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Janaina do Rosário

Foreign Language Vocabulary acquisition using Semantic Mapping Software: A Systematic Review

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Foreign Language Vocabulary acquisition using Semantic Mapping Software: A Systematic Review

O presente trabalho em nível de mestrado foi avaliado e aprovado por banca examinadora composta pelos seguintes membros:

Prof. Dr. Lêda Maria Braga Tomitch
Universidade Federal de Santa Catarina

Prof. Dr. Nayara Nunes Salbego
Instituto Federal de Santa Catarina

Prof. Dr. Celso Henrique Soufen Tumolo
Universidade Federal de Santa Catarina

Certificamos que esta é a **versão original e final** do trabalho de conclusão que foi julgado adequado para obtenção do título de mestre em Estudos Linguísticos e Literários.

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Prof. Dr. Celso Henrique Soufen Tumolo
Coordenador do Programa de Pós-Graduação

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Prof. Dr.Celso Henrique Soufen Tumolo
Orientador

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With heartfelt gratitude and affection, I dedicate my work to:
My parents, who are a model of success and hard work,
My daughter Lauren Sarah for loving me unconditionally and
for bearing with me all this hardness,
Everyone who supported and encouraged me
throughout my academic journey.

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“To accomplish great things, we must not only act, but also dream; not only plan, but also believe.” (Anatole France)

ABSTRACT

Vocabulary knowledge is vital for communication in any language, due to the fact it can assist learners in their receptive and productive skills. At the same time, its development is complex and can be facilitated with the use of digital tools such as computer software to generate semantic mappings. Semantic mapping can be described as a vocabulary technique for graphically displaying words and concepts, which allows learners to learn new words by mapping it with other related words similar in meaning to the new word. Considering the importance of vocabulary knowledge to the language learning process of an L2, and the influence of this ever-changing technological era, to elucidate the contribution of Semantic Mapping Software in the EFL educational contexts seems to be relevant. This research consists of a Systematic Review, which synthesized 10 years of primary research studies around the efficacy of learning with SM software compared to other traditional instructional (non-mapping) techniques for teaching and learning vocabulary in the context of English as a Foreign Language. Two research objectives were addressed: to investigate whether or not teaching vocabulary to EFL learners via Semantic Mapping software improves their vocabulary learning, based on the primary research studies, from 2010 to 2020, and to identify primary researchers' conclusions for the use of Semantic Mapping software for vocabulary learning. It followed an 8- step systematic review protocol based on Zawacki-Richter's study (2020) which encompassed: develop research question, design review of literature, construct selection criteria, develop search strategy, select studies, coding studies, assess the quality of studies, and synthesize the results. This systematic search of the literature via 7 virtual library databases identified 7 high quality studies that met the inclusion criteria and were appraised. The critical appraisal of the studies reviewed was based on Transparent Reporting of Evaluations with Non-randomized Designs (TREND) statement. The findings indicate statistically significant gains over vocabulary learning and retention in all experimental groups, that is, in the users of the SM software, when compared to their counterparts in the control groups. All the quantitative outcomes obtained and analyzed from a qualitative perspective are clear empirical evidence that SM software work effectively in promoting EFL learners' vocabulary acquisition, in other words, the use of Computer- Assisted Semantic Mapping (CASM) as a vocabulary instructional technique had a significant impact and hence improved students' learning and retention of EFL vocabulary knowledge. As a conclusion, it is possible to state that SM software are a potentially feasible and successful technique for vocabulary expansion and acquisition in EFL.

Keywords: Semantic Mapping Software. Vocabulary. Acquisition. Foreign Language.

RESUMO

Conhecimento de vocabulário é vital para a comunicação em qualquer língua, pelo fato de poder auxiliar os alunos nas habilidades receptivas e produtivas. Ao mesmo tempo, seu desenvolvimento é complexo e pode ser facilitado com o uso de ferramentas digitais tais como programas de computadores para gerar mapas semânticos. Mapa semântico pode ser descrito como uma técnica de vocabulário para graficamente mostrar palavras e conceitos que permite os alunos aprenderem novas palavras ao mapeá-las com outras palavras relacionadas semelhantes em significado com a nova palavra. Considerando a importância do conhecimento de vocabulário para o processo de aprendizagem de uma L2, e à influência desta era em constante mudança, elucidar a contribuição dos programas de mapeamento semântico no contexto educacional do Inglês como língua estrangeira parece ser relevante. Esta pesquisa consiste em uma revisão sistemática que sintetizou 10 anos de pesquisa primária em torno da eficácia de aprender com programas de mapeamento semântico comparados com outras técnicas educativas tradicionais (não mapeamento) para ensinar e aprender vocabulário no contexto do Inglês como uma língua estrangeira. Dois objetivos de pesquisa foram abordados: investigar se, ou não ensinar vocabulário para alunos de Inglês como Língua Estrangeira via programa de mapeamento semântico significativamente melhora o vocabulário, baseado nas evidências coletadas pelos pesquisadores primários em estudos entre 2010 e 2020, e identificar as conclusões dos pesquisadores primários para o uso do programa de mapeamento semântico para aprendizagem de vocabulário. Seguiu-se um protocolo de revisão sistemática de 8 passos, baseado no estudo de Zawacki-Ritcher (2020) que incluiu: delimitação pergunta de pesquisa, criação estrutura conceitual, criação critérios de seleção, elaboração estratégia de busca, seleção dos estudos, sistematização dos resultados dos estudos, avaliação da qualidade dos estudos, e sintetização dos resultados. Esta busca sistemática da literatura, via 7 base de dados de bibliotecas virtuais identificaram 7 estudos de alta qualidade, que atenderam aos critérios de inclusão determinados e foram apreciados. A avaliação crítica dos estudos revisados foi baseada na declaração da "*Transparent Reporting of Evaluations with Non- randomized Designs*" (TREND). Os resultados indicam ganhos estatisticamente significantes sobre aprendizagem e retenção de vocabulário em todos os grupos experimentais, ou seja, os usuários dos programas de MS, quando comparados com seus equivalentes nos grupos controles. Todos os resultados quantitativos obtidos e analisados sobre uma perspectiva qualitativa são evidências empíricas claras que os programas de mapeamento semântico funcionam efetivamente em promover aquisição de vocabulário dos alunos de Inglês como Língua Estrangeira. Em outras palavras, o uso do Mapa Semântico com Auxílio do Computador (CASM) como uma técnica educativa de vocabulário teve um impacto significante e, portanto, melhorou a aprendizagem e retenção do conhecimento de vocabulário dos alunos de Inglês como Língua Estrangeira. Como conclusão, é possível dizer que os programas de mapeamento semântico são uma técnica potencialmente viável e bem-sucedida para expansão e aquisição de vocabulário em Inglês como Língua Estrangeira.

Palavras-chave: Programas Mapeamento Semântico. Vocabulário. Aquisição. Língua Estrangeira.

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LIST OF ABBREVIATIONS AND ACRONYMS

CALL	Computer- assisted Language Learning
SM	Semantic Mapping
EFL	English as a Foreign Language
SL	Second language
SMS	Semantic Mapping software
CASM	Computer- Assisted Semantic Mapping
SR	Systematic Review
Scielo	Scientific Electronic Library Online
LISA	Library and Information Science Abstracts
ERIC	Educational Resources Information Center
CAPES	Coordenação e Aperfeiçoamento de Pessoal de Nível Superior
TREND	Transparent Reporting of Evaluations with Nonrandomized Designs
SPSS	Statistical Package for Social Sciences

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1 INTRODUCTION

When it comes to learning any foreign language, vocabulary acquisition[1] plays a fundamental role in the teaching - learning process at any stage. Understanding that the degree of proficiency in a language can be measured by the words learners know, the more words, phrases and collocations learners know, the better they can communicate with others, when dealing with the 4 skills[2] of the language**.** Dilek and Yürük (2013) highlight that, without words, written and spoken language cannot be used effectively.

Vocabulary knowledge is considered an important component to be taught because foreign language learners at some schools and universities face difficulties in memorizing and recalling the meaning of the words (ALBISTHAMI DJ, 2017; AL-JARF, 2015; LIU, 2016; MASOUD IBRAHIM, 2017); Moreover, they face difficulty in understanding reading texts due to English vocabulary deficiency (AL-OTAIBI, 2011; BAHADORI; GORJIAN, 2016; SHDAIFAT *et al.*, 2019). That is, learning new vocabulary is a challenging task for students learning EFL.

Studies conducted by Nation (2001) and Tumolo (2007) have focused on what teachers do about vocabulary in class, and, according to them, what takes place in the classroom does not consider the variety of possibilities suggested by theory and research. Regarding L2 vocabulary learning, it can be suggested that when teaching English as a Foreign Language[3] (EFL) the use of effective learning tools and memorizing strategies can facilitate and speed learners' vocabulary learning.

In doing so, there are certain teaching techniques that assist students in acquiring new lexical items in a creative way. Thus, in Oxford and Crookall's (1990) seminal book on language learning strategies, one of the strategies for the retention of language input is the use of the Semantic Mapping (SM) technique, also known as mind map. This technique falls under the broad category of graphic organizers[4] (BALEGHIZADEH; NAEIM, 2011). Roughly speaking, SM technique demonstrates how keywords or concepts are associated one to another through non-linear graphic representations. Khoii and Sharifafar (2013) describe the term as a

[1] For the purpose of this piece of research, learning and acquisition are used interchangeably to refer to increase in knowledge.
[2] It encompasses listening, reading, speaking and writing skills.
[3] Currently, other terms as English as an additional or international language may also be employed, which can be seen as more appropriate in contemporary society. In this current research I use English as a Foreign Language (EFL), but it is acknowledged the importance of other alternative terms (JORDÃO, 2014).
[4] Graphic organizers have different types for different instructional purposes. "Two commonly used are semantic maps and concept diagrams" (VAUGHN; EDMONDS, 2006, p. 135).

visual strategy for vocabulary expansion of knowledge by displaying in categories words related to one another. Ifenthaler and Hanewald (2014, p.5) acknowledge that "the power is in the visualization, simplistically coined in the adage that a picture is worth more than a thousand words", due to the fact it becomes easier for students to remember, to expand, and to retain vocabulary presented this way.

Nowadays, there are many technological tools that can be used to create SMs. Denton *et al.* (2007) stated that mind mapping tools, such as software, can be used to represent the SM technique. Accordingly, mind mapping software take SM beyond the realms of paper and pencil. Since the 1990's, companies have begun to develop digital mind mapping[5] that can be employed for ideas brainstorming, problem solving, decision making, presentation preparation, and ideas organization to assist learners to enhance their receptive and productive skills.

In line with that, as technology evolves, there has been a growing number of studies in this area. For that purpose, the primary goal of this study is to locate, organize, analyze and summarize primary research on the use of SM software for enhancing EFL learners' vocabulary. In order to do that, a Systematic Review (SR) design has been adopted, which consists of a reproducible and "systematic secondary review of accumulated primary research studies" (NORRIS; ORTEGA, 2006, p.4). Thus, the current research seeks to deepen our knowledge about the phenomenon under investigation.

The next section presents, in a more detailed way, the objectives and research questions that motivated the present study and worked as a basis for this investigation, in an attempt to contribute to a debate on the effectiveness of SM software for EFL vocabulary learning and retention.

1.1 OBJECTIVES AND RESEARCH QUESTIONS OF THE REVIEW

Understanding that the use of digital technology can be a useful resource for FL[6] learning when integrated effectively in the curriculum, this SR aims to achieve the possible coverage of primary researches published in English from 2010 to 2020, for the use of SM software for FL learners' vocabulary learning. The specific objectives are the following:

a) To investigate whether or not teaching vocabulary to EFL learners via Semantic Mapping software significantly improve their vocabulary, based on the evidence collected in the primary studies from 2010 to 2020.

[5] Open sources and commercially available mapping tools.
[6] There will be no distinction concerning the terms Second (L2) and Foreign Language (FL).

b) To identify primary researchers' conclusions for the use of Semantic Mapping software for FL vocabulary learning.

In order to conclude on the effect of teaching vocabulary through semantic mapping software, this study attempted to answer the following research questions:

RQ1. Does teaching vocabulary to EFL learners via Semantic Mapping Software significantly improve their vocabulary, based on the primary studies from 2010 to 2020?

RQ2. What conclusions have been found by the primary researchers in relation to the use of Semantic Mapping Software for the acquisition of vocabulary in English as a Foreign Language?

1.2 STATEMENT OF THE PROBLEM

Many experienced EFL/ESL teachers and scholars have realized that, indeed, vocabulary knowledge is also considered a very important component when learning any foreign language. Laufer (1997, p.54) stated that "vocabulary learning is at the heart of language learning and language use." In line with that, other studies have suggested that the more vocabulary knowledge a learner has, the better s/he will perform in the receptive[7] and productive[8] skills (NATION, 2001).

Bearing in mind the fact that most EFL learners are not immersed, or that exposure is not frequent in the target language outside the classroom, there is the need to provide them with meaningful and multiple input and output activities through the receptive and productive skills in the classroom in order to develop their vocabulary knowledge. Mizumoto and Takeuchi (2009) point out that when it comes to learning a FL, mastering vocabulary is one of the most challenging tasks that any learner faces. Nevertheless, what has been seen is that not sufficient attention has been devoted to teaching vocabulary effectively (FOLSE, 2004). Thus, students face difficulties in learning and retaining some vocabulary knowledge they need to deal with the 4 skills of the target language, which poses a great concern and challenge for educators.

Taking this into account, it can be said that vocabulary learning also contributes to language development[9]. Besides, technology plays a significant part to support students into their language development process as well. Nowadays, there are numerous digital resources

[7] When learners receive (are exposed to) input through reading or listening skills. That is, input.
[8] When learners produce language (orally or written) through speaking or writing skills. That is, output.
[9] For this piece of research, it refers to the process of progressing or developing in an L2.

such as software, apps, among others, that may aid learners in terms of language development. The endeavor to implement this timeless pedagogical technique into the learning environment along with CALL (Computer- assisted language learning) resources to language development seems to be a positive and innovative way of teaching and learning a new language.

Therefore, this study proposes to investigate through a SR the use of SM software in support of learner's vocabulary acquisition. It might be suggested that by implementing SM software to map a lexical item[10] it is expected that vocabulary learning can be a more engaging, creative, and hands-on experience where learners can be actively involved in the learning process by expanding their semantic knowledge of the target words. The next section elucidates the motivation and significance of this investigation.

