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The Effect of Brain-based Techniques on Vocational Vocabulary Acquisition A Case Study on Technical Diploma Students

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Abstract

The present study explored the impact of a brain-based technique namely; semantic mapping techniques on technical diploma students' learning of vocational vocabulary in English as a Foreign Language (EFL) classes. Forty-two male students, in total, were equally and randomly assigned to a control group who received traditional vocabulary teaching strategies and an experimental group whose teaching included semantic mapping techniques (i.e., concept categories map, definition-description-example map, and fishbone map). Both groups took an English placement test to assure the similarity of their proficiency levels and a pretest at the start of the intervention to assess their baseline vocabulary knowledge. This procedure was repeated as a post-test, at the end of the learning period to assess the impact of the mapping techniques. The results indicated that both groups had significantly improved their vocabulary of English for Specific Purposes (ESP) at posttest, but the improvement was greater for the students whose learning incorporated the semantic mapping techniques. An adopted five-point Likert scale questionnaire (by Hamdan & Alharbi, 2017) was also used to examine the experimental group learners' attitudes toward semantic mapping techniques and were found to be generally positive, particularly concerning the use of conceptual category maps. Some questionnaire statements were found to contribute positively to the learners' vocational vocabulary knowledge. The results are discussed in light of related literature and some recommendations are suggested for further studies.

Keywords: Semantic mapping, vocabulary acquisition, EFL, ESP, vocational vocabulary

Introduction

The acquisition of vocabulary is crucial for language comprehension and production, and is a key component of communicative competence (Laufer, 1997; Alqahtani, 2015; Khoii & Sharififar, 2013). Vocabulary serves as the fundamental gateway to language learners since lexical knowledge cannot be detached from other language skills, such as listening, speaking, reading, and writing (Qian & Lin, 2019). It should, therefore, be expected that the extent of second language learners' lexical knowledge is directly related to their ability to produce and comprehend a foreign language. Learners with extensive vocabularies should feel more confident in spoken and written communication, and as their use of a new language increases, so too does their demand for new lexical items, reflecting the significance of vocabulary in their language learning journey (Yaghoubi & Seyyedi, 2017).

Current methods for teaching vocabulary are primarily concerned with developing awareness of the functional roles words play in communication (Dilek & Yürük, 2013). Thus, much research has recognized the importance of expanding learners' vocabularies when English is being taught as a second language (ESL) or as a foreign language (EFL), and this has become one of the main goals of numerous EFL learners (Wisran, 2021). Consequently, teachers should not overlook the significance of vocabulary in the development of language proficiency, and should be aware of the different strategies and techniques that can be employed to advance it. These techniques also have the advantage of being applicable to other language skills, thereby accelerating students' overall language learning.

To gain adequate vocabulary knowledge, a language learner has to be engaged in a relatively challenging task,

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with the level of difficulty adjusted to match their general language abilities and in particular their current mastery of the vocabulary. (Nugroho & Arini, 2021). Learners with lower language proficiencies are therefore advised to acquire more vocabulary learning techniques as one element of any strategy to increase their proficiency level (Wisran, 2021). However, the techniques that are typically used to increase vocabulary, which include writing down target words on paper or memorization, rely primarily on word lists in textbooks and/or waiting passively for the teacher to explain new terms. These appear to be ineffective and monotonous for students, and may well lead to their becoming bored with vocabulary acquisition. Also, students frequently employ rote memorization strategies that are based on repetition to help them memorize new terms (Wisran, 2021). Consequently, learners should be encouraged to be independent and to understand where and how to effectively apply specific vocabulary learning strategies. It is, therefore, necessary to teach students how to use different techniques for vocabulary acquisition, to enable them to be more equipped for learning and more critical of their own techniques. As a result, the use of effective vocabulary acquisition techniques has been identified as one means for learners to take control of their vocabulary learning (Fadi, 2019; Saragih, 2019).

Literature review

Vocabulary Learning

Vocabulary learning is an essential part of any language-learning - attaining communicative competence, all require mastering more vocabulary (Alqahtani, 2015). While learning vocabulary seems a fairly straightforward task, language learners often find it challenging to retain the vocabulary required to be proficient in a second or foreign language (Oxford, 1990). Vocabulary learning occurs through two routes: intentional learning, which the student or teacher coordinates, and incidental learning, which happens as a spin-off when engaging in other activities. Laufer (1997) further categorizes intentional vocabulary learning as either direct or indirect. In direct vocabulary learning, students engage in vocabulary-focused activities and exercises like vocabulary games and word construction exercises, whereas in indirect vocabulary learning they concentrate on aspects other than the content of the message itself, and which might affect the learning of new words, as shown in Laufer (1997), who further points out the importance of students' previous experience and native language in acquiring new words. Indeed, overlap can occur between the learning of first- and second-language vocabularies, affecting the learning of the latter. As Schmitt (2020) points out, aspects of new words like length, phonetics, polysemy, abstractness, and semantics, all affect vocabulary learning. Learning a second or foreign language requires using vocabulary acquisition tools and changing the focus of language learning from instructor-centered to learner-centered (Khoii and Sharififar, 2013).

The vocabulary used in English Specific Purposes (ESP) is extremely important as it directly impacts learners' ability to communicate effectively within their professional fields such as technology, business, medicine, engineering, or law. Mastering specialized vocabulary not only helps in understanding ESP texts but also facilitates professional interactions (Coxhead, 2012; Hunchenko, 2023; Khazaal, 2019). ESP learners need to acquire an extensive terminological vocabulary related to their field of study. The Academic Word List is a valuable resource for teaching academic vocabulary across different disciplines (Brooks, 2014; Hunchenko, 2023). ESP courses, which focus on specialized language for specific professions, emphasize the importance of vocabulary learning and teaching. To enhance vocabulary acquisition, ESP teachers should encourage extensive reading and listening, teach vocabulary learning strategies, and involve students in active learning processes (Xhaferi, 2009). Research has shown a significant correlation between students' vocabulary mastery and their ability to comprehend ESP texts (Lily, 2019; Semartini et al., 2023). Therefore, vocabulary instruction is essential in ESP courses to develop learners' communicative competence and prepare them for their future professional environments (Curado Fuentes, 2001; Fitria, 2020).

