones do not relate to a concept (Frayer, Frederick, & Klausmeier, 1969). The model helps students to define the target concepts or vocabulary

words as well as to identify and understand unfamiliar vocabulary. It makes students understand words in the vast context of a reading selection, as it asks students to analyze the concept/word (definition and characteristics) and then synthesize or apply this information by thinking of examples and non-examples. The entire class, small groups, or individual students can make use of it.

Figure 2

The adapted Frayer model



The Frayer model takes two forms. In one form, students provide a definition, list characteristics, and provide examples and non-examples of the concept—knowing what a concept isn't helps define what it is. In other form, students identify a word's essential and nonessential characteristics and fine-tune their understanding by choosing examples and non-examples of the concept. The latter form uses a graphic organizer which can enhance students' learning of vocabulary in all content areas such as history, language, and science.

Nahampun (2014) carried out an experimental study to examine the effect of using Frayer model on students' vocabulary mastery. Sixty students of SMA Parulian 1 Medan were the study participants. They were first grade senior high schoolers. After randomization, they were assigned to two groups: experimental and control. While the control group was treated conventionally, experimental group was taught using Frayer model. Data collecting instrument was some objective multiple-choice test which consisted of 40 items. The reliability coefficient of the test was calculated through Kuder-Richardson (KR-20) formula by the researcher. The reliability coefficient of 0.73 (high) was output. The data were analyzed by using *t*-test. It returned 5.41 (as *t*-observed) which was higher than 2.00 (*t*-table) at the level of significance 0.05 (α) with the degree of freedom 58 (df). Thus, null hypothesis (Ho) was rejected and alternative hypothesis (Ha) is accepted. It was interpreted that teaching vocabulary through Frayer model is more effective than teaching vocabulary using conventional method.

According to Nahampun (2014), Frayer model encourages learners to grasp words within the larger context of a reading selection since it has learners first analyze the concept/word (definition and characteristics) and then synthesize or apply this information by considering non-examples and examples. Examples help learners to generalize concepts and see relationships among similar ideas. Non-examples, on the other hand, guide learners to distinguish among ideas and concepts so that they cease to over-generalize.

Hamada (2014) concluded that graphic organizers (Frayer models) enable students to visualize the relationships between words and their possible meanings. They work well along with the explicit vocabulary instruction of teachers. They may also be used as classroom assessment for learning since they provide teachers with a quick estimate of students' vocabulary knowledge.

Sullivan (2014) investigated the use of an adapted Frayer model as a graphic organizer to improve the vocabulary comprehension of Japanese university students. An adaption is made to the Frayer model to make it able to explain graph vocabulary which is less concrete than the language the model was originally used for. Subjects were assigned to two groups: test and control. Pre- and posttests on vocabulary comprehension were administered to both groups. It was the experimental group that used only adapted model charts, though both groups completed the assigned graph exercises. Both groups showed improvement. However, the experimental group showed a greater improvement in terms of the

mean score on a graph vocabulary test. A questionnaire was also used to assess attitudes of students towards the adapted model's usefulness. Results revealed that the adapted model was effective in understanding and applying graph vocabulary.

Iter (2015) was another researcher who gauged the effectiveness of the Frayer model in the development of vocabulary knowledge in social studies. A quasi-experimental non-equivalent control group design was used in the study. Thirty-seven students were randomly selected and assigned to two groups: experimental and control. The former was populated with 19 students and the latter with 18 ones. The experimental group was treated with the Frayer model as text-based organizer while the control group was taught by integrating the definitional and contextual approaches. The study was conducted in Bayburt, in 2013-2014 school year, at a state school with the 4th grade students. It employed the scale developed by Wesche and Paribakht (1996) and its reliability and validity were examined and adapted to Turkish students by the researcher. It was utilized to gauge the students' levels of vocabulary knowledge. The results showed that the experimental group was better at vocabulary building through the meanings of the target words. The results also demonstrated that Frayer model helped the students to find examples and non-examples as well as relevant and irrelevant attributes of the concepts and detect the hierarchical structures and relationships between the concepts which in turn lead to generate the meanings of terms by activating prior knowledge. Thus, the Frayer model contributed to the students' vocabulary acquisition.

Dazzeo and Rao (2020) state that the digital Frayer model can not only reduce a few challenges students may have when completing the graphic organizer but also increase their engagement in learning new words. As such, this framework can improve word knowledge.