1.3 MOTIVATION AND SIGNIFICANCE OF THE STUDY

Firstly, mastering vocabulary is like building a house, the better the construction is, the more robust the house will be like. In other words, the more worked upon and well-elaborated vocabulary acquisition is, the better learners' lexical growth will be along the language learning process. Recent studies (AL-JARF, 2010; AL-OTAIBI, 2011; HAMDAN; ALHARBI, 2017) have shown that Computer-Assisted Semantic Mapping (CASM) can support learners to retrieve and use words related, which can assist vocabulary development, because it allows the creative and productive use of language.

Secondly, in the 21st century digital technology also plays an essential part in language teaching and learning when integrated positively into the curriculum (STANLEY, 2013). It goes without saying that the advent of the Internet has paved the way for the availability of numerous pedagogical activities for educators to improve their teaching practice as well as for learners their language skills. Learning can be a more active and meaningful experience, when learners are motivated to develop ownership over their learning, and when learning is according to their own level, reality and needs (MOREIRA, 1999).

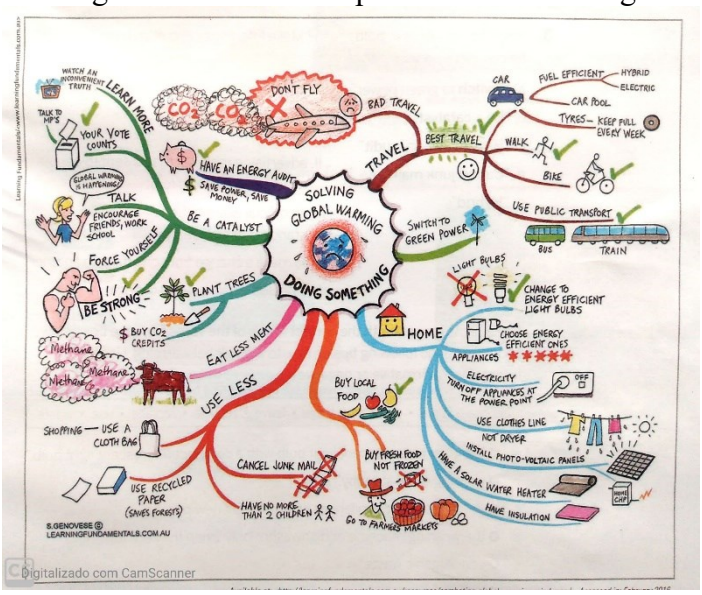
Thirdly, in the last decade new primary researches have appeared on the implementation of SM software within the educational context. Consequently, researchers have continued to investigate the efficacy of using SM software for teaching and learning vocabulary in the EFL, and in doing so have extended the instructional contexts, map features, and

[10] It is also called a vocabulary item or a lexeme. This term refers to a content word which can be a noun, a verb, an adjective or an adverb.

comparison conditions. It seems quite relevant to elucidate through this SR the challenges and potentials of this digital resource in the current educational contexts.

In short, to the best of the researcher's knowledge, when it comes to vocabulary teaching and learning, research on SM software (or also referred as MM software or E-mind mapping, and CASM) is still not so vast, since only 7 studies have been located. They are Albisthami DJ (2017), Al-Jarf (2015), Al-Otaibi (2011), Bahadori; Gorjian (2016), Liu (2016), Masoud and Ibrahim (2017) and Shdaifat *et al.* (2019)' studies which employed technological tools as independent variables in the EFL context within the last decade. All the reviewed studies focused on the effectiveness of SM software in comparison to paper-based traditional instructional techniques. Overall, it is acknowledged that vocabulary knowledge is essential for communication in any FL, and to facilitate and enhance its learning through the use of digital resources has always been my main personal motivation, due to the fact the English textbooks I have been using present vocabulary and texts in this format, as can be seen in Figure 1 below.

Figure 1 – A Mind Map on Global Warming



Source: Franco and Tavares (2017).

Bearing in mind the contribution of vocabulary knowledge to language learning process, and recognizing the influence technology may have nowadays, it is expected that this study can contribute to research in the realm of vocabulary acquisition in FL. To conclude, also, to shed some light on the availability of a pedagogical and technological vocabulary tool that may be implemented into EFL language classrooms to improve learners' lexical repertoire. Next, the thesis' organization is presented.

1.4 ORGANIZATION OF THE RESEARCH

The current research is organized into Chapter 1, the introduction where the researcher contextualized the investigation, showed the general and specific objectives, the research questions, the statement of the problem and significance of the research. In Chapter 2, the review of literature is presented by discussing the process of FL teaching and learning, the role of vocabulary acquisition in FL learning, Semantic Mapping as a teaching and learning tool, and it narrows down to present CASM**.** In Chapter 3, the method explains systematic review in educational research. Chapter 4 presents the results including the coding, the critical appraisal of the studies reviewed, the synthesis, and, in the discussion, the two research questions are answered. Finally, in Chapter 5 the final remarks bring the pedagogical implications, limitations of the study and suggestions for further studies.

2 REVIEW OF LITERATURE

To learn another language is to have one more window from which to look at the world.
Chinese proverb.

When it comes to learning an L2/ FL, literature acknowledges that it is an intricate process due to its different contexts and linguistic varieties that come into play. Regarding FL learning research, Kuhl and Gleitman (2007) recognize the need to take into consideration different aspects such as motivation, memorization, learning styles and strategies, as well as teaching and learning techniques.

Understanding the paramount role vocabulary plays when learning a FL as well as the variety of instructional techniques available currently, a relevant technological resource that has paved the way for vocabulary expansion is mind mapping or Semantic Mapping tools, which is the core of this SR. As explained by Kiliçkaya (2020), since the 1980's with the implementation of digital resources in L2/ FL learning, much has been investigated and written by researchers and educators regarding the potential contribution of technology to mastering the target language.

Thus, the objective of this section is to present the theoretical background that gives support to the present study, which is all discussed and exemplified through some relevant studies in each field.

2.1 FOREIGN LANGUAGE TEACHING AND LEARNING PROCESS

Within the realm of L2/FL learning, there has been a quite large significant number of teaching theories, approaches, and methods that have attempted to contribute to better support learners' language acquisition. Thus, this brief overview provides a broad idea of different methods within second language acquisition. Generally speaking, naming a few methods and approaches such as Grammar – Translation, Direct Method, Reading Method, Audiolingual, Silent Way, Total Physical Response, Communicative Language Teaching among others, each one tried to convey the idea of being the ideal method which would surpass the previous one, in a way that they were more exclusive than inclusive to each other (LEFFA, 1998). Considering their positive and negative points throughout history, they all have somehow contributed to promote learners' language learning.

However, currently language educators have become more aware and open to the idea that, in fact, there is not only one correct method to be followed; therefore, according to

Tavakoli and Jones (2018, p.23, apud LORENSET, 2019) “the most effective approach to language teaching is to employ a combination of methods depending on the context to be taught.” Putting it simply, the scenario may have shifted to a more eclectic way of teaching and learning a FL, which takes more into consideration the students’ needs and interests to reach a better outcome (LEFFA, 1998). Thus, learning has moved from a teacher-centered class to a much more student - centered class, which has paved the way for students’ being more engaged, creative and responsible for their own learning.

The language systems of a FL are composed by their vocabulary, grammar, phonology, and discourse. Vocabulary refers to the content words, lexical phrases, collocations, and idioms of the target language. Folse (2004) corroborates with the idea that learning a language entails learning numerous elements about that target language, but the heart of it is vocabulary. Additionally, it might be said that vocabulary plays an important part both in testing situations as well as in the target language use, since the level of proficiency in a language is measured by the words users know. In this vein, this SR investigates whether and to what extent the use of SM software can provide learners with language learning opportunities to develop their vocabulary knowledge in the EFL classroom.

2.1.1The role of Input and Output

Foreign language learning is claimed to involve *input* and *output* (ELLIS, 1997). Elaborating more on the role of input and output there are some theories that support their importance in the L2 acquisition. Input can be defined as pieces of language to which a learner is exposed to. According to Krashen’s (1982) Input Hypothesis, L2 acquisition takes place when a learner can understand input that contains grammatical forms that are at i+1[11], that is, a little more advanced than the current state of learner’s interlanguage. Thus, learning relies on comprehensible input[12], for instance, when learners would be employing the language context and their prior knowledge to assist themselves in terms of grasping the message in the target language. Also, for Krashen, learners would be concentrating more on *meaning* than on form, and that learning the structure of the language would be a consequence of the input previously received. Although input can be relevant to language learning, Tumolo (2007) proposes that comprehensible input itself is not sufficient for learning to occur.

[11] An aspect of language that the speaker has not acquired but that he/ she is ready to acquire.
[12] Learners understanding input, which is the essential environmental ingredient in language acquisition.

Besides input for learning, learners also need to produce language, that is, the language output, defined as learners' language written or oral productions. Swain (1995) proposed the Output Hypothesis, which suggests that production of language also plays a relevant role into language development. Besides, the author points out that comprehensible output is as important as comprehensible input in order to make communication occur properly which can contribute to language acquisition. Going further, for Swain (1995), comprehension and production differ from each other because output will force learners to make more mental efforts to generate the sentences that will require them to recall vocabulary and grammar knowledge as well as their background knowledge to be able to interact with an interlocutor.

In other words, in order to produce language, linguistic forms and meanings have to be integrated and put into use, thus learners can become aware of what they are and are not able to do (SWAIN, 1995, p.127). According to Swain's Output Hypothesis, there are three functions in which producing language (orally or written) may serve throughout the language learning process: (1) Output aids to promote the *noticing-gap* function**,** whenever learners have to produce samples of language becomes possible for them to identify what lacks or needs improvement, that is, what their limitations and lack of knowledge are. Consequently, this cognitive process may trigger changes in their L2 for the next encounters, serving as a consciousness- raising role; (2) The second works as the *hypothesis - testing* function, which learners employ when they want to try out (novel) language to check a hypothesis of comprehensibility and, in case it does not work properly, they will have to reprocess their output by seeking external resources. Creating and testing hypotheses can be considered strategies that might be used to solve the linguistic problems that have been noticed; (3) The *metalinguistic* function or *reflective* function, since learners think and reflect upon how they make use of their own target language aiming at meeting the gaps between L1 and L2. Along this thoughtful process, it can be seen learner's noticing function by realizing what they know and do not know yet and testing this hypothesis to find out what works. In other words, output plays a reflective role that allows learners to monitor and incorporate their linguistic knowledge (SWAIN, 1995).

Overall, it can be suggested that both input and output are essential for language learning process because it is when learners put in practice what they have been exposed and learned. Narrowing down to this current research, input can be related to being exposed to the maps, when learners brainstorm, review, or recap new vocabulary, taking place in open-group, with the teacher's guidance. Output, on the other hand, can be refer to the process of producing the maps, when learners need to generate a SM based on a core concept word, and to create branches and sub-branches by linking a word to its meaning, it can take place individually, in

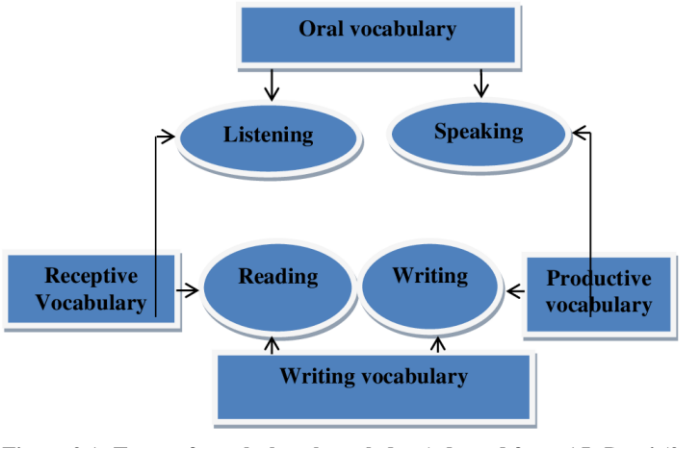
pairs or in groups. After having presented the role and importance of input and output for second language learning, the next section is devoted to explaining EFL vocabulary acquisition.

2.2 VOCABULARY ACQUISITION IN FOREIGN LANGUAGE

> "Lack of grammar knowledge can constrain a conversation,
> Lack of vocabulary knowledge can stop a conversation."
> (FOLSE, 2004, p.3).

Generally speaking, vocabulary can be defined as a group of words of a specific language that individual speakers might employ to communicate in many different ways and contexts (HATCH; BROWN, 1995). Thus, vocabulary acquisition is the process of learning the vocabulary of a language, that is, its group of words. Going further, literature has shown that knowledge of an L2 vocabulary item is defined by many dimensions of word knowledge such as "phonological and orthographic, morphological, syntactic and semantic" (TAKAC, 2008, p.10). Furthermore, the knowledge of vocabulary can be receptive and productive (NATION, 2001), that is, there are different degrees of knowing a word. Being able to recognize and understand a word is known as receptive vocabulary and is normally connected with listening and reading skills (Figure 2). If we are able to produce and use a word of our own accordingly when speaking or writing, then that is considered productive vocabulary (Figure 2), due to the fact it requires more mental effort by the language learner to be able to employ the target vocabulary independently and appropriately in a given context.

Figure 2 - Receptive and productive vocabulary



Source: Moyo (2018).

Sok (2014, p. 21) pointed out that "over the last three and a half decades, research in vocabulary acquisition has flourished." That is, the teaching of vocabulary has gained the attention it deserves. This shift of attitude has been for three reasons Nunan (1999): a) theoretical developments in the linguistic study of vocabulary; b) opening up of new possibilities as a result of the development of computer-based language corpora; and c) the impact of comprehension and strategy-based methods on language improvement.

Bearing in mind the vital role vocabulary learning plays in any language, Nunan (1999, p.4) highlights that:

> It is a cumulative process and that it must be deliberately taught, learned and recycled. This is critical for several reasons: 1) learners need to encounter the words in a variety of rich contexts, up to sixteen encounters, 2) learners remember words when they have manipulated them in different ways, so variety is essential for vocabulary teaching, and 3) learners forget words within the twenty-four hours after class, so it is important to follow up a vocabulary lesson with homework that recycles the words.