Semantic Mapping Techniques

Semantic mapping is not a novel practice, having been used previously for many years under different names, such as "semantic webbing", "semantic networking", or "plot maps" (Heimlich & Pittelman, 1986: 3). The two words "semantic" and "mapping" refer to the lexical meaning in the target language, and the explicit organization of words, respectively. Therefore, semantic mapping could be considered as a technique to visually embed the word within related conceptual structures and deepen comprehension by displaying related terms in graphical form. It has been considered a successful and useful teaching and learning

technique that creates and extends the learners' background knowledge and schema (Nofriati, 2017).

According to Mah (2011), it was initially intended to enhance the instruction of study skills. Ausubel asserted in 1963 that people will not be able to understand new concepts explicitly until they are meaningfully connected to pre-existing ideas or "schemata." Ausubel how new concepts and vocabulary items are acquired depends on existing knowledge structures. The concept of the mapping method was developed by Prof. Joseph D. Novak at Cornell University in the 1960s, in which the value of previous knowledge in learning about new concepts is emphasized.

Moreover, Hanf (1971) contributed significantly to the development of the semantic mapping procedure, utilizing "sense relations" as the basis of semantic mapping. In the early 1980s, three articles generated considerable academic interest in semantic maps. Lazard (1981) addressed the nature of semantic universals and devoted a brief passage to revealing the global semantic organization of past grammatical markers via a map. Anderson (1982) was the first significant and comprehensive article on the technique that laid the groundwork for subsequent studies. Anderson's 1986 paper established a map of evidential space that exemplified the inductive approach to creating such semantic maps and the reasoning behind inferences based on similarities of word meanings, which are themselves based largely on form similarities and can explain linguistic phenomena such as semantic shifts.

Semantic mapping as a practice, is a method for depicting concepts graphically (Antonacci, 1991), with the aim of increasing students' vocabulary by developing new relationships with already well-known concepts. The technique can be used as a pre-reading exercise in vocabulary instruction and learning to chart the knowledge about a thought, subject, or a specific word. It can likewise be applied while reading to fully comprehend the original material in the text. Semantic mapping uses what are known as "word maps" or "word clouds". Making a visual map could illustrate the links between a term or expression and a group of associated words or ideas. Hence, it has been argued that such maps should support students in recognizing, comprehending, and remembering the sense of words they read in a text, especially those students who struggle academically and those with disabilities (Saragih, 2019).

Semantic mapping has been found very effective at enhancing instruction and intensive learning; for example, it improves students' vocabulary knowledge, reading comprehension, and writing. Buis (2004) adds that semantic mapping is a practical approach that aids ESL and EFL pupils reading and writing, improving their interest in lexical acquisition and making them "feel connected to the words they read" (Buis, 2004, p. 20). Moreover, Nyoni (2012) found that semantic mapping is an effectual diagnostic tool teachers can use to assist pupils with writing difficulties. Harmer (2001) and Buran & Filyukov (2015) both claim that semantic mapping is a highly appealing means of raising lexical awareness and of inducing pupils into recalling, exposing, and engaging in what they recognize as supportive in problem solving, brainstorming creative ideas, rendering new lexis, taking notes, enhancing their reading abilities, consolidating multiple tasks, and creating presentations.

Studies on Semantic Mapping

Al-Ghazo (2015) conducted a study to look at the efficacy of two vocabulary techniques, SQ3R and semantic mapping, for reading comprehension. SQ3R which is a well-known reading strategy for approaching a text and stands for survey, question, read, recite, and review (Robinson, 1941), and semantic mapping, both had a beneficial effect on reading comprehension. A study by Dilek and Yürük (2013) examining how semantic mapping affects lexicon acquisition in pre-intermediate language learners, also found that students taught using semantic mapping had increased vocabulary learning compared with their traditionally taught counterparts.

In a study concerning the use of semantic mapping and its impact over vocabulary learning of intermediate EFL learners, Keshavarz et al. (2006) and Saeidi and Atmani (2010) both took gender effects into account, and found no evidence of any relationship between gender and the impact of semantic mapping, with the technique having an equally positive influence on male and female EFL students' vocabulary learning. They concluded that semantic mapping enriched the process of word acquisition and thus benefited both genders. Furthermore, Vakilifard et al. (2020) examined the validity of the cooperative learning approach, which emphasizes knowledge exchange between students within a group through collaboration on a shared goal (Freeman & Anderson, 2013), as well as the effect of semantic mapping on the attainment of the L2 Persian lexicon. Their findings revealed a large positive impact in all three experimental groups (semantic mapping, cooperative learning, and both techniques combined), when compared to the control group. Vocabulary learning was most enhanced in the group who used semantic mapping alone. Recent studies by Ilxom qiz and Alisher o'g'li (2023), Udaya (2022), and Wisran (2021), used semantic mapping as a training technique for vocabulary expansion. The studies found that initiating and affording more rehearsal using semantic mapping techniques positively affects vocabulary recall and preservation, and that

learners have optimistic attitudes towards semantic mapping. Interestingly, Ilxom qiz and Alisher o'g'li (2023), explained the results based on the depth of processing hypothesis, which postulates that it is the cognitive effort involved in processing information, that enhances retention, recall, and use, rather than the length of time a person is exposed to it (Craik and Lockhart, 1972; Craik and Tulving, 1975).