Buehl (2001) argued that the Frayer model activates students' prior knowledge of a topic and builds connections. It requires students to complete the chart that in turn activates students' prior knowledge of a topic and helps build connections. This allows new knowledge to be built upon existing schema. The model works well as far as learning new concepts and ideas is concerned because it is a graphic organizer which allows the multiple pieces of information about a concept or word to be viewed at a glance. It uses the prior knowledge of the student as resource to set up connections among new concepts and develop a visual reference by means of which students learn how to compare attributes and examples (Graves, 1985).

According to Peters's (1974) findings, the use of word charts helped students understand difficult concepts and perform better on social science comprehension tests than when they used just their standard textbook. Monroe and Pendergrass (1997) also compared the use of Frayer model with simply studying definitions and found that using the former was more effective in learning complex math terms than the latter.

As regards Nation's (2001) aspects of word knowledge, the Frayer model word chart helps learners not only understand the written form of a word and make connections between the word form and its meaning but also uncover the word's related meanings—since examples and attributes are included.

Ropic and Abersek (2012) concluded that graphic organizers enabled students to recognize text structure since they could monitor the flow of information through graphic organizers. Learners could keep track of data along with the text structure while deriving important pieces of information from a text.

Graphic organizers, Sam and Rajan (2013) found, help the students take accurate notes which result in providing more accurate answers on the test. Moreover, as students make use of graphic organizers to organize their thoughts during an assessment, they could make their performance better on reading selections. Graphic organizers were good at hooking students to the assignments so that they found them interesting. Students were satisfied when they were filling in graphic organizers associated with

comprehension passages. Pang's (2013) study report describes how graphic organizers can be used in the most effective ways with English language learners (ELLs). It highlights empirical evidence such that graphic organizers enable ELLs to classify facts, analyze problems, summarize main points, and criticize or evaluate the decisions made by authors.

The benefits of using the original Frayer model as a graphic organizer have been debated. Greenwood (2002, 261) argues against it such that the Frayer model is "the most time-consuming and labor-intensive" alternative. Despite these pitfalls, other researchers, such as Beck, McKeown, and Kucan (2002), have found it highly effective in vocabulary instruction. A key benefit of the Frayer model is that it helps provide students with a more thorough, deeper understanding of a particular concept.

In conclusion, the relevant literature constitutes the foundation of the question and the variables of the current study.

METHODOLOGY

In this section, a comprehensive description of design and context, the participants, instruments, data collection procedure, and data analysis procedure of the study are provided.

Design and Context of the Study

To serve its purpose, this study employed a quasi-experimental control group posttest-only design. It employed two groups: experimental and control. Its independent variable was Frayer model and its dependent variable vocabulary learning in language for specific purposes learning environment. It took place at the Isfahan Institute of Applied Sciences in one of the urban towns of Isfahan called KhomeiniShahr.

Participants

Participants of the study were from two intact classes of Iranian undergraduate computer sciences majors—having taken LSP course—selected in a convenience sampling fashion. The number of the students was 62 (28 students in the experimental class and 32 students in the control class). In terms of gender, 37 of them were females and 25 of them, males. They all had already passed General English course as a prerequisite course to LSP one. Their age range was from 20 to 45 years old. In addition, all of them were Iranian nationals speaking a variety of Farsi dialects and their language learning experience was restricted to language credit units of secondary and tertiary (university) education. Following table (Table 1.) provides a summary of the participants' demographic data.

Table 1

Demographic Background of the Participants

No. of Students	**62 Undergraduates**
Gender	37 Females & 25 Males
Age Range	20-45
Native Language	A Variety of Farsi Dialects
Major	Computer Sciences
Universities	Isfahan Institute of Applied Science at KhomeiniShahr
Second Language Background	English, limited to the credit units of language in secondary and tertiary education
Academic Years	2017-2018

All of the participants were supposed to take only a (reading) achievement posttest. In addition, the participants' gender is not taken into account as a variable in this study. All of the participants attended English for Computer Sciences Majors course in two separate classes at the institute during 12 weeks.

Instruments

Target Words as the Fayer Model Charts

First, some words were selected from the vocabulary section of the units of the ESP textbook *English for Computer Engineering* (Yousefkhani et al., 2007). The criteria for choosing the target words include unfamiliarity of the participants with the words, all parts of speech representativeness, avoidance of homonyms, and avoidance of the ambiguous and abstract words. The number of words was in line with the background knowledge of the learners and such that does not demotivate students. Then, prior to put the Frayer model to test, they were adapted as target words for use with participants.

Posttest

As mentioned before, the participants were members of two intact classes as experimental and control groups. The control group was taught vocabulary following the textbook procedure. The procedure first presents a word along with its type and definition; then provides other derivations and or inflections of the intended word, i.e. its related parts of speech; and finally presents it or some of its derivations in the context of sentences. The experimental group was treated using the Frayer model charts of the same words.