Learners need not only know new words, however, to have quite a good number of opportunities to remember and use them often in different contexts. Thus, it is worth noting that to master all the language skills vocabulary knowledge plays an important part in this language learning process. Taking it into account, Hatch and Brown (1995) emphasized that there are five essential steps to learning new words which are: having sources to encounter them, getting their form, getting their meaning, consolidating their form and meaning into memory and, finally, start using them. Put it simply, to be able to use the word independently and appropriately in different contexts.

Generally speaking, as pointed out by Nation (2001), knowing a word involves being familiar with the written and spoken forms of the word and being able to connect meaning with

those forms. At the most general level, knowing a word entails its form, meaning and use. Similarly, for Oxford and Crookall (1990, p.9) knowing an L2 word involves "being able to use it communicatively in any of the four main language skills." Equally important, according to Min (2013) that there are three conditions for language learners to be able to say they know a word: which words they are usually associated with; what are their grammatical characteristics and how they are pronounced and spelled. Narrowing down to this research, it is worth noting that the use of SM technique within the language learning process is designed to contemplate semi- contextualizing contexts[13](OXFORD; CROOKALL, 1990). Seeking to contemplate the five steps described previously through the implementation of semantic mapping technique, this research's main objective is to elucidate through a SR the efficacy of SM software for vocabulary learning in the EFL context.

Bearing that in mind, many authors (CALDERÓN; SLAVIN; SÁNCHEZ, 2011) *et al.* acknowledge that vocabulary instruction should be incorporated as an important part of the class and curriculum for either L1 or L2 teachers. Regardless of the advantages that theory and practice have shown, what usually happened in the language classrooms according to Oxford and Crookall (1990, p. 9), is that students were:

> expected to 'pick – up' vocabulary on their own without any guidance. […] Many instances of so - called vocabulary instruction involve merely giving students lists of words to memorize or providing limited practice opportunities with no further assistance to the often- overwhelmed learner.

Based on that, it might be suggested that the implementation of vocabulary learning techniques can be used not only to develop vocabulary in English. Dilek and Yürük (2013) state that vocabulary learning techniques are recognized as a way to empower students to take control of and responsibility for their vocabulary learning.

With regard to the frequency and number of encounters with words, Barcroft (2015) proposes that vocabulary learning all begins when learners meet and get to know the lexical items through input activities such as listening and reading. Besides, what, how, and how often learners work upon that input is what will assist their process of memorization. In this vein, it is also worth mentioning the importance of output through multiple and meaningful exposure when producing language, since input and output can be considered crucial for vocabulary learning. By relating the role of input and output when teaching and learning vocabulary as well as the five essential steps to learning new words (HATCH; BROWN, 1995) input then, for example could occur when using Semantic Mappings for introducing, presenting, recapping

[13] Allow some degree of context [...]new words may be linked with something that is meaningful to the learner, but they are not used as part of naturalistic communication (OXFORD; CROOKALL, 1990, p.10).

lexical items in vocabulary receptive activities like in reading or listening, which would allow learners to have sources to encounter new words, get a clear image or visual (written or spoken form) and learn the meaning of the words via the visual and conceptual map exposure; Whereas output, for instance, could take place when the Semantic Mappings are produced by the learners, through vocabulary productive skills usually connected to writing and speaking skills, that is, providing opportunities to use the target word independently and appropriately to build the maps, as well as contribute to the process of consolidating word form and meaning into memory. In other words, how to turn receptive vocabulary knowledge into productive vocabulary knowledge.

Accordingly, knowing a word means that learners also have to encounter the same word several times in a rich variety of contexts and/or vocabulary activities that a deeper understanding of its meaning and use will develop (SÖKMEN, 1997). That is, these multiple encounters can assist learners to enrich and strengthen their relations with the new lexical items to be learnt.

2.2.1 Knowing a word: a semantic field perspective

A core factor to take into consideration within foreign language vocabulary learning is the Semantic Field Theory. According to Guo (2010), the most systematic and scientific strategy should be the one based on semantic field theory. Roughly speaking, its role is to analyze linguistically the relationship between a set of semantically related words that are in or under a certain group, since it is suggested that words of a language system are connected to each other (GAO; XU, 2013). Within this language system, certain lexical items could make up a semantic field dominated under a common concept. Gao and Xu (2013, p.2031) defines semantic field as a "combination of a group of words that interact, dominate, distinguish and depend on with each other."

That is to say, semantically- related words are simply words or phrases that are related to each other conceptually. In the realm of the semantic field, there are three major semantic relations, which can be classified as Hyponymy, Antonymy and Synonymy. Hyponymy is the most common of all since it contains all the words that are under the same category (e.g. content words[14]). Antonymy refers to lexical items of opposite meanings. Synonymy refers to two or more lexical items that have the same or nearly the same meaning

[14] They are words that have meaning, for instance nouns, ma in verbs, adjectives, and adverbs are usually in this group.

but different form. These three basic semantic relations are usually easy to identify among groups of closely related words, or semantic fields. Putting it simply, they are all a means to enlarge learner's vocabulary knowledge as well as repertoire in an L2 because they allow the lexical items to be encountered in a variety of contexts and end up strengthening their semantical relation.

In addition to that, when it comes to L2 vocabulary learning, Seal (1991, p.300) explains that when words are learned in semantic sets[15], "the learning of one item can reinforce the learning of another," as well as facilitate understanding. Furthermore, according to the author, it is important to note that there are at least two benefits associated with learning words in semantic sets: the similarity between items (a) serves to facilitate the learning task and (b) causes the learner to notice fine-grained distinctions between words, which leads to a better understanding and retention of the words that are learned.

Accordingly, attempting to make L2 vocabulary learning effective for students, that is, consolidating word form and meaning in memory as well as providing opportunities for word use (HATCH; BROWN, 1995), this study through a SR investigates the use of semantic maps in the process of learning and retention of semantically related words.

2.2.2 Incidental and Intentional learning

When it comes to the matter on how EFL/ESL learners can learn novel words and lexical phrases, Nation (2001) proposes that it can take place *incidentally* or *intentionally*. Incidental vocabulary learning refers to learners picking up words and lexical phrases without a direct vocabulary teaching instruction, that is, learning from the context, for instance, while reading or conversing for meaning. In turn, intentional learning happens when one deliberately focuses attention and effort to remember and retain novel words or lexical phrases. Similarly, Hulstijn (2001, p.14) defines the former as the "learning of vocabulary as the byproduct of any activity not explicitly geared to vocabulary learning, while the latter referring to any activity aiming at committing lexical information to memory."

With regard to the intentional learning, it is relevant to mention that it may have some varying degree of intentionality depending on the nature of the instructions proposed in the activities in the classroom. From Barcroft's (2015) point of view, when learners are provided with instructions on how to work with vocabulary in a text, that is, what is expected from them

[15] Words which share the same semantic and syntactic characteristics, grouped under a common concept e.g. flower names. In other words, they are linguistically derived.

to do and how they will be tested, the more they learn L2 vocabulary from a text. Taking that into consideration, the present study investigates whether or not the implementation of CASM can benefit learners from intentional vocabulary learning in EFL instructional settings.

2.2.3 Frequency of encounters with words and spacing of repetitions

As previously mentioned, input and output play a fundamental role in vocabulary and language development at any stage. In other words, it all begins with exposure to the target words and other lexical items within the input, then, through the output, learners are able to produce words, phrases and sentences independently and appropriately, until they finally incorporate them in their lexicon. There are several studies (e.g. LAUFER, 2015; LORENSET, 2019; NATION, 2001) that highlight the importance and connection between frequent repetition and vocabulary learning. In a sense that the more repetitions, the broader the learners' possibilities of noticing, retrieving, and/ or using the new words in a variety of contexts.

Frequency can be related to the numerous times that it is necessary for encountering the target words. Although it is hard to define a precise number since learners may be different in terms of time and number of repetitions required for learning, some studies suggest they may vary from at least 5 to 7 repetitions, or more. Tinkham (1993) discovered that most learners required five to seven repetitions for the learning of a group of six paired associates. Nation (2001, p.115) suggests up to 16 encounters with the new words until it is consolidated in our long-term memory and states that "repeated meetings can have the effects of strengthening and enriching previous knowledge." This is valid not only for acquiring new words, but also for maintenance of old ones. The more the encounters, the better the retention of the words in the long- term memory.

Another factor to bring to discussion concerns the spacing of repetitions. Nation (2001, p.114) defines spaced repetition as "spreading the repetitions across a long period of time." On the other hand, massed repetition refers to spending very intense and continuous time but only one encounter with the word. According to several authors (BLOOM; SHUELL, 1981; DEMPSTER, 1987;, 2016), spaced repetition results in more effective learning than massed repetition. Elaborating more upon that, Ullman and Lovelett (2016, p.8) point out that "if a given item is presented with temporal space between presentations, retention of the item is better than with massed presentation, that is, without spacing between items." However, it is worth mentioning that the first spaced repetition should occur right after learning the new word, otherwise forgetting may occur (NATION, 2001).

Overall, it is possible to state that learning from repetition also relies on the spacing of repetitions. The more spaced encounters learners have with the new word, the more chances they have to learn and retain it. In addition to that, considering the lack of regularity of semantic mappings used for learner's production in the L2 classroom, it is worth investigating what the efficacy of learning with semantically related words is, through the implementation of semantic mapping software.

The sections 2.1.1 and 2.2 have looked at some of the relevant theoretical conditions that can lead to vocabulary development, such as input, output, retrieval, creative use, intentional and incidental learning, including SM technique for learning vocabulary. Which can be all considered a means of bringing conditions for learning into play. Additionally, studies have shown that since 5 steps and multiple encounters are needed to start learning new words, this research investigates through a SR the effectiveness on the use of SM software. Then, the next section analyzes Semantic Mapping within the educational context, considering its definition, and scope.

2.3 SEMANTIC MAPPING AS A TEACHING AND LEARNING TOOL

> People learn better from words and
> pictures than from words alone.
> (Richard Mayer, 2009).

Within the realm of vocabulary techniques available for teaching/learning a FL, there are several teaching techniques tools. Semantic Mapping, also referred as 'mind mapping, concept map, and a type of graphic organizer' (PEARSON; JOHNSON, 1978), was chosen to be analyzed due to its graphical, timeless and mnemonic nature. Thereby, the current study investigates the use of this technique assisted the process of vocabulary learning in English as a FL. In the interest of understanding SM as a pedagogical tool, it is appropriate to define and describe what it is. Roughly speaking, they are maps or webs of words, described by Khoii and Sharifafar (2013, p. 202) "as a visual strategy for vocabulary expansion of knowledge by displaying in categories, words related to one another." Therefore, SMs are made up of two elements: *visual* and *conceptual*. The former entails the pictorial design of geometric shapes such as boxes, circles or rectangles linked through lines and arrows. The latter entails the verbal data within such shapes (FISHER, 1995). In line with that, Novak (1991) pointed out that, since SMs are techniques used to depict knowledge, the most appropriate way to read it is from top

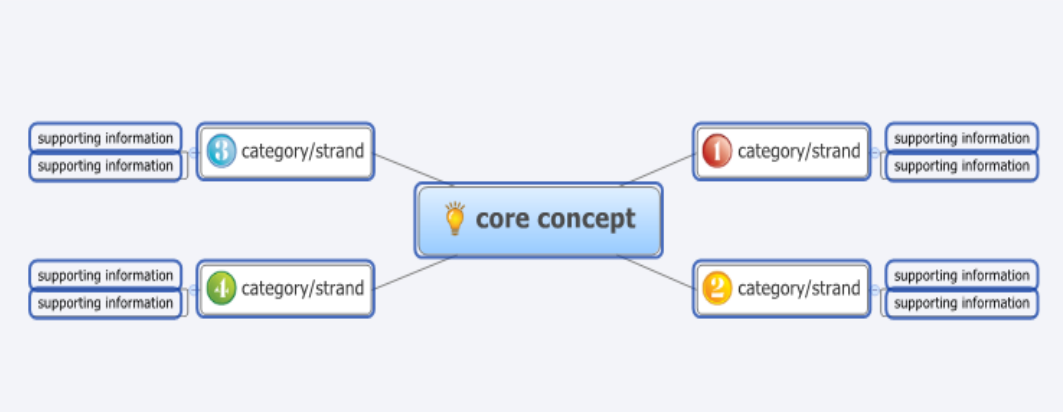
to bottom, that is, from general to more specific concepts. Going further, Pearson and Johnson (1978, p.79) define SM as:

> A visual and graphic representation of knowledge of a specific fact or concept, which is derived from our social practices, engrained in ourselves due to experience. It is a way of structuring information into categories, which are organized in a non- hierarchical but semantic nature. Its main objective is to activate, recap, and unfold previous knowledge and the tangible relationship that can be established within a single theme.

In other words, SM relies heavily on associating new ideas to students' own prior knowledge and previous experiences. Stahl and Vancil (1986) argue the effectiveness of this technique due to students' active participation in this process. By drawing learners' prior knowledge and using discussion to elicit information about word meanings. As explained by Novak (1991), the creation of graphic organizers can be enhanced when learners are able to see and then organize all information they bring to the task of learning in order to build their knowledge actively by adding new lexical items to their maps. Consequently, this technique allows the productive and creative use of words.

Thus, SM construction would play an important role in order to connect already existing knowledge with new knowledge and promote meaningful learning. A SM is composed of three parts: 1) The core concept or key word, which is the map main focus. 2) The strands or categories are secondary ideas that help to clarify the main concept, which can be created by the learners. 3) Supporting information: extra details that are related to each strand (DENTON *et al.* 2007). Also, the supporting information assists to explain the strands and distinguish one strand from another, as it can be seen in Figure 3.