In the Saudi setting, the effectiveness of semantic mapping as a vocabulary-teaching method for EFL students has been highlighted by Abdelrahman (2013). In this study the experimental group used four different types of maps: thematic, spider, problem, solution, and fishbone, with the outcomes demonstrating the benefit of applying semantic mapping over traditional vocabulary teaching methods. In contrast, Al-Otibi (2016) employed computer-assisted semantic mapping (CASM) with nursing pupils as an aid for understanding and recalling medical vocabulary. The students were taught via an amalgamation of conventional in-class training and semantic mapping using the FreeMind program (FreeMind v.0.8.1, http://freemind.sf.net/). The findings showed that because the program couldn't reinforce reading comprehension, semantic mapping didn't successfully improve students' reading ability. In a similar study, Hamdan and Alharbi (2017) examined the effectiveness of the semantic mapping on increasing the lexicon of Saudi female preparatory-year EFL pupils for reading transcripts. It also explored students' positions concerning five styles of semantic maps: concept category, hierarchical organization, definition - description - example, compare and contrast, and fishbone. The findings showed that semantic mapping strategies positively impacted students' vocabulary performance and reading compared to those taught traditionally. Furthermore, the students rated the concept-category maps as the most helpful type of semantic mapping technique, followed by compare-contrast maps. Lastly, the results of a survey they carried out confirmed how valuable students felt all types of semantic mapping techniques were as aids to learning. In addition, Al-Khasawneh and AlHawamdeh (2023) discussed the impact of instruction on the use of semantic maps for improving vocabulary mastery among Saudi university students. Their results found a significant positive effect of teaching semantic mapping techniques on the students' lexical mastery.

The Significance of Semantic Mapping

An extensive study of the literature found that teaching semantic mapping helps EFL students improve their vocabulary acquisition and retention by enabling them to integrate new knowledge into their existing knowledge structures. Moreover, it helps students associate the meaning of new words with words from their existing vocabulary (Tateum, 2007). Additionally, according to Chamot (2005), adopting semantic mapping entails using several techniques, such as grouping language, emphasizing associations, and providing a visual means to link existing word knowledge to the new terms. Through semantic mapping, substantial, meaningful learning can take place, enabling students to consolidate their knowledge in their existing cognitive systems.

In addition, the webs or maps used in semantic mapping can be used to illustrate connections between words based on their usage in particular texts. It is also considered more effective when teachers and students use it in collaboration which encourages contact and cooperation. Semantic mapping lets students see the connection between vocabulary and organize target words. Such collaborative work encourages classroom engagement and allows pupils to make their thoughts explicit and make sense of the concepts they are learning (Hussein, 2016).

Current study

From the previewed literature, it seems that little research has looked into the outcomes of teaching semantic mapping techniques on helping to increase lexicon learning generally and technical vocabulary specifically. Only one study surveyed students' attitudes toward semantic mapping and the types of maps that students found most beneficial (Hamdan & Alharbi, 2017). Wisran (2021) suggested that further research should study whether semantic mapping affects pupils' motivation to obtain vocabulary and to do this particularly in the field of ESP (English for Special Purposes). However, in the Saudi context most research has been dedicated to the lexicon size of pupils, with outcomes showing that students typically possess an overly limited vocabulary (Abdelrahman, 2013; Alahmadi & Foltz, 2020). As a result, the current study examines the potential of semantic mapping techniques on Saudi technical diploma students' learning of English for Specific Purposes (ESP), their motivations for using it, and their attitudes towards the different types of mappings. The results can, with due caution, be generalized to all technical and vocational Arab learners. The study, therefore, aims to address the following research questions:

RQ1. Is there a significant difference between technical ESP learners' pretest vocabulary scores and their scores after learning using semantic mapping techniques?

RQ2. Is there a significant difference between technical ESP learners' pretest vocabulary scores and their scores after learning using conventional techniques?

RQ3. Is teaching vocabulary to technical ESP learners via semantic mapping techniques more effective than conventional vocabulary instruction techniques?

RQ4. What are technical ESP learners attitudes towards semantic mapping as an aid to vocabulary learning?

RQ5. Do students who report more positive learning involvements with one of the tested semantic techniques show larger gains in their technical vocabularies than their peers who report lower positive learning involvements?

Method

Research Design

This study employed a quantitative method, which involved a detailed examination of the collection and analysis of numerical data to identify patterns and measure variables (Creswell & Creswell, 2017). The study focused on the impact of a semantic mapping technique on the technical vocabulary gain of EFL male technical college students. The analysis included a placement test and a pretest-posttest comparison of vocabulary scores for target words. Additionally, a comprehensive questionnaire was used to assess students' attitudes toward the use of semantic mapping and their perceptions of specific types of semantic maps.

Participants

The 42 participants were technical students at the Al-Rass College of Technology (ACT) in Qassim, Saudi Arabia, and diploma-degree. English for technical students is a division of ESP since General English (GE) courses do not cater for specialized language needs. All the participants were male students aged between 20 and 29 years old, 64% of whom were between 20 and 24 years old, 19% between 25 and 28 and 17% 29 and above.

ACT students must complete four English courses as a prerequisite for studying for a diploma degree specializing in computer technology. The participants were randomly assigned to two groups: an experimental group (N = 21) and a control group (N = 21).

Material Instruments

Placement Test

This study included a concise online English proficiency test (https://www.efset.org/quick-check/) to measure participants' English level and check that both groups had similar proficiencies at the start of the study (see Table 1). This information was also used to examine the relation between students' proficiency and their preferred semantic mapping technique, which could be of value to educational applications. The test is reliable and includes 20 questions covering different language skills and has been designed to categorize proficiency levels as beginner, intermediate, or advanced. The estimated time was 15 minutes, with an instant result on the screen. These brief reports were collected and linked to students' background information (Table 1).