After the treatment, i.e. at the end of the LSP course, both groups were given the same teacher-made achievement test containing multiple-choice items on the target words. The vocabulary part of achievement posttest consisted of 20 multiple-choice items which were selected from the target words. This part of the test was intended to measure the LSP students' vocabulary knowledge. Every correct answer was scored +1 and every incorrect answer was given 0. No negative score was considered as penalty. The total score of the test was 20.

In order to estimate the reliability of the vocabulary part of the test, one of the split-half methods, to be more precise, Cronbach alpha was used to calculate the 20 vocabulary items reliability. It returned an alpha coefficient (α) equal to 0.45 (see Table 4.).

Data Collection Procedure

The data collection procedure followed these steps: first target words were chosen; then they are taught differently to control and experimental groups—conventional textbook procedure and the Frayer model charts respectively; third an achievement test was developed containing some target words items; afterward, the posttest was administered to both groups at the end of the course; finally the students/participants performances were scored and two datasets of scores were produced.

After the selection of about 48 target words, the differential treatment commenced. On the one hand, the control group followed the textbook procedure. On the other hand, the experimental group received treatment in 12 sessions in the following manner and in line with the Cohen and Cowen's (2008) procedure.

The participants in the experimental group received vocabulary instruction using Frayer model charts. The teacher brought power-point slides to present the Frayer model charts to the LSP students on a monitor screen. He first placed the target word at the center of the chart. Then he had students brainstorm a list of questions and ideas about the word that had been presented. Afterward, he asked the participants to involve actively in generating its definition, essential characteristics, synonyms, antonyms, examples,

and non-examples. Finally, he explained the target word's attributes one by one. In each session, only 4 items, including a verb, an adverb, a noun and an adjective, were presented.

As the treatment was underway, an achievement posttest was developed based on the objectives and abilities that were intended to measure. To ensure its content validity, the researcher had a few of his colleagues see if it was content relevant and representative.

Finally, both groups received the posttest in order to check and compare their vocabulary gains. Posttest was administered in accordance with the institute's test schedule. To ensure maximum reliability, the test administrator/the teacher tried to provide proper testing conditions by allocating adequate time, answering all the questions before administering the test, and preventing them from cheating. Since multiple-choice items scoring was done easily and precisely given a key answer sheet, the posttest was considered as objective and reliable account of the participants' performance. Finally, two sets of students' raw scores were yielded.

Data Analysis Procedure

After collecting data, they were analyzed through the statistics software *SPSS 24.0*. A variety of statistical methods was utilized to analyze the data. Descriptive statistics were used in order to show a full picture of the datasets. Most importantly, the researcher used the measures of inferential statistics to answer the research questions. An independent samples *t*-test was run between two score sets of the control and experimental groups on posttest.

RESULTS

The purpose of this study was to examine the effectiveness of the Frayer model in vocabulary development of Iranian LSP students. Two sets of score were collected from two intact LSP classes through a posttest to be analyzed in order to answer the following research question.

Does the use of Frayer model have any effect on English vocabulary development of Iranian computer sciences majors as it is achieved through the language for specific purposes?

Answering the Research Question of the Study

In order to answer the research question of the study, both groups were given an achievement posttest containing 20 vocabulary items right on the institute final exams schedule. The descriptive statistics of both groups are compared with each other in Table 2.

Table 2

Descriptive Statistics of Participants' Performance on Posttest

Descriptive Statistics

	N	Minimum	Maximum	Sum	Mean		Std. Deviation
Control & Experimental Groups	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
1. Control Group Test Scores	32	5.00	15.00	338.00	10.5625	.55710	3.15142
2. Experimental Group Test Scores	28	8.00	18.00	370.00	13.2143	.55720	2.94841

The means of two score sets of experimental and control groups on the posttest were 13.21 and 10.56 respectively. On the surface, the performance of the control group on the posttest was weaker than experimental group.

In order to answer the research question, an independent samples *t*-test was performed between the score sets of control and experimental groups on posttest. The results are shown in Table 3.

Table 3

Independent Samples T-Test on Posttest

Independent Samples 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 Difference	Std. Error Difference	Lower	Upper
Control & Experimental Test Scores	Equal variances assumed	.538	.466	-3.350	58	.001	-2.65179	.79149	-4.23612	-1.06745
	Equal variances not assumed			-3.366	57.723	.001	-2.65179	.78793	-4.22915	-1.07442

The number of d.f., 58, was checked across to the 0.05 column. The critical value of *t* needed for our selected significance level of 0.05 was 2.000. Fortunately, the study observed *t* value (*t*= -3.350) was enough above *t* critical that the researcher was safe in answering the research question affirmatively. Needless to say, that there is no difference between positive and negative values in reading the table because the distribution is assumed symmetrical. The value of that size meant that LSP experimental group outperformed the LSP control group on the posttest and the application of the Frayer model charts to vocabulary instruction had been significantly effective.