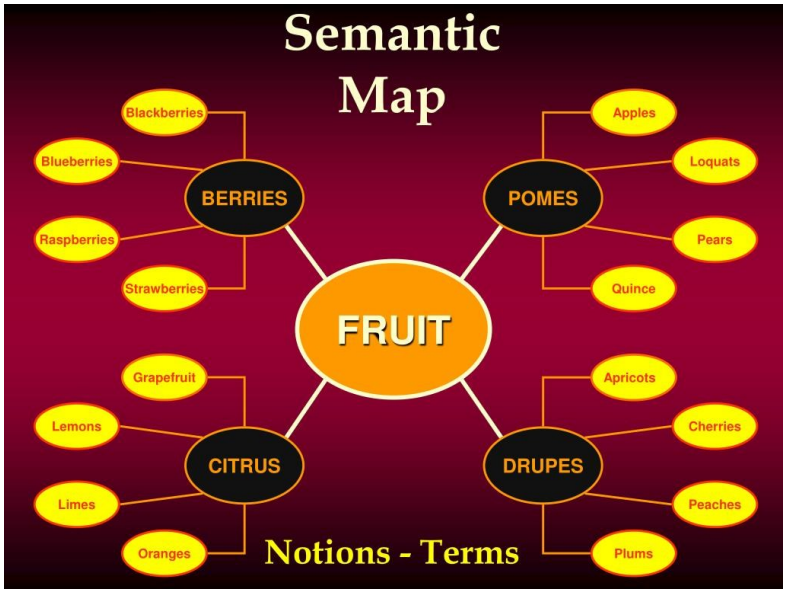
Figure 3 - The structure of a Semantic Mapping



Source: According to the image presented in Denton *et al.* (2007, p. 1).

Regarding its layout, SM can display data linearly or geometrically. When they are presented in the form of a web, the core concept and the categories are well – defined and highlighted as shown in Figure 4. Thus, Lim *et al.* (2003) point out that SM open – ended nature allows and supports further connections, adjustments, elaboration, which is an ideal visual tool to help break down complex topics into smaller, more understandable chunks. Figure 4 is an example of a web SM.

Figure 4 - A web Semantic Mapping

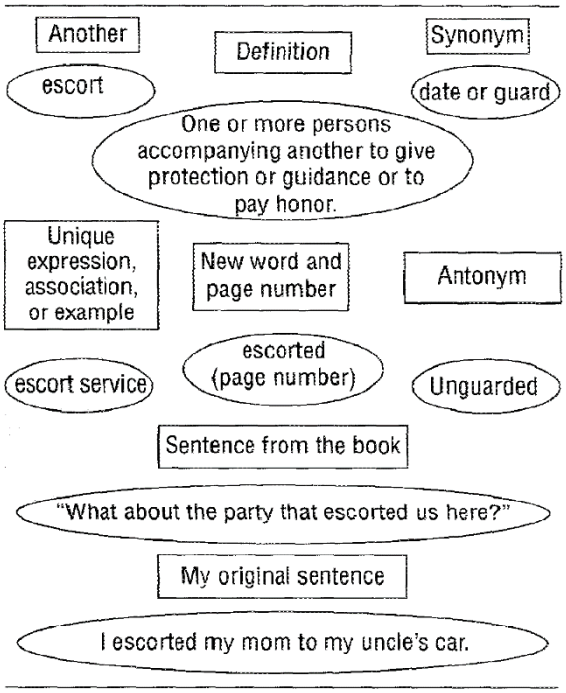


Source: Ralph (2019).

Semantic mappings tend to combine multiple related words to a core concept at a single point in space, that is, in the center of the map based on the target concept/ word superior hierarchical plan, while in texts, lists of words or other formats the concept/ words would be spread and presented in linear format.

When it comes to implementing SM for word – mapping activities, some scholars propose some sequence that can be followed. Harmon (1998 *apud* ROSENBAUM, 2001, p.45) proposed seven techniques essential to vocabulary practice, which can be employed when mapping words: 1) Synonyms; 2) Brief descriptions; 3) Examples and nonexamples; 4) Rephrasing; 5) Repetition; 6) Associations; and 7) Unique expression. Rosenbaum (2001, p.45) illustrates and explain the sequence to be carried out by students: 1) Write the target word and page number in the middle of the map; 2) In another bubble, copy the sentence from the book which the word was inserted, to provide context for the new lexical item. 3) Use an online dictionary to provide the word's definition in another bubble; 4) Also, look up the target word synonym and antonym from the dictionary and place in two other bubbles; 5) Come up with derivatives of the word in the bubble called 'another', with word's morphology and structural analysis to assist learners' integration of prior knowledge with new knowledge and application into different contexts. 6) Write an example, a unique expression, or an association related to the target word in another bubble, aiming at supporting students' to personalizing new vocabulary. 7) Finally, create a novel sentence, by employing the target word appropriately and independently. All the steps by Rosenbaum are illustrated in Figure 5 below**.**

Figure 5 - Word Map completed by a student



Source: Rosenbaum (2001, p. 46).

Taking the word map production example above, and applying it to build a semantic mapping, it is possible to suggest that deeper understanding of the target word would take place. In other words, three sub-skills of vocabulary word knowledge can be contemplated, for instance: generalization[16], application[17] and breadth[18] of the words. Due to the fact, that a typical SM places the vocabulary word at the center and includes additional links or concepts connected to the central word. That is, using SM in vocabulary teaching and learning provides a framework for organizing conceptual information in the process of defining a word.

In short, SM entails drawing learners' attention to the interrelationships among lexical items through graphic organizers, which can be considered a useful learning tool due to its visual (e.g. pictorial), and mnemonic nature which can better assist and enhance vocabulary learning. Teaching and learning vocabulary with Sematic mappings take into account the existence of different theoretical frameworks that have been used to justify its use in education.

One theory that stands out when trying to explain the dual presentation format of visual and verbal languages within the semantic maps, is the multimodality theory. Roughly speaking, it can be defined as the integration of different kinds of language such as visual and verbal within the same text, aiming at building more meaning and understanding to the reader/

[16] The ability to define a word (CRONBACH, 1942).
[17] Selecting an appropriate use of the word (CRONBACH, 1942).
[18] Knowledge of synonyms and multiple meanings (CRONBACH, 1942).

interlocutor. That is, bringing different compositional elements and modalities such as visual and verbal to be integrated and arranged in a text, in order to complement and facilitate communicative situations as well as language learning. Thus, multimodality encompasses not only the study of written language, but also visual language.

According to Rojo (2012, p.19) “multimodality is not only the sum of languages, but the interaction among different languages in the same text.” In line with that, it is possible to say that when images and words interplay together, these different languages interaction can occur and strengthen the meanings conveyed. All in all, when it comes to analyzing the composition of the words, colors, images, the way pictures and words are formatted and displayed in the text, these visual resources and features can assist the reader to build meaning to the text to be dealt with (PELECHATE; CHINCOVIAKI, 2015).

In line with it, in a study conducted by Salbego, Heberle and Balen (2015), the authors have suggested the importance of considering the way other semiotic resources besides the verbal language interrelate to each other in texts nowadays, and how this integration between the two modalities can contribute positively to foreign language learners, mainly in beginner levels that visual elements may play a part to illustrate (some kind of support) and provide some clues to the verbal language proposed in the texts. Equally important, from a pedagogical point of view, it aims at assisting students to learn how to analyze and consequently interpret images when learning a second/ foreign language (SALBEGO; HEBERLE; BALEN, 2015), and more specifically vocabulary in this study.

It goes without saying that the advent of the computer and the Internet, besides the English textbooks exposure, students and teachers are exposed to quite a great variety of images and pictures which are easily found on the Internet, in websites and other online sources; Therefore, a growing number of different new multimodal genres (such as posts, digital mind maps, chats, pages, funclips, tweets, etc) have emerged and become part of their academic and personal daily life. In order to take advantages of these affordances into the educational context for foreign/ language learning, the authors propose “to instruct students to make sense of and explore the visual and verbal resources in these texts” (SALBEGO; HEBERLE; BALEN, 2015, p.6). That is, empower students with tools and techniques on how to read and understand images properly to facilitate their language learning on the activities proposed.

2.3 SEMANTIC MAPPING IN THE LANGUAGE EDUCATIONAL CONTEXT

Besides being used in other fields such as business, engineering, psychology, SM usage and growth has also been implemented for language learning (AL-OTAIBI, 2011). Therefore, as noted by Melendez (1991), SM has been employed in the classrooms for three main objectives: 1) For general vocabulary development; 2) As a pre- and post- reading technique as well as a pre- and post- writing; and 3) As a study skill strategy; because it allows the flexibility and creativity to display the interrelationships among the ideas and concepts.

Concerning its practical application for vocabulary learning, there can be several starting points for SM, for instance, it can involve the recall of a previously read story, a recent current event, a film, a unit of study, or simply learners' general prior vocabulary knowledge of a topic (NATION, 2001). Moreover, SM has been used successfully by teachers at all levels to motivate and actively involve learners in the reading and writing processes (HEIMLICH; JOHNSON; PITTELMAN, 1986) by asking learners to participate and contribute with information to write around the SM. This technique, then, is not only feasible for learning vocabulary, but also for yielding prior knowledge to reading (McNEIL, 1984). In this sense, as reported by Johnson, Pittelman and Heimlich (1986), when dealing with any reading content material, this technique seems to be very relevant for pre- and post- activities.

In addition, Dilek and Yuruck (2013) indicate that this technique aims at helping learners to be prepared and more confident to grasp, learn and assess data to be read. SM can be used to pave the way for content contextualization, brainstorming, eliciting, recapping, organizing words and phrases visually, as well as categorizing the information produced. To the best of this researcher's knowledge, most of the studies related to the use of SM for vocabulary development is connected with pre- and post- reading activities.

All in all, SM may be considered a useful learning resource due to the fact that it assists learners to visualize, classify and notice how concepts and words are semantically associated one another because of their interrelating networks or relations between them. It is relevant to underscore that nowadays, there are many technological tools that can be used for students to create SMs, for instance, Denton *et al.* (2007) state that digital mind mapping tools can be used to represent the SM technique. With an interest growth on technological digital resources for foreign language learning, the next section looks at computer-assisted semantic mapping, focusing it on the area of vocabulary learning.

2.4 COMPUTER-ASSISTED SEMANTIC MAPPING

We need to embrace
technology to make learning more engaging.
Because when students are engaged
and they are interested,
that is where learning takes place.
(unknown author)

According to Kiliçkaya (2020), since the 1980's with the implementation of digital resources in the L2/FL classroom, much has been investigated and written by researchers and educators regarding the potential contribution of technology to learning a FL. Understanding the paramount part vocabulary plays when learning an L2/FL as well as the variety of learning techniques available currently, a prominent technological resource that has paved the way for vocabulary expansion is Mind Mapping tools, also known as e-Mind Mapping software, Computer-Assisted Semantic Mapping, and Semantic Mapping through the use of a software.

Initially, the maps were created manually, that is, hand-drawn (with pen and paper). However, with the advent of computers and internet, it has been possible to create the maps electronically. During the 1990's, companies began developing software with capability to create digital versions of Semantic Mind Mappings. There are many Mind Mapping software packages that are classified as free versus commercial or web-based versus desktop. Thus, they can be created by using software that can be installed on desktop computers, laptops, tablets, or apps to be downloaded and used on smartphones. Based on Tucker, Armstrong and Massad's (2009) study, some of the most popular software packages include: MindManager, MindGenius, FreeMind, Inspiration, MindMeister and MindView. In their study, they also proposed a Table 1 highlighting their key differences such as capabilities, cost, and applications.

Table 1 - Differences in Software Packages

Software	Cost	Operating System	Comments
FreeMind9	Free	Linux/ Mac/ Windows	Most popular free software
Inspiration8	$69	Mac/ Windows	Integrated mind map with outline
MindView3	$389	Mac/ Windows	Integrates with Microsoft Office
MindManager8	$399	Mac/ Windows	Commercial market leader MindJet Connect allows collaboration
MindMeister	$72/yr. Bus $15/yr. Edu	Web-based	Good for collaboration Skype and Twitter integration
MindGeniusV2	$221 Bus $86 Edu	Windows	Integrates with Microsoft Office

Source: Tucker; Armstrong; Massad (2009, p. 5).

Relating it to their findings, it seems that FreeMind is the most popular of the public (business, education and government) domain mind mapping software. From the researcher's view, it might be suggested that it is probably due to the fact this is a free of charge software, which can be more accessible and feasible for different areas of work and study. Additionally, it was adopted by Al-Jarf (2015) and Al-Otaibi (2011) in their academic studies. With regard to its affordances, it provides the basic elements for map construction, by offering users a variety of options for linking other content to maps, thus users can create links to web pages, local folders, executables, and any file. However, online collaboration is not available (TUCKER; ARMSTRONG; MASSAD, 2009).

Narrowing down for educational purposes, according to the research, Inspiration was considered the most popular designed primarily for it. For this reason, in Liu's study (2016) it was adopted to check its effectiveness on language learning. Some of its main features are learners can brainstorm, diagram, plan and organize in either the graphic organizer or traditional outline view. Also, Inspiration supports hypertext linking, e-mail messages and other files, as well as add pictures to the maps from a large image bank. However, it does not have online collaboration capabilities (TUCKER; ARMSTRONG; MASSAD, 2009). Lastly, the software also offers dictionary and thesaurus and the ability to import movies and sounds, which can assist leaners in the process of vocabulary development because it can contemplate word form and meaning.

MindManager can be considered the commercial market leader. It stands out for its possibility of integration abilities with Microsoft Office and online collaboration. Furthermore,

it offers advanced tools[19] in generating and editing mind maps. The following software is MindGenius, which permits exporting to other programs, and it works well with Microsoft Office in the sense that map outlines and pictures of maps can be imported and exported easily. In addition to that, it stands out for providing a good structured with the ability to re-arrange the map into a variety of layouts, and it is available in three versions: one for home, business and education.

The next mind mapping software is MindMeister, which is the most popular web-based one. Like the others, it also has the basic functions for creating and editing a map. One advantage of MindMeister[20] is that its users can employ it to collaborate in synchronous mode with their partners. That is, by sharing the maps in real-time the full collaboration mode can occur simultaneously. Besides, it is possible to integrate both Skype and MindMeister software, so collaborators may chat over the Internet while editing a map.

The last software is Mind View, which offers a lot of export and import functions as well as having a closely integration with Microsoft Office. Similar to MindGenius, it has a variety of structured layout options and views. It comes in two versions, business and education, with a free viewer enabling other people without MindView software to see documents created by it.In this vein, vocabulary learning techniques based on the use of CASM can aid language learning because they offer innumerous opportunities for repeated exposure and practice at any time, in the learner's own pace, with feedback. Additionally, Schmitt (2000, p.146) indicates that computers are "[…] very patient about repetition and recycling."