However, to guarantee the homogeneity of the two groups we ran an independent sample T-test on students' scores levels. The independent samples t-test confirmed that there was no significant difference in the proficiency scores of the experimental and control groups, $t(40) = -0.36$, $p = .72$.

Pre-test and Post-test

The pre-test and post-test of vocabulary were identical, and comprised multiple-choice questions designed to be similar to the students' training textbooks. This ensured that the style of the test was familiar to the students. The full trial took around two months started with the previous described English proficiency test for both experimental and control groups to ensure that their proficiency levels were similar.

Table. 1 Descriptive statistic for participants' proficiency level

Descriptive Statistics

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
experiment group levels	21	12	73	44.38	3.852	17.651
control group levels	21	22	68	42.67	2.981	13.661
Valid N (listwise)	21					

This was followed by a pretest phase including the target words list. However, to ensure the novelty of target words to participants, target lexical objects were introduced to participants prior the trial and they were asked to provide a translation to the words in the list and leave it blank in case they did not know the meaning. Consequently, three words from the designed list were identified by most participants thus, it were replaced by other two words. At the end of the experiment, both groups were given the vocabulary test again (the posttest) to see how the semantic mapping technique had affected the experimental group's lexical knowledge in comparison to the control group who received conventional instruction.

The vocabulary items in both tests were chosen from the students' textbook by researchers and reviewed by two expert instructors. The selected textbook is entitled *Technical English 2* and written by Celia Bingham. The course book focuses on different topics related to technical English (e.g., safety, projects and disasters). A total of 40 words were chosen from the glossary, and included words from all chapters in the book. The target vocabulary was assumed to be new for both groups, according to the target words' novelty process mentioned above. Thirty of the words were selected as target words and ten as control words. The control words were not included in the experiment to increase the test's validity.

To increase the validity of designed vocabulary list, both target and control words were listed according to their frequencies to ensure they did not vary significantly. Words frequencies were obtained from the British National Corpus (https://www.english-corpora.org/bnc/). The average frequency was 189 (SD = 174) for the target words, and 279 (SD = 244) for the control words. A t-test indicated that the mean rates through each settings did not vary significantly (t = 1.773, SE = 31. 83, p =.087) for target words and (t =.740, SE = 77.26, p =.478) for control words. Of the 40 words 17 were nouns, 14 were verbs and 9 were adjectives.

The Attitude Questionnaire

A five-point Likert scale-style questionnaire was designed by the researchers to elicit students' opinions about the different types of semantic mapping used for the experimental group. The questionnaire comprised 10 items written in Arabic to be easily comprehended by the participants. The questionnaire asked students to react to every question by clicking on one of the Likert scales that were marked as "Strongly Agree", "Agree", "I do not know", "Disagree", "Strongly Disagree". A concise explanatory sheet with pictures accompanied the Likert scale to ensure that students could complete the survey and understood the references to the different semantic mappings.

Data Collection & Procedures

The study had three phases, the introductory phase, the lexical instruction phase, and the activity phase. Before the experiment began, the online English placement test and the vocabulary test (pre-test) was given to all participants. Following the end of phase three, the same vocabulary test was given to both groups (the post-test) to remeasure the control and experimental group's vocabulary after the teaching intervention.

Phase one

Phase one took place medium-sized classroom at the technical college and lasted for a month. The groups were taught in two classes and each class was given the same introductory session. There were four sessions in total and before each session a word central to one of the topics of interest was selected by the researchers before discussing its meaning in the class. Students were then given a text that included the target words, and were taught to read the text and identify difficult words. They were then asked to brainstorm and were questioned by the teacher to stimulate them into generating related words. These procedures were used for both groups during each session.

Phase two

In phase two several teaching methods were used for both groups to teach the students new vocabulary. The control group had a classroom discussion about the target words, followed by conventional teaching of vocabulary that used mimes, examples, paraphrasing, or pictures. The students were then instructed to write a sentence with the newly learnt words.

In the experimental group the target words were taught using semantic mapping. The words were first presented through three different semantic mapping models (i.e., concept categories map, definition-description-example map, and fishbone map), each of which was displayed visually on the classroom projector with several examples, to help students understand how the target words' meanings were connected to concepts. Once the students were satisfied with these models, they were asked to form pairs or small groups and to categorize the target words according to the relationships they had to other words or concepts. Students were given a blank sheet of paper and asked to represent the words on the paper schematically structured according to an appropriate semantic mapping model. They were then asked to provide feedback to one another.

Phase three

In phase three, the experimental group were given the same exercises as the control group with the additional activity of

group work during which they were asked to create dissimilar charts for distinctive words from the textbook. This exercise was repeated in all of the phase three sessions. During all the four sessions, the teacher followed up the exercise with students to ensure they completely understand the vocabulary and the technique. At the end of the session, an individual assignment relating to semantic mapping was given to the students with vocabulary connected to the topic.

The control group were asked to perform traditional vocabulary learning exercises in all sessions comprising phase three. These exercises included selecting the right words, completing sentences, or choosing the right meaning for target words. At the end of the session, the students were given vocabulary assignments based on the topic and similar to what they had done in the session.

On completion of phase three, both groups were given the same vocabulary test they had taken at the start of the study period - the posttest. The purpose of the posttest was to assess the students' achievement level in the experimental (semantic mapping) and control (traditional) groups. However, the experimental group were given one additional session in which to complete the attitude questionnaire (see. Hamdan & Alharbi, 2017). The authors modified the questionnaire style by including a short schematic diagram representing each of the examined semantic mapping techniques, so as to remind students of the different mapping types. This ensured that students are pointing to the right technique while answering the statements. The number of statements in the questionnaire were reduced to 10 instead of the 12 in the original questionnaire to avoid redundancy. The questionnaire used has been reviewed for its validity and reliability, but Cronbach's alpha was computed to re-check its reliability after the amendments described above. The results indicated very high reliability (a = 0.931), and therefore the test was considered reliable.