Reliability Index of the Posttest

Descriptive statistics of two halves (odd-numbered items vs. even-numbered items) of the posttest and the split-half reliability index are provided in Table 4. Cronbach alpha, i.e. a split-half method, was utilized to compute the split-half reliability. It returned an alpha coefficient (α) equal to 0.45. The reliability of the vocabulary test proved to be low. This degree of reliability was due to: (1) vocabulary items constitute one part of a multipart achievement test and (2) the number of items was not large enough to take care of the reliability.

Table 4

The Split-Half Reliability Statistics of the Posttest

	N	Mean	SD	Cronbach's Alpha (α)
Odd items	10	6.178	1.722	0.45
Even items	10	7.035	1.933	

DISCUSSION

As the results showed, the instruction of vocabulary using Frayer model charts was successful in fostering the LSP students' vocabulary leaning in an effective way. Therefore, the current finding is consistent with already mentioned results, those of Nahampun (2014), Hamada (2014), Sullivan (2014), Iter (2015), Gu (2010) just to name a few.

In brief, Nahampun (2014) examined the effect of using Frayer model on students' vocabulary mastery. It was concluded that teaching vocabulary through the Frayer model is more effective than teaching vocabulary using conventional method since it has learners first analyze the concept/word (definition and characteristics) and then synthesize or apply this information by considering non-examples and examples. Hamada (2014) also found that graphic organizers (Frayer models) help students to visualize the relationships between words and their possible meanings, and as a result, can significantly promote learners' comprehension. Furthermore, Sullivan (2014) measured the effects of the Frayer model on students' comprehension of graph vocabulary and came to a conclusion that the Frayer model facilitated learners' vocabulary knowledge building. Moreover, Iter (2015), who measured the effect of the Frayer model on the development of productive vocabulary knowledge in social studies, reported that the experimental group was more successful in productive vocabulary knowledge owing to the Frayer model's impact. Equally, Gu (2010), who studied the relationship between changes in vocabulary learning strategies and shifts in development of vocabulary knowledge, found that the Frayer model, as a leaning strategy, is significantly effective in making changes in students' receptive and productive vocabulary knowledge.

Despite direct compatibility of the results of this study with the above studies' findings, they might be in agreement in some way with studies relevant to recalling and retention of vocabulary words, critical thinking, prior knowledge activation, sharpening language skills, raising awareness of text structure, and browsing through the texts for information.

However, the results of this study hardly support those of O'Donnell (1993)—who investigated the impact of prior knowledge and graphic organizers on listening comprehension of the undergraduate students—because it was found that graphic organizers did not help learners improve their listening comprehension. The reason was that graphic organizers were only most useful for the text that did not require prior knowledge, while high levels of prior knowledge were necessary for succeeding in the tests.

CONCLUSION

This study managed to highlight something that merited scrutiny: the effectiveness of the Frayer model charts in vocabulary development of English for specific purposes students, more precisely vocabulary development of computer sciences majors. It posed a question based on this hypothesis. Then, it set out to provide some differential treatment for an experimental group contrary to placebo treatment for a control group. After the intervention, a vocabulary achievement posttest was administered to both groups to capture the difference in treatment effects. Finally, an independent samples *t*-test was run to see if any considerable change had occurred in the vocabulary size of the students under examination. It was found that the Frayer model charts are capable of increasing vocabulary learning gain. In other words, computer sciences majors who applied the Frayer model charts to learning vocabulary items in their LSP course outperformed the control group which followed the conventional textbook procedure.

There is no doubt that findings like this have many bonus implications for language teachers, course designers, and material developers/publishers alike. For instance, instructors can lift the burden of teaching vocabulary by training students in its learning strategies, such as the Frayer model, so that they become responsible for their learning. They can use multimodal channels including graphic organizers for communicating information and feelings. In a similar vein, syllabus designers can be aware of the benefits of graphical representation of knowledge so as to include appropriate loads of visual materials

into the syllabus. As for material developers, they can embellish vocabulary and reading textbooks with a good level of graphical demonstrations to allow students to make use of different media of instruction/presentation.

Last but not least, examining the potential impacts of such cognitive learning strategies as mind mapping, brainstorming, and semantic networks on ELLs' vocabulary development in general and on LSP students in particular is recommended.

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