Regarding the role of CASM usage for vocabulary learning, it is worth noting that its use allows students freedom and creativity to express ideas and display interrelationships between concepts and/or lexical items in a very visual and non-linear structure, which the maps can be posted online, shared, commented, revised, displayed in many different formats, printed, accessed from different devices and edited (either in synchronous[21] or asynchronous[22] mode) by one person or a group of people. Furthermore, it is possible to link to other information such as hyperlinks and notes, to modify and filter map easily, create templates easily, and to integrate into other software.

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[19] Advanced features encompass the capability to hyperlink to the Internet, graphics, spreadsheets, interactive PDFs, document protection and security (TUCKER; ARMSTRONG; MASSAD, 2009).
[20] It has online collaboration capabilities.
[21] Digital communication pertaining to a transmission technique that requires a common clock signal (a timing reference) between the communicating devices in order to coordinate their transmissions.
[22] Digital communication pertaining to a transmission technique that does not require a common clock between the communicating devices; timing signals are derived from special characters in the data stream itself.

On the other hand, SM software presents some drawbacks such as: high cost of no free-source software, computer and internet access, know-how to use the software, map design flexibility restricted by software options, as well as map sharing restricted by format incompatibility (TUCKER; ARMSTRONG; MASSAD, 2009). Even though there may be some disadvantages when implementing them for language learning purposes, the advantages still outweigh the drawbacks by considering the digital era we are all immersed in the 21st century.

Going further, as Stanley (2013, p.39) states, computer-based resources "can aid learners to increase their vocabulary practice because it is more memorable if it is presented in an interesting and creative way." Henceforth learners can engage actively with words and phrases emotionally. Besides, integrating online learning tools effectively in the curriculum and guiding students on how to use them properly helps to promote their lifelong learning skills that can be used either in the classroom or beyond. Literature has shown that digital SM seems to have advantages over traditional in-class instruction[23]. According to an experimental study conducted by Al-Otaibi (2011), the group who used CASM outperformed the other group who used a traditional technique by showing a more significant effect on their achievement.

All in all, the current study then investigates through a SR the contribution of CASM within the realm of FL vocabulary learning from 2010 to 2020.

2.5 SUMMARY OF THE CHAPTER

By way of summary, *vocabulary* is a core component of language proficiency and provides much of the basis for how well learners speak, listen, read, and write. As presented previously, there are some elements that can facilitate the process of retaining new vocabulary, for instance through multiple meaningful encounters with a lexical item, preferably at spaced intervals, efficient retrieval and active use of lexical items, cognitive depth, and use of vocabulary learning techniques such as SM. It is worth noting that teaching and learning of vocabulary can be effective if those principles can be well – planned and incorporated in the learning process.

Although in the classroom learners are exposed to the target language as well as its vocabulary through input provided by the educator and by the textbook, it may not be sufficient for students to learn and retain the meaning of new words. Therefore, the use of SM technique seems to be a creative way to produce vocabulary semantically – related and expand learners'

[23] It refers to teaching new lexical items based only in the techniques presented in the textbook, such as: giving definitions, translations, and word lists.

lexical knowledge. In line with that, it can be suggested that both input and output are essential for language learning process because it is when learners put in practice what they have been exposed and learned. Additionally, Laufer (2015, p.6) suggests that "the more the task pushes learners to use the target words, the better the retention of the words that are practiced in the task is likely to be."

Considering all that, this study seeks to investigate whether and to what extent the use of a vocabulary learning technique in the digital format can enhance and increase students' vocabulary knowledge in English as a FL. After having presented the review of literature, the following section introduces the method applied to carry out this research. It explains the general research design, the protocol procedures used for the selection criteria, search strategies and the selection process to locate and retrieve the studies analyzed in this research.

3 METHOD

Knowledge without action is vanity and action without knowledge is insanity. (IMAM GHAZALI)

The current research intends to investigate through a Systematic Review (SR), vocabulary acquisition in EFL with the assistance of semantic mapping software. The objective of this chapter is to briefly explain SR within Educational Research, and to provide information regarding the protocol procedures for the research, particularly for the selection criteria, selection process as well the search strategies used, in order to locate the studies included in this research.

3. 1 SYSTEMATIC REVIEW IN EDUCATIONAL RESEARCH

Roughly speaking, a SR can be defined as a secondary level of research, in the sense that it does not collect any type of data (e.g. with participants); however, primary researchers' findings from third parties are analyzed. In other words, as observed by Denyer and Tranfield (2009, p. 671) a SR is:

> a specific methodology that locates existing studies, selects and evaluates contributions, analyses and synthesizes data, and reports the evidence in such a way that allows reasonably clear conclusions to be reached about what is and is not known.

Furthermore, this type of secondary research follows a very specific and transparent protocol to be conducted thoroughly from its conception to its final conclusions. Based on Zawacki-Richter's study (2020), it is possible to say that it encompasses 8 fundamental steps: (1) elaborate research question; (2) outline conceptual framework; (3) formulate selection criteria; (4) construct search strategy; (5) screen studies using selection criteria; (6) code studies; (7) evaluate the quality of studies; and (8) synthesize individual studies to elucidate the research question. In an attempt to understand how this protocol functions, the 8 steps are defined and exemplified next.

Elaborating the research questions, step 1, serves as a guide to drive the direction of the investigation, which basically aims at helping to decide which primary studies to include, in order to answer the research questions. They then should be defined at the very beginning due to the fact that it aids to determine the inclusion and exclusion criteria, the creation of the search strategy, the collection of data, and the presentation of the findings. Counsell (1997, p.381) highlights that "a good systematic review is based on a well-formulated, answerable

question." Conversely, if one raises a poor or tricky question to be answered, a poor systematic review it would be.

Outlining the Conceptual Framework[24] or review of the literature, step 2, is considered a valuable research tool for the researcher due to the fact it supports and deepens the author's perceptions and understanding throughout the research of the phenomena being investigated. That is, a framework that can yield theoretical logic and relevance to the study being carried out, due to the fact it elucidates key concepts of the research.

Formulating selection criteria, step 3, refers to the process of constructing both inclusion and exclusion criteria. This process revolves around and is designed according to the research questions and conceptual framework, in order to restrict some aspects of the study. Taking into account that a SR follows very specific protocols, and therefore it is a transparent modality of research, the rules for the studies included in it must be clear. The main goal of being explicit about the selection criteria is to make the researcher's decisions available for assessment, as well as to make easier the updating of SR by other reviewers (DENYER; TRANFIELD, 2009).

Constructing search strategy, step 4, involves 2 phases. The first refers to the details of the sources that are searched, and the second to how they are searched. Nowadays, it is possible to have access to collections/ periodicals on virtual libraries databases via search engines[25]. These are some important academic websites that can be used in the first phase: Scientific Electronic Library Online (Scielo), Library and Information Science Abstracts (LISA), Educational Resources Information Center Proquest (ERIC), "Portal de Periódicos da Coordenação and Aperfeiçoamento de Pessoal de Nível Superior" (CAPES), ACM Digital Library, Web of Science, Scopus, and Google Scholar. Having established the sources, the keywords[26] and/ or controlled terms[27] are searched in all the electronic databases described previously.

Screening studies using selection criteria, step 5, consists of 2 phases. First of all, the screening process takes place by reading the titles and abstracts to check if the studies retrieved are relevant to address the research questions, that is, if they meet the selection criteria. Second of all, the relevant studies are then read from the titles to the references to check their quality, with the assessment of their objectives, methodological quality, results and conclusions. In

[24] "It may be viewed as a working hypothesis that can be developed, refined or confirmed during the course of the research" (ZAWACKI-RICHTER, 2020, p. 7).
[25] It refers to internet searches.
[26] It refers to terms used in natural language, general knowledge, or popular names.
[27] Categories used by the database to classify papers.

order to facilitate information storage and analysis for screening and coding there are some SR software that can be used in this process such as the EPPI- Reviewer (commercial web-based), Rayyan (free web-based platform and mobile app), and Mendeley.

Coding the studies, step 6, means to identify and register systematically specific information presented in each study, which consists of their main characteristics. Zawacki-Richter (2020, p. 12) suggests that the coding describes: (1) details of the studies to enable mapping of what research has been undertaken; (2) how the research method was undertaken to allow assessment of the quality and relevance of the studies in addressing the RQ; and (3) the results of each study so that these could be synthesized to answer the RQ.

Evaluating the quality of studies, step 7, refers to the appraisal of the quality of studies, which can also be referred as Critical Appraisal (PETTICREW; ROBERTS, 2005). It is worth noting that what takes place during this process can vary quite a lot depending on the focus and relevance given to the study design, and method employed for each specific study. However, according to Gough (2007), within the Critical Appraisal, 3 components are essential to be considered: (1) the appropriateness of the design to the research questions context; (2) the quality of the (study method) execution; (3) the study's relevance to the review question. Moreover, for Tomitch (2012) the reviewer's knowledge and/or expertise in that specific field of study can also be considered an important aspect. Overall, the Critical Appraisal can be used to help the researcher to evaluate, report studies and their possible limitations.

When it comes to critically appraising the academic quality of Nonrandomized group studies research design, the "Transparent Reporting of Evaluations with Nonrandomized Designs" (TREND[28]) statement provides quite a great support and basis for the reviewers. It contains a 22- item checklist[29] specifically developed to provide guidelines for standardized reporting of nonrandomized controlled trials. "These guidelines stress the reporting of theories used and descriptions of intervention and comparison conditions, research design, and methods of adjusting for possible biases [...]" (DES JARLAIS, 2004 p.361). Transparent reporting is essential for assessing the validity and efficacy of these intervention studies, and it facilitates synthesis of the findings for evidence-based recommendations.

Synthesizing individual studies to elucidate the research question, step 8, refers to an overview of all studies presented in terms of data extracted. At the most basic level, studies synthesis consists of summarizing the results of each study and bringing them together, that is,

[28] . It was developed by Des Jarlais *et al.* (2004).
[29] Available at: https://www.cdc.gov/trendstatement/pdf/trendstatement_TREND_Checklist.pdf

to make associations between the parts identified in individual studies. A synthesis entails more than a mere description of data, that is, it can be considered information integration in a new arrangement. Consequently, it may yield knowledge which goes beyond what it is brought by the findings of the primary researches, in order to answer the research questions. Zawacki-Richter (2020) states that carrying out any type of synthesis always involves some data transformation which can occur through 3 ordinary analytic steps, which are: searching for patterns in data, checking the quality of the synthesis, and integrating data to answer the research questions. The study is presented next.

3.2 THE STUDY

This section presents the steps taken to carry out this SR. It presents, in 3.2.1, its selection criteria, in 3.2.2, its search strategies, and in 3.2.3, its selection process, which deals with the selection of the studies. The following chapter presents in 4.1, its coding, 4.2, its quality of the studies appraisal, in 4.3, its synthesis results, and in 4.4 its discussion with the two research questions being answered, and in 4.5 the summary of the chapter is presented. That is, chapter 4 concentrates on the *analysis* of the studies' results and conclusions, in order to elucidate the two research questions posed in this current research. Overall, it is undertaken and discussed in the light of theories concerning vocabulary acquisition in EFL along with CASM.

3.2.1 Selection Criteria

In line with the requirement for transparency of process, SRs employ a collection of explicit selection criteria to be carried out, involving inclusion and exclusion criteria. Thus, the studies included and excluded in this research followed some specific criteria. For inclusion, they: 1) reported on the use of SM software, CASM, e-Mind Mapping, or mind mapping software, and concept; 2) focused on foreign or second language learning; 3) collected data with foreign/second language learners; 4) focused on vocabulary learning; 5) were published between 2010 - 2020; 6) were written in English; 7) focused on the effects on the use of SM for vocabulary learning; 8) were empirical research; 9) were quantitative or qualitative method of research; and 10) were articles, proceedings papers, or undergraduated theses. For exclusion, they: 1) were in other disciplines and/or subjects; 2) were created using paper-based Semantic Mapping, or hand-drawn SM; 3) were written in other languages; 4) studies with native

speakers of English; 5) were with disabled learners; and 6) were based on writing or reading skills.

3.2.2 Search Strategies

Aiming at locating the studies on the bibliographic databases, it is important to develop elaborated search strategies. In this vein, it is worth noting that these bibliographic databases are organized according to a specific topic using keywords and/or controlled terms. The SR search string Table 2 below shows the topic and search terms used to carry out this research.

Table 2 - Systematic Review search string

Topic and cluster	Search terms
Vocabulary	"Vocabulary learning" OR "Vocabulary acquisition" OR "Vocabulary development" OR "Lexical development"
Semantic Mapping	"Semantic Mapping" OR "Mind Mapping" OR "Concept Mapping".
Computer	"Computer-Assisted" OR Software* OR "Computer Program" OR Computer software OR "Computer- based"
Education	"Foreign language teaching" OR "Foreign language learning" OR "Foreign language education".
Student	Learner* OR student* OR" Foreign language learner" OR "English as a Foreign language learner" OR Second language learner.

Source: Data generated by this researcher.

In order to locate and retrieve a broader range of relevant studies in the electronic databases, Galvão, Pluye and Ricarte (2019) and Zawacki-Ritcher (2020) suggest the construction and use of 'advanced research strategies' along with the Boolean operators 'AND', 'OR', 'AND NOT', to combine the terms (Table 2).

For this study, seven electronic databases were used and included: Web of Science (Table 8), ERIC (Table 9), LISA (Table 11), Scielo (Table 12), Scopus (Table 13), ACM Digital Library (Table 10), and lastly Google Scholar (Table 14), which are all presented in detail in the appendices of this research. Moreover, it is worth mentioning that all these academic platforms (except Google Scholar) were accessed via Portal de Periódicos da CAPES using UFSC's VPN access, which is the researcher's respective institution of current study.

It is important to highlight that there was the need to adapt the search strings to different databases because some of them proved to be off topic or dead end, depending on the database. Furthermore, these search terms and search options have undergone several tests and modifications before the final application. Overall, both the elaboration of advanced search

strategies and search terms contributed to the number of significant studies located in the electronic databases to carry out this research. Thus, based on the research questions proposed in this study, the electronic databases and number of search terms used to obtain the primary studies are described in detail in Tables 8,9,10,11,12,13 and 14, which can be all found for further information in the appendices.

Trying to locate the studies and to find a reasonable number of high- quality papers is a long and laborious undertaking. After having dealt with 6 academic libraries and retrieving only 5 studies, the last database used was ‘Google Scholar, which is described in detail in Table 14 (available in the references). It was the last exhaustive search as an attempt to locate more relevant studies to be included in this research. After a thorough search as mentioned before, in the very last database two more studies were located and included (ALBISTHAMI DJ, 2017; MASOUD; IBRAHIM, 2017). To conclude, 7 studies met the inclusion criteria and were appraised.