Results

Participants levels

Participants' proficiency levels were examined at the start of the experiment, to check the homogeneity of the two groups' vocabulary knowledge. The test scores indicated that most participants fell into the intermediate category for English language proficiency (see Figure 1).

The scores for both the experimental and control groups were similar and ranged approximately from 20 to 70 out of 100, indicating that they had not attained the advanced language proficiency level estimated for an EFL diploma-degree students (see Figure 1 and Figure 2). This proficiency level and the similarity in the scores of the two groups was

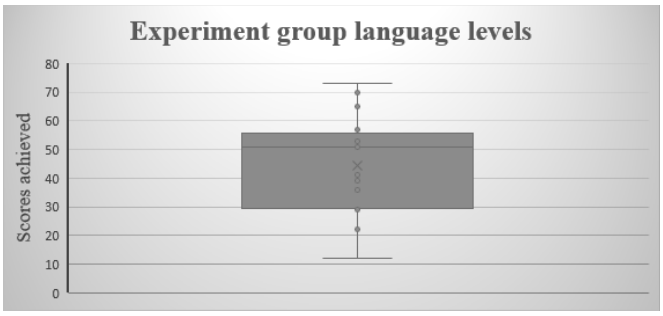

Figure 1. Descriptive plot for experiment group proficiency level

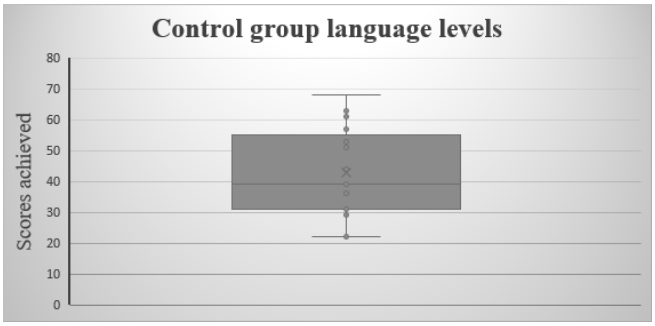

Figure 2. Descriptive plot for control group proficiency level

expected from the participants with the same language background.

Pre-test

The vocabulary pretest showed that, participants in both groups knew only knew a few target words, which does not raise any concerns about the validity of results, as these words were not included in the contrast analysis between pretest and posttests in the proportional learning effect equation (see, *Pretest Vs. Posttest* subsection for further details). On average, participants only knew 3 out of the 40 words listed for the study. The average grade of the experiment al group was 0.86 *(SD=910)* while for the control group it was 1.29 *(SD= 1.23)*.

Post-test

The posttest was administered at the end of the study to determine the extent of vocabulary development in the students in the two groups. The posttest results showed a higher mean score of 7.71 *(SD= 5.64)* for the experimental group and 4.00 *(SD= 2.42)* for the control group. Participants in both groups had therefore increased their vocabularies to include many of the new technical words.

Chart 1 illustrates the progression from the pretest to the posttest within both groups.

Pretest Vs. Posttest

To answer RQ1 and RQ2, the authors carried out a one sample t-test to determine whether there was a significant difference between learners' pretest scores and their posttest scores. To determine whether participants had increased their vocabularies we computed a new variable called "proportional learning effect", calculated for each student as their posttest score minus their pretest score. For example, if the student got 10 at the posttest and 3 at the pretest then, their proportional learning effect would be 10 – 3 = 7. The t-test for the experimental group's pretest scores and proportional learning effect scores are shown in Table 3, and indicated a significant difference between their pretest and posttest scores ($t(20) = 5.83$, $p = <0.001$).

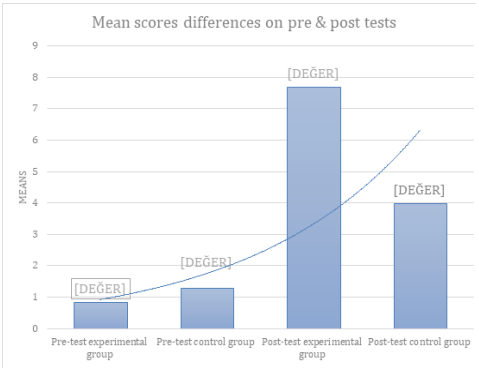

Chart 1. Mean scores comparison between study groups during pre and posttests

The same analysis was carried out for the control group scores and the outcomes showed a significant statistical difference between participants scores at the pretest and their proportional learning effect ($t(20) = 5.96$, $p < 0.001$), see Tables 4 & 5.

We decided to investigate the found relationship further by merging each group's results in one statistical pair (i.e. pretest for experiment group and their proportional learning effect & pretest for control group and their proportional learning effect). This conducted to determine whether this analysis would reveal the same statistical difference or not. To achieve this, we conducted a paired samples t-test. The results indicated a significant difference between the two examined factors at each statistical pair with p <0.05 (see Table 6).

Table 2: Experiment group one sample t-test descriptive statistics

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Pre-test for control group	21	1.29	1.231	.269
Proportional learning effect control	21	2.86	2.197	.480

Table 3: Experiment group one sample t-test values

One-Sample Test

	Test Value = 0						
	t	df	Significance One-Sided p	Significance Two-Sided p	Mean Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper
Pre-test experimental group	4.315	20	<.001	<.001	.857	.44	1.27
Proportional learning effect experiment	5.832	20	<.001	<.001	6.857	4.40	9.31

Table 4. Control group one sample t-test descriptive statistics

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Pre-test for control group	21	1.29	1.231	.269
Proportional learning effect control	21	2.86	2.197	.480

Technical vocabulary acquisition

To compare the proportional learning effect in both groups, a further statistical comparison was computed using an independent-sample t-test, which found a significant difference between the proportional learning effect of the experimental group and the control group. However, the scores in the control group (*SD* = 2.20) were more homogeneous than the experiment group (*SD* = 5.38), as shown in Table 7.