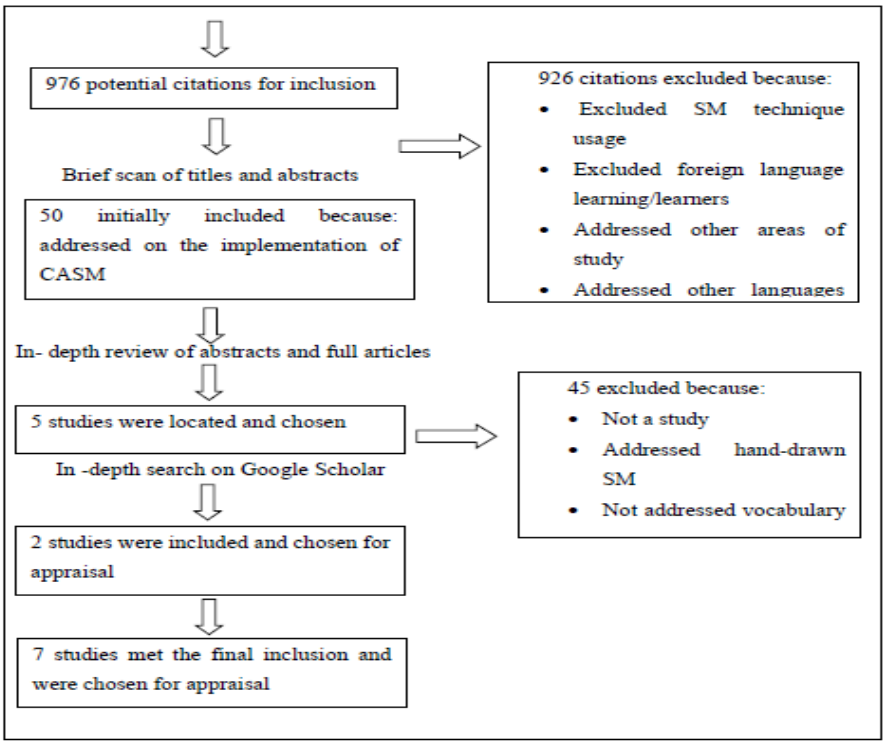
3.2.3 Selection Process

When it comes to the selection process, it is worth considering and highlighting the 2 aforementioned phases involved in it, when screening relevant studies to answer the research questions. Within the second phase, which entails reading the whole studies (articles, or undergraduate theses) from the titles to the references, one way to facilitate the process of storage, organization, and removal of the duplicated studies was to include all of them into a reference management software called Mendeley. In other words, Mendeley software was used to assist in the screening of the located studies.

A total of 976 potential primary research studies were identified. A brief scan of titles and abstracts was completed and 926 were eliminated because they did not meet inclusion criteria. An in- depth reading and screening (from the title to the references) was done with the 50 articles selected, which addressed some form of vocabulary acquisition, or implementation of semantic mapping software, or with foreign language learning. Of these, 45 were excluded because they were not empirical studies, did not address the use of SM software (or computer program), and/or did not address any relation that promoted vocabulary learning in a FL. The remaining 5 studies were selected for appraisal as shown below in Figure 6. Going further, aiming at locating more studies, the last database used was ‘Google Scholar’, and after an

exhaustive search 2 more studies were located and included, totaling 7 studies chosen for appraisal.

Figure 6 - Process for identifying studies to be included in this research



Source: Data generated by this researcher.

Figure 6 displays the process for selecting studies to be included in the research, rationale for exclusion of remaining studies, and decision of final studies chosen for appraisal.

3.3 SUMMARY OF THE CHAPTER

The method of this research was based on a SR protocol which followed systematically eight steps (ZAWACKI-RICHTER, 2020). They were all described and explained in detail previously in this chapter. It is worth noting that all the steps equally contributed directly to carry out this study, mainly in terms of locating and retrieving high quality papers, and consequently to be able to answer the research questions.

In the next section, the discussion and results of the studies selected for this research are presented, in order to properly answer the research questions proposed.

4 RESULTS AND DISCUSSION

This chapter aims at presenting the results and discussion of the studies which met the inclusion criteria and were chosen for appraisal based on a qualitative analysis of this research. In order to organize the results and discussion of the findings, this chapter is divided into five sections devoted to answer the proposed research questions. Concerning the studies' data and results, in Section 4.1 the coding is presented, in Section 4.2 the quality of the studies appraisal, and in Section 4.3 the synthesis results are explained.

To answer the research questions raised and elucidate on the role of SM for vocabulary acquisition, Section 4.4.1 aims at answering RQ1 with the focus on the effectiveness of the SM software on EFL learners' vocabulary learning. Section 4.4.2 intends to answer the RQ2 by discussing the conclusions on the implementation of SM software to improve learners' vocabulary acquisition. Finally, a chapter summary is presented in section 4.5. The following section encompasses the 7 empirical studies which met the inclusion criteria and were selected for this research.

4.1 CODING

This section focuses on the studies' findings of the data analyses, aiming at extracting and displaying the most relevant information about the main results and discussions drawn in the primary studies, which were included to be analyzed in this research. In doing so, the following data extraction items were employed based on Mills' (2016) study, which include: the title, the author's name, the year of publication, the objectives, that is, what was investigated; the method used; the results obtained; and finally, the conclusions presented.

Table 3 - Studies that met the selection criteria of this SR

TITLE AUTHOR YEAR	OBJECTIVES	METHOD	RESULTS	CONCLUSIONS
Improving the vocabulary application at the seventh grade students'of SMPN 18 Makassar through E-Mind map in academic year (ALBISTHAMI DJ, 2016/2017).	1) To know whether the E-Mind Map is effective to improve EFL students' vocabulary or not; 2) To find out how effective the E-Mind Map Application is in order to improve students' vocabulary.	Quasi experimental with nonequivalent control and experimental group; with pre-test and post- test; with descriptive statistic (frequency, mean score, and standard deviation) and inferential statistic (independent sample t-test). The treatment occurred 6 times.	The increase of mean score of experimental class that is 42.7 in the pre-test and 80.7 in the post- test. The t-test also showed that E-Mind Map was effective because the t-test value was 4.115 higher than t-table value was 2.000.	The use of E-Mind Map was effective to improve the students' vocabulary, since there was significant difference between the students' vocabulary mastery before and after using E-Mind Map Application.
A model for enhancing EFL Freshman students' vocabulary with mind-mapping software (AL-JARF, 2015)	Investigated whether mind mapping software could help freshman students to enhance their vocabulary in translation.	Quasi experimental; with pre-test and post-test; With control and experimental group design; It took place during one semester.	It was shown that students who used vocabulary mind maps made higher gains in vocabulary acquisition and more accuracy in vocabulary knowledge.	Mind maps can be used in introducing, categorizing, visualizing and reviewing vocabulary and as mnemonic devices, that is, they aid to improve word and concept knowledge. The author suggested EFL instructors a model to be followed on how to use the MMS to teach vocabulary effectively.

Table 3 - Studies that met the selection criteria of this SR (continued)

TITLE AUTHOR YEAR	OBJECTIVES	METHOD	RESULTS	CONCLUSIONS
The Effect of Semantic Mapping on Students' Vocabulary (AL-OTAIBI, 2011)	Investigated the efficiency of Computer-Assisted Semantic Mapping (CASM) in improving ESP nursing students' vocabulary knowledge when mapping medical terms.	A quasi experimental design known as the nonequivalent-control- group design; with pre-test and post-test. The semantic-mapping treatment lasted 8 weeks.	It indicated that students' vocabulary of both groups have increased significantly. However, students of the experimental group outperformed and achieved significantly greater gains than the control group in the post-tests.	When using SM as a memorization tool, students' retention of word meaning has been improved, which assisted in expanding their vocabulary by connecting new information to old one. Pedagogically, CASM can make students´ assignments more organized, reduce dependence on teachers, which allows learners to become more active in the learning process.
The Role of Mind Mapping software in developing EFL learner's vocabulary at the Pre-Intermediate Level (BAHADORI; GORJIAN, 2016)	Examined the role of mind mapping software when using vocabulary among EFL pre-intermediate students.	Quantitative research method; With pre-test and post-test. Independent samples t-test was used to calculate the data and descriptive statistics. 10 sessions of instructions.	Learners who used the mind mapping software outperformed the control group, however both groups showed progress in vocabulary learning.	Mind mapping software significantly aided to improve learners' vocabulary proficiency when compared with those obtained after the traditional method.

Table 3 - Studies that met the selection criteria of this SR (continued)

TITLE AUTHOR YEAR	OBJECTIVES	METHOD	RESULTS	CONCLUSIONS
Mobile English Vocabulary Learning based on Concept-Mapping strategy (LIU, 2016)	Explored how teachers could apply digital concept mapping (by using mobile phones and technology) strategy to teach EFL lexical items, to facilitate students' vocabulary learning.	A quasi experimental design; with two independent -sample (t-tests); with pre-test, post-test and delayed post- test. Group interviews were conducted to check their feelings and opinions. The treatment lasted 3 weeks.	The concept-mapping group significantly outperformed the text-only group on both post - tests. The concept-mapping learning strategy had a positive effect on memory for vocabulary.	The group of concept-mapping students retained what they learned for longer periods. Compared with the learning approach for the control group, the concept mapping approach provided a more efficient memorization tool for the students to organize and represent vocabulary knowledge.
The Effectiveness of using an e-Mind Mapping software based Program in developing Faculty of Education 2nd year English Majors´ Vocabulary Acquisition and use (MASOUD; IBRAHIM, 2017)	Developing **vocabulary acquisition** and **use** of 2nd year English Majors at Minia Faculty of Education through an e-mind mapping software program.	A quasi experimental pretest- posttest design was employed; Participants were distributed onto 2 groups randomly: experimental and control groups; with t-test and t-value (mean score and standard deviation.	Experimental group achieved a significantly higher degree of improvement on the vocabulary **acquisition** and **use** tests. It was revealed that the e-MM was effective because assisted EFL learners´ ability to increase their lexical repertoire and use.	E-mind mapping usage facilitates vocabulary acquisition and recall for a longer period of time, due to its visual clues such as images, arrows, colors, shapes and non- linear structures. Learners reported that they felt motivated and interested in generating digital mind maps.

Table 3 - Studies that met the selection criteria of this SR (concluded)

TITLE AUTHOR YEAR	OBJECTIVES	METHOD	RESULTS	CONCLUSIONS
The Impact of an-E-mind Mapping Strategy on Improving Basic Stage Students' English Vocabulary (SHDAIFAT,*ET AL.*, 2019)	To compare the effect of E-mind mapping strategy versus the conventional method in an EFL setting.	Quasi experimental research design; with pre-test and post-test; participants were distributed into 2 groups randomly; The treatment lasted 7 weeks.	Statistically significant results in the post- test mean scores of the E-mind mapping group, who outperformed their counterparts. Students in the E-mind mapping group obtained higher achievement in their vocabulary performances and vocabulary sub-skills.	Electronic mind mapping technique improved students' lexical achievements in test scores. That is, it excelled the effect of paper-based mind mapping, because it was easier, faster and more attractive. Moreover, its implementation proved to be an effective method in teaching.

Source: Data generated by the researcher.

Understanding the importance of the 7 main topics extracted and coded from the primary research studies in order to carry out this SR, and prior to the quality of the studies appraisal, some relevant aspects needed to be addressed. They refer to: 1) terminology and mind mapping software chosen, 2) research questions, 3) statement of the problem, 4) profile of the EFL research population (age, schooling and proficiency level, and 5) research design.

Firstly, concerning the terminologies used to refer to SM strategy, authors used the nomenclature mind mapping software (=5), Computer-Assisted Semantic Mapping (=1), and digital concept mapping (=1). Even though these semantic mapping techniques were referred with different names, they all fall under the general category of "graphic organizers" (BALEGHIZADEH; NAEIM, 2011), whose main purpose is to generate related concepts, words, and ideas of a certain topic. More specifically in this research, these mapping tools were used along with the affordances of digital technology. Regardless of the terminology used a mind mapping or semantic mapping software is a visual representation of knowledge used as an instructional technique.

Regarding the adoption and implementation of the 7 mind mapping software, e-mind mapping or CASM to check their efficiency when measuring the experimental group users' gains, the following ones were chosen: iMind Map 9 (ALBISTHAMI DJ, 2017), Free Mind

0.8[30] (AL-JARF, 2015; AL-OTAIBI, 2011), X Mind Mapping 6[31] (BAHADORI; GORJIAN, 2016), Inspiration software (LIU, 2016), Kidspiration e-mind mapping (SHDAIFAT *et al.*, 2019), and lastly e-mind mapping based program on Facebook[32] (MASOUD; IBRAHIM, 2017), which was probably created by the own authors. It is worth noting that only Free Mind 0.8 software was employed and analyzed twice by 2 authors. Perhaps, it can be related to the fact that their studies took place in the same King Saud University, in Saudi Arabia, although in different higher education majors, namely Nursing (AL-OTAIBI, 2011), and Translation (AL-JARF).

When it came to analyzing the research objectives (=6) and hypothesis (=1) / (MASOUD; IBRAHIM, 2017) of the primary studies, in general they were all investigating and aiming at focusing on the same objectives; Which were to find out whether or not, and to what extent the implementation of SM software can be effective to improve EFL student's vocabulary knowledge when compared to conventional vocabulary strategies such as textbook only, vocabulary lists, or translation into L1.

Under my lens, with regard to the statement of the problem which might have worked as a trigger to the primary studies to be carried out, it could be seen that in Liu (2016), Al-Jarf (2015), Masoud and Ibrahim (2017) and Albisthami DJ (2017)' studies they had something in common. That is, EFL students face difficulties in recalling the word meanings and memorizing them. These obstacles involve recognizing (to associate the form and meaning of the words), differentiating and remembering new words. Besides, in Shdaifat *et al.* (2019), Bahadori and Gorjian (2016) as well as in Al-Otaibi (2011)' studies, it was shown that due to students' low level of vocabulary knowledge in their specific areas of study, they could not read and understand texts properly, which hindered their language performance during the classes. Therefore, it was necessary to combine the teaching of English vocabulary with SM software.

Another significant aspect is the profile of the EFL research population, which was made up of college students in most of the studies (n=5), and their age ranged from 17 to 19 years old. In addition, their English Proficiency level ranged from pre-intermediate to intermediate level, which was based on their English Proficiency placement tests, and the other studies (n=2) the population was from 7th grade students (13 years old) from regular schools. By relating these demographic similarities found among them, it seems to suggest they may

[30] Available at: www.freemind.com
[31] Available at: Xmind.net
[32]Available at:https:www.facebook.com/groups/1610125102336549

provide more reliability and consistency on the probable effect size of the intervention under scrutiny, due to their analogous level of proficiency in relation to English language learning.

All studies adopted the quasi experimental research design to compare both groups: control and experimental performance before and after the intervention. Furthermore, it is worth highlighting that Al–Jarf's (2015) study was the only one which did not present and explain how the quasi experimental research design was carried out from the beginning up to the end, as well as the type of statistical model that was taken into account. However, Al-Jarf (2015) rather presented a model on how to help students to learn vocabulary effectively, which lacked some relevant data on how both groups were tested before and after the intervention during one semester, and the quantitative analysis of their scores.

As can be seen in Table 3 above, when it comes to the number of sessions and/or amount of time exposures in relation to the SM software intervention to measure the outcomes their frequency ranged from 6 to 10 sessions of exposure in a semester, except Al-Jarf (2015) which took place over one whole semester. Having addressed these 5 main aspects, the focus now is on the critical appraisal of the studies reviewed.

4.2 CRITICAL APPRAISAL OF THE STUDIES REVIEWED

As mentioned previously, the 7 studies included employed quantitative non - randomized control trials research designs, using a pretest - posttest experimental design. However, Liu (2016) went deeper and further by adding a delayed post-test in her study aiming at measuring the participants' level of vocabulary retention after the posttest.

For this research, to appraise the academic quality of the empirical studies[33] reviewed specific general checklist was followed to help in evaluating them. Therefore, to critically appraise the literature, it was employed the TREND[34] statement checklist as can be seen in Table 4 for the quantitative studies, aiming at improving their accuracy and transparency. This 22-item checklist focuses on description of the intervention, theoretical base, comparison condition, outcomes, as well as data related to the study design to assess possible biases in the reported outcomes (DES JARLAIS *et al.*, 2004).

It is worth emphasizing that TREND criterion is not intended to be a grading standard with points; its aim is to assist and guide authors to ensure they included all pertinent information (MILLS, 2016) in their articles and/or theses. Elaborating more upon that, the

[33] Primary research based on experiment, observation or simulation.
[34] It stands for "Transparent Reporting of Evaluations with Nonrandomized Designs".

TREND statement checklist contains 5 paper sections, which are: Title and Abstract, Introduction, Methods, Results, and Discussion. Within them, there are 22 items namely, title and abstract, background, participants, interventions, objectives, outcomes, sample size, assignment method, blinding, unit of analysis, statistical methods, participant flow, recruitment, baseline data, baseline equivalence, numbers analyzed, outcomes and estimation, ancillary analyses, adverse events, interpretation, generalizability, and overall evidence. For this current research, all the 5 paper sections were covered, and 17 out of 22 items were contemplated and applied when critically appraising the selected studies, due to the fact that this SR is concentrated on a behavioral intervention (educational contexts), and not on public health ones, in other words, some items may not be relevant or feasible for this specific kind of pedagogical intervention reporting.

Taking that into consideration, depending on the item in each paper section, more than one descriptor (criterion) was employed. The topics employed were: the ***title and abstract*** (1), in the ***introduction*** the background (1), in ***methods*** the participants(1), interventions (3), objectives (1), outcomes(1), sample size(1), assignment method (2), unit of analysis(1) and statistical methods (2); Within ***results*****,** the participant flow[35] (3), recruitment(1), baseline equivalence(1), numbers analyzed(1), outcomes and estimation(1), as well as adverse events(1); Lastly, in ***discussion****,* the interpretation (2) was included. The numbers revolve around the quantity of TREND descriptors used in each topic aiming at improving the reporting standards of each study being appraised. As can be observed in the Table 4 below, the criterion marked with an "X" refer to each study's limitations, which mentions that the author (s) did not present some piece of information considered essential within their academic studies.

[35] It entails the flow of participants through each stage of the study: enrollment, assignment, allocation, and intervention exposure, follow-up, and analysis.

Table 4 - Limitations found while using TREND

Studies	Al Albisthami DJ 2017	Al - Jarf 2015	Al-Otaibi 2011	Bahadori; Gorjian 2016	Liu 2016	Masoud; Ibrahim 2017	Shdaifat *et al.* 2019
TREND Criterion							
Information on target population or study sample							
Scientific background and explanation of rationale							
Method of recruitment (e.g.referral or self-selection),including the sampling method if a systematic sampling plan was implemented							
Setting: where the intervention was delivered							
Deliverer: who delivered the intervention							
Exposure quantity and duration: how many sessions were delivered? How long they intended to last.	X					X	
Specific objectives and/or hypotheses		X					
Activities to increase compliance or adherence (e.g. incentives)	X	X	X	X	X	X	X
How sample size was determined and, when applicable, explanation of any interim analyses and stopping rules		X					
Method used to assign units to study conditions […]		X					
Unit of assignment (the unit being assigned to study condition (e.g., individual, group, community)		X					
Description of the smallest unit that is being analyzed to assess intervention effects	X	X			X		

Table 4 - Limitations found while using TREND (continued)

Studies	Al Bisthami 2017	Al - Jarf 2015	Al-Otaibi 2011	Bahadori; Gorjian 2016	Liu 2016	Masoud; Ibrahim 2017	Shdaifat *et al.* 2019
TREND Criterion							
Statistical methods used to compare study groups for primary methods outcome (s), including complex methods of correlated data		X			X		
Statistical software or programs used	X	X	X		X	X	
Assignment: the numbers of participants assigned to a study condition		X					
Allocation and intervention exposure: the number of participants assigned to each study condition and the number of participants who received each one		X					
Analysis: the number of participants included or excluded from the main study		X					
Dates defining the periods of recruitment and follow-up		X		X	X		
Data on study group equivalence at baseline and statistical methods used to control for baseline differences	X	X					
Number of participants included in each analysis for each study condition, particularly when the denominators change for different outcomes.		X					
For each primary and secondary outcome, a summary of results for each estimation study condition, and the estimated effect size [...]		X					

Table 4 - Limitations found while using TREND (concluded)

Studies	Albisthami DJ, 2017	Al-Jarf 2015	Al-Otaibi 2011	Bahadori; Gorjian 2016	Liu 2016	Masoud; Ibrahim 2017	Shdaifat *et al.* 2019
TREND Criterion							
Summary of all important adverse events or unintended effects in each study condition [...]	X	X	X	X	X	X	X
Discussion of the success of and barriers to implementing the intervention							
Discussion of research, programmatic, or policy implications	X	X			X	X	

Source: Data generated by the researcher.

By relating the studies´ limitations found while using TREND checklist as seen in the Table 4 above, some salient findings can be pinpointed, for instance: Shdaifat's *et al.* (2019) study was identified to present the least number of limitations when compared to the others, 2 out of 25 items, followed by Bahadori and Gorjian (2016) and Al-Otaibi (2011) with 3 out of 25 limitation items, Masoud and Ibrahim (2017) with 5 out of 25 limitation items, Liu (2016) with 7 out of 25 limitation items, next Albisthami DJ (2017) with 7 out of 25 limitation items. Lastly, Al-Jarf (2015) was reported presenting the highest number of limitations found in the author's article, 18 out of 25 items. Based on Al-Jarf's low reporting quality, it may be suggested that in the author's article she concentrated much more on how to present and inform EFL instructors a *model* on how mind mapping software could be used to help students learn vocabulary effectively in practice, than on focusing on how the author herself carried out the method and results precisely. Consequently, in Al-Jarf's article a six-stage in-class instruction with the mind mapping software was explained in detail, which encompassed: orientation, presentation and modeling, guided practice, independent practice, extension activities, and assessment. It is worth noting that Al-Jarf's (2015) model was cited in Al-Otaibi (2011), Albisthami DJ (2017), Masoud and Ibrahim (2017) and Shdaifat's *et al.* (2019) as a reference on the implementation of SM software to teach vocabulary to EFL learners.

As can be analyzed in the Table 4, when it comes to the paper sections of the studies appraisal, no limitations were located in the ***Title and Abstract***[36], as well as in the ***introduction***[37], although they contained only one descriptor in each one. Within ***methods,*** the number of limitations found was 9 out of 12 descriptors, except in the items referring to the

[36]Which refers to "information on target population or study sample."
[37] It means the "Scientific background and explanation of rationale."

method of recruitment, setting, and deliverer (who delivered the intervention). This meaningful number of limitations can cause some concern in how the primary studies were carried out in order to measure the likely effect size and results due to the SM intervention.

Going further into methods, there were 2 criteria which caught my attention since none of the authors could contemplate them into their studies. Firstly, "activities to increase compliance or adherence (e.g., incentives)" means that in the studies, it was not mentioned if the participants were provided any financial support (e.g., bus tokens, food, etc) to take part in the research. Secondly, another relevant limitation to bring to discussion regarding statistical methods is the "statistical software or programs used", where the majority of the studies, 5 out of 7, did not include this piece of information regarding the program used to analyze the quantitative data. Conversely, in Shdaifat's *et al.* (2019) study the model Statistical Package for Social Sciences [38](SPSS) was adopted while Bahadori and Gorjian (2016) used the version 17 of the SPSS.

When analyzing the ***results***, it could be reported that the highest number of limitations was located, due to the fact all descriptors employed (8 out of 8 descriptors) lacked relevant information within their academic studies. The 2 most evident descriptors were: the dates defining the periods of recruitment and follow-up, where 3 out of 7 studies presented limitations, and the summary of the adverse events where 7 out of 7 studies did not include this data. The former entails insufficient information on the specific month, semester or year that the studies were carried out by Al-Jarf (2015), Bahadori; Gorjian (2016) and Liu (2016). It can be understood as the initial period when the researcher established a connection with the voluntary participants by providing them all pertinent information about the phases and processes of the research up to the follow-up stage.

Regarding the latter, the adverse events in the results, all the studies lacked reporting the following criteria: "summary of all important adverse events or unintended effects in each study condition, including summary measures, effect size estimates, and confidence intervals" (DES JARLAIS, *et al.*, 2004, p. 365). For instance, it could refer to situations such as lack of classes (e.g. because of a natural disaster, a war, a pandemic) which would affect the participating students from the recruitment/ sampling area, or even lack of computers, Internet, or digital literacy.

Finally in the ***discussion*** paper section, concentrating on the interpretation item itself, 2 out of 7 studies (ALBISTHAMI DJ, 2017; AL-JARF, 2015) did not say anything about the

[38] It is a widely used program for statistical analysis in social Science, which is a comprehensive system for analyzing data.

"discussion of the research, programmatic, or policy implications". All the authors included the descriptor "discussion of the success of and barriers to implementing the intervention" which contributed to improve the reporting standards of nonrandomized evaluations of behavioral interventions.

All in all, the quality evaluation of the studies has an impact on conclusion which aims at providing more reliability for the current research. It also sheds some light on the kind of the academic data that should be available for the readers in the studies to deepen their knowledge about them.

The outcomes of the studies included in this research regarding the likely effect size the of mind mapping/ semantic mapping software application on EFL students' vocabulary acquisition (that is, the independent variable over the dependent variable) is presented and discussed next. In other words, the focus now is on the outcomes.

4.3 SYNTHESIS RESULTS

After having coded and critically appraised the studies which met the inclusion criterion, the synthesis commences. Generally speaking, the synthesis entails putting together findings from different studies, and to produce a summary of the likely effect size of the intervention. That is, it comprises the studies aiming at finding out whether, or not, the intervention with SM had a positive or negative impact on EFL learners' vocabulary acquisition. In a qualitative synthesis, it is possible to explore analogous and different meanings of respondents across the studies (DENYER; TRANFIELD, 2009), in order to investigate what their commonalities are.

Taking into consideration the aforementioned, and the results of the primary studies, it can be indicated that the success of the SM software treatment was very consistent across the 7 studies analyzed in this review. That is, the experimental groups achieved more significant and positive results on their vocabulary performance and learning after being exposed to the SM intervention, than their counterparts with traditional (conventional) vocabulary techniques[39]. The posttests' scores revealed higher gains in favor of the treatment groups, which seems to suggest that the application of SM software was effective for the EFL learners' vocabulary improvement.

[39] For instance: translation into L1, vocabulary lists, or textbook only.

Albisthami DJ (2017), Al-Otaibi (2011), Bahadori and Gorjian (2016) reported that the control groups also increased their vocabulary according to their posttest scores when compared to pretests. In Albisthami DJ's (2017) study the controlled group mean score was 48.9 in the pre-test and 62.1 in the post-test, which accounted for a gain of 13.2 while the experimental group mean score was 42.7 in the pre-test and 80.7 in the post-test, which had a gain of 38. In the same vein, in Bahadori and Gorjian' (2016) study, the mean score of the control group went from 17.000 in the pre-test, to 18.3667 in the pos-test whereas the experimental group increased from 16.5667 in the pre-test to 23.3000 in the post-test.

Even though the control groups increased the score in the post-tests, it was much smaller than the experimental groups gain score which increased significantly. Both, Albisthami DJ (2017) and Al-Otaibi (2011) stated that the reason why the experimental groups significantly outperformed their counterparts was due to the implementation of the SM software as an instructional pedagogical tool. None of them reported anything about the reasons, effects, or theories underlying why the control groups had shown some increase.

Conversely, in Al-Otaibi's (2011) study, the control group mean score went from 16.34 in the pre-test to 25.15 in the post-test while the experimental group went from 16.31 in the pre-test to 28.21 in the post-test. As can be seen, students' vocabulary of both groups have increased significantly, but still the experimental group outperformed those in the control group in the vocabulary post-test. Corroborating with the 2 other authors' studies aforementioned, these significant increases in the vocabulary of the experimental group was due to the use of the CASM, and no explanations or reasons were given regarding the increase of the control groups.