A Levene's test of homogeneity of variance found a significant difference level at $p = 0.027$, implying that equal variances could not be assumed in the t-test. There is a significant difference in the amount of technical vocabulary learning students gained in the two groups (Table 8), with the larger mean differences among the experiment group showing that they gained more technical lexical items than their counterparts in the control group.

Student semantic mapping attitude

To answer RQ4, we examined how students rated their attitude towards the three types of semantic maps. Only the experimental group participants completed the questionnaire, as they were taught the target words through semantic mapping techniques. Table 13 displays applicants' mean ratings of their experience using each semantic map (i.e., concept categories map, definition-description-example map and fishbone map). The answers were on a Likert scale from 1 = "Strongly disagree" to 5 = " Strongly agree". The table shows that students agreed with most statements. The highest mean rating was for the concept categories map (*mean* = 39.08, *SD* = 11.77). The second-highest ratings were given for the definition-description-example map (*mean* = 34.99, *SD* = 12.65). The fishbone map had the lowest mean rating (*mean* = 29.42, *SD* = 12.78). These ratings show that participants found the concept categories map the most useful aid for acquiring novel technical vocabulary.

4.4 Students' attitudes and vocabulary learning

To discover whether learners who stated having a more favourable learning involvement using one of the tested semantic mapping techniques gained

Table 5: Control group one sample t-test values

One-Sample Test

	Test Value = 0						
			Significance		Mean Difference	95% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p		Lower	Upper
Pre-test for control group	4.788	20	<.001	<.001	1.286	.73	1.85
Proportional learning effect control	5.958	20	<.001	<.001	2.857	1.86	3.86

Table 6: Paired samples t-test for experiment and control groups mean scores

Paired Samples Test

		Paired Differences					t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			One-Sided p	Two-Sided p
Pair 1	Pre-test experimental group - Proportional learning effect experiment	-6.000	5.282	1.153	-8.404	-3.596	-5.205	20	<.001	<.001
Pair 2	Pre-test for control group - Proportional learning effect control	-1.571	2.657	.580	-2.781	-.362	-2.711	20	.007	.013

Table 7. Experiment and Control group statistics

Group Statistics

	Experiment or Control group	N	Mean	Std. Deviation	Std. Error Mean
Proportional learning effect	Experiment	21	6.86	5.388	1.176
	Control	21	2.86	2.197	.480

more vocabulary than learners who stated having a less favourable learning involvement using the same semantic techniques (RQ5). This research query was addressed by observing whether participants who exhibited greater agreement with the following statements: *It helps in expanding my vocabulary knowledge*, *This type of map can be used in group work*, and *More effort and time is needed in building this type of map* produced larger proportional learning effects. These three questionnaire statements were chosen since they received the highest mean ratings as defined by combining the mean scores for "Agree" and "Strongly agree" within all the explored techniques. We analyzed each of the three examined semantic mapping techniques separately (i.e., concept categories map, definition-description-example map and fishbone map). For this purpose, we ran a univariate general linear model with the proportional learning effect as the only dependent variable and the level of agreement to the questionnaire items as independent (predictor) variables. The independent variables were centered to reduce multicollinearity (Table 9)

Table 8: Independent Samples t-test of the proportional learning effect on both groups combined

Independent Samples Test											
		Levene's Test for Equality of Variances			*t-test for Equality of Means*						
					Significance				*95% Confidence Interval of the Difference*		
		F	*Sig.*	*t*	*df*	*One-Sided p*	*Two-Sided p*	*Mean DF*	*Std. Error DF*	*Lower*	*Upper*
Proportional learning effect	Equal variances assumed	5.2	.027	3.1	40	.002	.003	4.0	1.270	1.43	6.56
	Equal variances not assumed			3.1	26.4	.002	.004	4.0	1.270	1.39	6.60

Table 9: Participants average agreement with statements about the use of semantic mapping

	Concept-mapping	*Definition-description*	*Fishbone map*
Items	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
1. This type of semantic mapping helps me connect new words to previous knowledge	4.05 *(1.11)*	3.3 *(1.23)*	3 *(1.17)*
2. It promotes my critical thinking	3.8 *(1.15)*	3.5 *(1.21)*	3.0 *(1.14)*
3. It aids in growing my vocabulary	4.3 *(0.91)*	3.4 *(1.20)*	3.05 *(1.28)*
4. Appling this category map helps in acquiring new words	4.2 *(1.13)*	3.4 *(1.20)*	2.9 *(1.37)*
5. This type of map can be used in group work	4.6 *(0.91)*	4.09 *(1.09)*	3.19 *(1.50)*
6. This category is more valuable as an individual assignment	3.4 *(1.20)*	3.5 *(1.40)*	3.05 *(1.16)*
7. I like to apply this category in acquiring novel words	3.9 *(1.33)*	3.4 *(1.28)*	2.76 *(1.48)*

	Concept-mapping	*Definition-description*	*Fishbone map*
Items	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
8. More effort and time are needed in building this type of map	3.04 *(1.49)*	3.5 *(1.50)*	3.43 *(1.36)*
9. I think I might apply this category a lot when memorizing novel words	3.95 *(1.32)*	3.3 *(1.31)*	2.57 *(1.16)*
10. I will inspire and train my colleagues to learn and apply this category of map	3.90 *(1.17)*	3.6 *(1.27)*	2.71 *(1.05)*
Total mean score *(SD)*	39.08 *(11.77)*	34.99 *(12.65)*	29.42 *(12.78)*

Table 10. Univariate General Linear Model for students' proportional learning effect and the highly rated statements

Concept categories map						
	Sum of Squares	*df*	*Mean Squares*	*F*	*Sig.*	*Partial Eta Squared*
Contrast	29.02	2	14.5	.415	.669	.060
Error	454.7	13	34.9			
Definition-description-example map						
	Sum of Squares	df	Mean Squares	F	Sig.	Partial Eta Squared
Contrast	189.7	4	47.4	2.2	.158	.525
Error	171.9	8	21.4			
Fishbone map						
	Sum of Squares	df	Mean Squares	F	Sig.	Partial Eta Squared
Contrast	126.5	4	31.6	5.4	.064	.845
Error	23.16	4	5.79			

As shown in Table 10, the general linear model did not identify any significant relationships between the three highly rated statements mentioned above and the students proportional learning effect.

To discover the highlighted relationship, we compared students' proportional vocabulary learning effect with all statements in the attitude questionnaire using a multiple regression analysis. The authors predicted that there would be a relationship between the additional examined factors. Following the backward elimination procedure, all independent variables (questionnaire statements) were entered in the analysis and the variable least correlated with the dependent variable (proportional learning effect) was removed from the model. The procedure revealed that for the concept categories mapping, no variable could account for the variance in students' significantly more than simply using the mean. In contrast, for the definition-description technique, the results showed that statement 5, *This type of map can be used in group work*, explained 23% of the variance in scores, implying that students who follow this technique could increase their technical vocabulary by almost 23% (see Table 15 & 16).

With regard to the fishbone map technique the applied regression analysis has revealed that statements 2 & 9, *It promotes my critical thinking* and *I think I might apply this category a lot in memorizing novel words*, could account for

Table 11: Model regression summary between definition-description technique and students' proportional learning effect

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.482[a]	.232	.181	5.005	.232	4.540	1	15	.050

a. Predictors: (Constant), Question 5 Definition-description

Table 12: ANOVA test summary between definition-description techniques and learners vocabulary proportional learning effect

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	113.732	1	113.732	4.540	.050[b]
	Residual	375.798	15	25.053		
	Total	489.529	16			

a. Dependent Variable: Proportional learning effect

b. Predictors: (Constant), Question 5 Definition-description

able 13. Regression model summary for predicting students' proportional learning effect from the fishbone mapping technique

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.651[a]	.424	.342	4.487	.424	5.158	2	14	.021

a. Predictors: (Constant), Question 9 Fishbone-map, Question 2 Fishbone-map

Table 14. ANOVA test summary between fishbone map techniques and learners vocabulary proportional learning effect.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	207.671	2	103.835	5.158	.021[b]
	Residual	281.859	14	20.133		
	Total	489.529	16			

a. Dependent Variable: Proportional learning effect

b. Predictors: (Constant), Question 9 Fishbone-map, Question 2 Fishbone-map

42% of the proportional learning effect scores, which means that students who follow this technique could increase their technical vocabulary by almost 42%.(Table 13 & 14).

Discussion

The current study examined the influence of using semantic mapping techniques to acquire technical vocabulary for English for Specific Purposes (ESP) students. The investigation was carried out by comparing the vocabulary scores of students in the experimental and control groups individually before and after the experimental manipulation (RQ1 & RQ2). The results indicated that a considerable amount of technical vocabulary had been gained by both groups. A further analysis was conducted to compare the vocabulary learning effect of students who received semantic mapping techniques with their counterparts who received traditional learning techniques (RQ3). The analysis found that learners using semantic mapping techniques acquired more technical vocabulary than their peers who received traditional teaching techniques. In addition, the attitudes of the students towards the semantic mapping techniques were measured (RQ4). Of the three semantic mapping techniques (concept categories

map, definition-description-example map, and fishbone map), students found the concept categories mapping strategy the most helpful. The most highly rated techniques were found to partially mirror the students proportional learning effect scores (RQ5). The general linear model did not reveal any significant relationships between the statement ratings and the proportional learning effect, although some questionnaire statements could explain 23% and 42% of the increase in learners technical vocabulary knowledge. We discuss these results in the following subsections.

Technical vocabulary learning

Interestingly a significant learning effect was found between learners' pretest scores and their proportional amount of learning throughout the study in both examined groups. The results indicated a higher learning effect between the experimental group learners, although the learners in the control group also benefitted from the traditional teaching strategies (e.g., blackboard drawings, synonym & definition and translation) for acquiring the target technical vocabulary. This is not a surprising outcome, as traditional teaching strategies are established methods that can have a positive impact on learners' vocabulary knowledge (Ali & Zaki, 2019; Zhonggen, 2018). The present results are in agreement with preceding studies that have found a positive effect on learners vocabulary knowledge from using traditional learning strategies, but one that is not as great as that from other advanced lexical learning approaches. The detected positive learning effect among our experimental group using sematic mapping techniques is in line with several studies (e.g., Abdelrahman, 2013; Al-Khasawneh and AlHawamdeh, 2023; Dilek and Yürük, 2013; IIxom qiz & Alisher o'g'li, 2023; Keshavarz et al. 2006; Saeidi and Atmani, 2010; Udaya, 2022; Vakilifard et al. 2020; Wisran, 2021). The results suggest that the semantic mapping techniques as an effective tool for students to use to acquire new vocabulary. In addition, our findings add to the literature finding a positive impact of the tested semantic mapping techniques on the acquisition of vocational vocabulary. This suggests that using these techniques may be of benefit in more applications in ESP contexts.

However, semantic mapping techniques are not expected to always have a positive impact on students' vocabulary knowledge (e.g., Khoii & Samira, 2013). This is because the educational background of the tested students, is one which focuses on memorization as a means to acquire new vocabulary (Khoii & Samira, 2013). Another reason might be associated with the students' proficiency level, as the more proficient students were also the ones who found the semantic mapping techniques most helpful (Wisran, 2021). Therefore, learners with higher proficiencies are more likely to use cognitive vocabulary learning strategies competently (e.g., lexical inferencing and/or semantic mapping) as they possess superior lexical knowledge ((Alahmadi & Foltz, 2020; Amirian & Momeni, 2012).

Students' attitudes and vocabulary acquisition

Overall, the current results indicated that the learners were highly satisfied and had a positive attitude towards the semantic mapping techniques used in the study. Such an outcome is in line with several previous studies (e.g., Hamdan & Alharbi, 2017; Udaya, 2022; Wisran, 2021). In line with such studies, students seem to be motivated and more willing to explore a novel vocabulary learning strategy to assist them expand their technical lexical knowledge (Clarke, 1991; Sabbah, 2015). Similarly, the positive attitudes they showed add to the optimistic atmosphere the authors observed during the teaching sessions and in individual conversations with the students after the experiment. Nonetheless, the overall positive attitudes should not mask the fact that there were some differences between the ratings given to the different types of semantic mapping techniques. The concept categories map was ranked as the most valuable technique, followed by the definition-description-example map and lastly the fishbone map. A similar result was found by (Hamdan & Alharbi, 2017). That the concept categories mapping technique was found most helpful, suggests that students typically prioritize the application of their prior lexical knowledge when considering a concept word. According to Duffy (2009), such a strategy could be beneficial if it combined a word's visualization with a conceptualization of its meaning. The definition-description-example map is less familiar to learners. Hamdan & Alharbi (2017), justified that definition-description-example map is a strategy that might need more time and mental effort besides teacher orientation. Students may also need wider semantic knowledge to find a possible definition for the target word. Fishbone maps appear to be the least less popular amongst the participants. Nation (2013) argued that a cause-effect strategy seems to be more suitable for introducing medical words as it usually makes students consider the causes related to the words.

Finally, we explored whether the students' positive learning attitudes toward semantic mapping techniques could be linked to their having a larger technical vocabulary learning effect. When the higher rated statements were used to predict students' proportional learning effect the analysis, none of the highly-rated statements were found to be significant predictors. We assumed that this was because the authors restricted the statistical comparison to only

the highly rated statements. Therefore, all questionnaire statements were added to the multiple regression analysis. Surprisingly, despite being found as the most commonly used technique among leaners, concept-categories mapping statements could not explain a significant amount of variance in students' proportional learning effect. A similar result was pinpointed by Tanyer & Öztürk (2014) who found that even though participants who rated determination vocabulary learning strategies as the most frequently used, this could not explain any variation in their lexical knowledge. This has several possible explanations. Firstly, participants seem not entirely aware of the semantic mapping techniques that best contribute to their lexical knowledge. Secondly, definition-description and fishbone mapping techniques are more complex and time-consuming compared to concept categories mapping, and students' ratings could be influenced by the relative simplicity of a particular technique.

However, for the definition-description-example mapping, statements like "This type of map can be used in group work", could explain 23% of learner's proportional learning effect when used as a predictor. Although this suggests definition-description techniques may be useful student aids, instructors should not assume such effects would be consistently replicated if they used those techniques. Such a technique might require more teamwork to acquire target words, given that its use in group work was referred to in the statement students were agreeing with. In contrast, the fishbone map was the least highly rated strategy, but explained the most (42%) variance in the learning effect when included in the regression model. The relevant statements ("It enhances my critical thinking" and "I think I may use this type a lot in memorizing new words") suggests that this type of map encourages deep mental processes that could be constructive (Ilxom qiz & Alisher o'g'li, 2023). The deeper information is processed, the more likely it is to be recalled. Despite the possibility that fishbone mapping technique can be beneficial by encouraging deeper thinking, it is a time-consuming strategy and this might explain the lower rating score given by students.

Conclusion

The current study explored the impact of semantic mapping technique (i.e. concept categories map, definition-description-example map, and fishbone map) on English for Specific Purposes (ESP) students and their attitudes toward them. In order to achieve the prior aim, participants were exposed to an online proficiency test and divided equally and randomly into two groups; experiment and control. To guarantee the homogeneity of the two groups, an independent samples t-test was performed and thus found that there was no significant difference in their proficiency scores. Moreover, an identical pre and post vocabulary tests were designed and presented to both groups to test their vocabulary knowledge of the target words prior and following the trials.

We found a significant learning effect between learners' pretest scores and the quantity of new vocabulary learnt during the study in both the experimental and control groups. However, the average proportional learning effect among learners in the experimental group outperformed their counterparts in the control group. Generally, students held positive attitudes towards the three semantic mapping techniques used for the experimental group. The individual rating scores for each technique showed the concept categories map to be preferred, followed by the definition-description-example map and the fishbone map. The general linear model did not reveal any significant relationships between the statement ratings and the proportional learning effect. Lastly, the multiple regression analysis showed that some questionnaire statements referring to the definition-description-example map, and fishbone map could explain between 23% and 42% respectively, of the gained score in the proportional learning effect.

Suggestion for the further studies

This study achieved its objective of investigating the impact of semantic mapping on pupils' vocabulary learning. It would be valuable for further research to use semantic mapping as an instructional practice for developing other language skills, such as reading or writing, since this method is not only appropriate for vocabulary teaching but can also be applied to improve reading and writing. Also, future studies could be conducted on female vocational students to obtain a more representative picture of the influence of teaching semantic mapping for all students. Lastly, using a mixed-methods research approach like interviews could provide a comprehensive understanding how semantic mapping techniques can be used in teaching to enhance foreign language vocabulary learning.

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