After analyzing the results of the empirical studies, it may be suggested that the use of SM software assisted and improved the learner's ability to remember and retain the related concepts and words for a longer time than compared to traditional techniques. In addition, students could provide the words with related meanings into a digital map and generate or present words logically and in an organized and non-linear way relating to their prior vocabulary repertoire. Since the mind mapping software activities used in the studies included lines, shapes, arrows, pictures, videos, links and spatial organization, the participants had the opportunity to see and learn the lexical items in both visual and verbal modes of presentation, which might have helped them to memorize the target vocabulary. In line with these findings, SM as a memorization tool assists learners' retention of word related meaning under the same concept (or category of words) which expands their vocabulary knowledge by relating new and old information (AL-OTAIBI, 2011).

Based on the outcomes reached by the studies analyzed in this review, it was possible to claim that SM technique used along with the digital affordances has proved to be effective for teaching and learning vocabulary in the EFL context with different learners from 6 different countries. The results indicate that learners can better understand concepts and related lexical items when they have visual and verbal representations of them, that is, when the form (written/ spoken), meaning and images of the words are provided in the non- linear structure of the maps. In addition, as Al-Otaibi (2011) and Liu (2016)' studies suggested, SM worked as an effective memorization tool since it enabled learners to organize, classify and represent vocabulary knowledge in a deeper way by using the meaning, written form and use of the target words.

Based on the results, SM can assist to promote students' retention of word meaning, which ends up increasing in size their lexical repertoire since new vocabulary is connected to already known vocabulary. Accordingly, when one has some encounters, that is, is exposed to the same words and makes use of their different forms, these interplays may contribute to make a strong memory connection with target words (HATCH; BROWN, 1995), in other words, it will lead to memorization. As Al -Jarf (2015), suggested SM software activities can be used in visualizing, introducing, categorizing, and recapping vocabulary, which also functions as mnemonic devices in order to improve concept and word knowledge and they function as an efficient memorization tool for the learners to organize and represent lexical knowledge (LIU, 2016).

After the coding, the critical appraisal of the studies reviewed, and the synthesis of the results, the next section is devoted to answer the two research questions posed in this research.

4.4 DISCUSSION

One goal of vocabulary instruction is to enlarge EFL learners' lexical repertoire. Nowadays, there have been several pedagogical vocabulary techniques to serve this purpose. As the technologies evolve, SM vocabulary technique has been incorporated into the digital format and started being employed pedagogically due to the growing number of mind mapping tools available on the Internet nowadays.

This section aims at answering the two research questions posed in this systematic review, namely: **RQ1**. Does teaching vocabulary to EFL learners via Semantic Mapping Software significantly improve their vocabulary, based on the primary studies from 2010 to 2020? **RQ2**. What conclusions have been found by the primary researchers in relation to the

use of Semantic Mapping Software for the acquisition of vocabulary in English as a Foreign Language? Both are presented and answered next.

4.4.1 RQ1. Does teaching vocabulary to EFL learners via Semantic Mapping Software significantly improve their vocabulary, based on the primary studies from 2010 to 2020?

The first research question of this current study explored whether the use of SM software can improve learners' vocabulary acquisition or not. In order to answer it, I will present data based on the primary studies that concern: the nature of tests employed, the comparison treatment to examine the effect of SM software to non-mapping conditions (the pre-tests and post- tests results of the control and experimental groups), and the SM software map type used, either constructed or studied.

With regard to the nature of the vocabulary tests employed to measure the participants of the studies, Albisthami DJ's (2017) study included 20 items of multiple choice, where 10 items used pictures and 10 items used text. Al -Jarf (2015) did not present this data. Al-Otaibi (2011) used 30 items to explore students' ability in identifying meanings of words by matching them to their definitions. Bahadori and Gorjian (2016) had 40 open-ended questions containing 4 types of vocabulary items (10 for each one) namely, 1) identifying the definition, 2) matching, 3) understanding vocabulary, and 4) making definitions. Liu (2016) chose 32 target words to test students in the form of a word definition fill-in format. Masoud and Ibrahim (2017) adopted 2 kinds of tests: one specific for vocabulary acquisition skills and one for vocabulary use skills, each one containing 50 items, and the total 100 questions. Shdaifat, *et al.* (2019) employed 40 items, 10 designed for each specific sub-skill such as: generalization[40], application[41], breadth[42], and precision[43]. All the tests designed in the studies, except Al-Jarf (2015), seem to have worked upon the form and meaning of the target words, and the study by Masoud and Ibrahim (2017), Jbeili (2013), and Shdaifat *et al.* (2019) have employed more elaborated word knowledge pre-tests and post-tests.

To properly answer this first research question, one needs to compare students' performance in both groups – control and experimental – before and after the treatment. The

[40] The ability to define a word (CRONBACH,1942).
[41] Selecting an appropriate use of the word (CRONBACH,1942).
[42] Knowledge of synonyms and multiple meanings (CRONBACH,1942).
[43] The ability to apply a term correctly to all situations. In other words, degree of correctness, or precision (CRONBACH,1942).

pre-test was used to compare students' performance in both groups before and after the treatment. The main aim of the pre-test is to ensure that both groups were equivalent before carrying out the experiment. To guarantee the equality of both groups, all the researchers (except AL-JARF, 2015) used the independent samples t-test. In Liu´s (2016) study, it was mentioned that the results of the paired t-test confirmed no significant difference in the pre-test of both groups, although the author did not present the table with both groups' mean score results. By analyzing the 5 following studies below in Table 5 (AL-OTAIBI, 2011; BAHADORI; GORJIAN, 2016; MASOUD; IBRAHIM, 2017; MASOUD; IBRAHIM, 2017; SHDAIFAT *et al.*, 2019), it can be concluded that there was no significant difference in the pre-test mean scores between the 2 groups namely, control and experimental before the commencement of the treatment, except for Albisthami DJ's (2017) study that showed a significant higher difference of 6,2 in the control group pre-test mean scores, when compared to the experimental group pre-test mean scores. As it can be seen in the Table 5 below.

Table 5 - Vocabulary Pre-Test results using the Independent Samples t- test

Author Year	**Control group Mean score**	**Experimental group Mean score**
Albisthami DJ (2017)	48.9	42.7
Al-Jarf (2015)	-	-
Al-Otaibi (2011)	16.34	16.31
Bahadori and Gorjian (2016)	17.0000	16.5667
Liu (2016)	-	-
Masoud and Ibrahim (2017)	26.50 acquisition test 24.97 use test	27.10 acquisition test 24.03 use test
Shdaifat, *et al.* (2019)	13.44	14.20

Source: Data generated by this researcher

Afterwards, to find out whether SM software implementation increased the vocabulary knowledge of students within the experimental groups, the independent samples t-tests were used to analyze their vocabulary post-test results. Based on my qualitative analysis of the 7 selected studies' for this research, the findings revealed that the learners' vocabulary learning was affected and hence improved through SM strategy significantly. These findings are based on the quantitative mean score comparisons as well as measures between their pre-tests and post-tests statistical results obtained within the experimental groups along the interventions, thus, the t-test values showed that the vocabulary improvement was effective because there were significant gains, as Table 6 shows.

Table 6 - Vocabulary Post-Test results using the Independent Samples t- test

Author Year	Control group Mean score	Experimental group Mean score
Albisthami DJ (2017)	62.1	80.7
Al-Jarf (2015)	-	-
Al-Otaibi (2011)	25.15	28.21
Bahadori and Gorjian (2016)	18.3667	23.3000
Liu (2016)	25.95	31.69
Masoud and Ibrahim (2017)	26.77 acquisition test 25.03 use test	43.47 acquisition test 42.73 use test
Shdaifat, *et al.* (2019)	20.04	30.24

Source: Data generated by this researcher.

From the results above, it is possible to see that vocabulary increased significantly, and participants of the experimental group outperformed well their counterparts in the control groups. Besides, the results showed that the participants who were exposed to the SM software intervention, obtained higher degree of improvement on their vocabulary performance such as accuracy (AL-JARF, 2015; SHDAIFAT *et al.*, 2019), and acquisition, that is, the application of SM helped to enrich the EFL learners' words memorization and retention, when compared to their counterparts in the control groups. As depicted in Table 6, in Masoud and Ibrahim's (2017) study, the efficacy of the e-Mind Mapping[44] application was measured on both vocabulary acquisition test and vocabulary use test in the treatment group, and analysis of the data revealed that they surpassed the control group in the performance of both post-tests. In Shdaifat's *et al.* (2019) study the students in the e-Mind Mapping group outperformed the control group in their overall vocabulary performance as well as in the 4 sub-skills of vocabulary namely, application, generalization, breadth, and precision. The findings seem to indicate that SM software helps to engage learners in more cognitive activity, deeper processing, and higher retention in vocabulary learning, due to the fact, that deeper processing takes place through the application of the form, image, meaning and productive use of words, which yields to more word retention. In line with this finding, Nation (2009) suggests that having vocabulary knowledge of a word entails knowing its form, meaning and use, that is to say, being able to use the word appropriately and independently.

In Liu's (2016) study, the experimental group outperformed the control group on both post-test and delayed post-test, as shown in Table 7 below. Liu's study differs from the other 6

[44] Masoud and Ibrahim (2017), Shdaifat *et al.* (2019) and Albisthami (2017) adopted the term e-Mind Mapping in their studies to refer to a category of graphic organizers to map words, concepts, and ideas used along with a computer software. Bahadori and Gorjian (2016) and Al-Jarf (2015) preferred to adopt the term mind mapping software. Al-Otaibi, (2011) adopted the term CASM and SM software simultaneously. Liu employed the term concept mapping.

ones which did not include a delayed post- test in their studies. The author's goal was to use the *post-test* to measure the participants' *lexical acquisition*, and the *delayed post-test* to test their *retention*.

Table 7 - Results of Independent t-tests of control and experimental groups on the post-test and delayed post-tests

Liu (2016)	**Control group Text-only group Mean score**	**Experimental group Concept-mapping Mean score**
Post - test	25.95	31.69
Delayed Post-test	20.68	29.90

Source: Data generated by this researcher.

Accordingly, it may bring one aspect to be taken into account in this research, i.e., SM is also effective for long-term retention of information. As can be seen, the implementation of the SM software has assisted learners to significantly improve and enlarge their EFL vocabulary knowledge, it might be suggested that it was due to the use of SM software. Consequently, I would state that it can be considered an effective and creative memorization technique to enhance students' vocabulary knowledge in EFL.

Another aspect concerns the kind of the map used in the studies analyzed, that is to say, whether students constructed or studied the semantic mappings, or both. It was observed that in 6 out of 7 studies the students constructed their SM via the computer software. Albisthami DJ's (2017) did not make clear how he used this instructional technique tool with his students, although it is likely it was employed to present and study vocabulary (as input). Liu's (2016) students used the SM software to study the vocabulary proposed and to construct their maps. This data can reveal that, by constructing the maps, the effect is likely to be more effective and meaningful than only studying the semantic mappings.

In a study conducted by Nesbit and Adesope (2013), the results indicated that the group who constructed the concept maps averaged significantly higher effect sizes than those in which students only studied concept maps. By looking at the process which entails creating and constructing SM through a piece of software, one can say it is an active learning process kind of activity due to the fact learners must engage in elaborative cognitive process, by reflecting and deciding how words can be semantically related to each other, then arranged, organized and categorized to best visually and spatially represent them in the maps. In other words, productive vocabulary activities through writing or speaking skills require more mental effort by the language learner, which can facilitate vocabulary acquisition and retention. Conversely,

when being exposed and studying vocabulary through CASM through reading and/or listening skills, receptive vocabulary knowledge may occur when recognizing and understanding the lexical items to be dealt with.

This SR supports the conclusion that activities that either involve being exposed to vocabulary or produce vocabulary through the use of semantic mappings are effective teaching and learning in relation to a variety of other teaching and learning vocabulary strategies (e.g. textbook only, translation into L1, or vocabulary lists). The second research question is presented and explained next.

4.4.2 RQ2. What *conclusions* have been found by the primary researchers in relation to the use of Semantic Mapping Software for the acquisition of vocabulary in English as a Foreign Language?

The second research question seeks to elucidate some *conclusions* that may have contributed to the effectiveness of the SM software on vocabulary learning over their users when learning English as foreign language. Aiming at answering this question, some relevant factors are drawn namely, the multimodality contribution, the structure of SM software as a teaching tool, the role of semantic field theory, the role of semantic mapping software as an instructional teaching resource used for input and output, and the role of CASM activities to assist in vocabulary learning.

First and foremost, based on the 7 empirical studies analyzed in this SR, all the results reported statistically significant results with the use of SM software, shown in the post-test mean scores of all experimental groups, where they obtained higher achievement over their vocabulary performance and learning, and by Al-Jarf (2015) and Shdaifat *et al.* (2019) also identified higher accuracy gains in vocabulary. All the quantitative outcomes obtained and analyzed from a qualitative perspective are clear empirical evidence that SM software works effectively in promoting EFL learners' vocabulary acquisition.

Second, it is possible to suggest that by using CASM, the multimodality plays a significant part in the process of visual analysis of images, more specifically the semantic maps in this study, due to the fact it provides the two modes, or modalities, of presentation at the same time namely visual and verbal languages. Understanding that technology plays an important role nowadays due to the availability of digital pedagogical tools and materials for language learning, Macken-Horarik (2004, p.24) states that

> Whatever the subject, students have to interpret, and produce texts which integrate visual and verbal modalities, not to mention even more complex interweaving of sound, image and verbiage in filmic media and other performative modalities.

In this regard, it is important to consider the relevance of profiting from multimodality in educational contexts aiming at meeting the demands of the contemporary world, since both visual and verbal modalities convey meaningful meaning compositional elements. More concentrated on the learning of visual literacy the authors Kress and Van Leeuwen (2006) propose the implementation of a grammar of visual design (GVD); generally speaking, its purpose is to "describe the way in which depicted people, places, and things combine in visual statements of greater or lesser complexity and extension" (KRESS; VAN LEEWEN, 1996, p.1). Put it simply, through the use of images a variety of meanings can be express by the use of different compositional elements such as colors, lines, shapes, images, angle, tone and framing which influences in the meanings conveyed and interpreted by the viewers.

In the same vein, based on the GVD framework developed by Kress and Van Leeuwen (2006) on the visual language to analyze the meaning of images in multimodal texts, the GVD can be representational[45], interactive[46] and compositional[47]. Narrowing down to this study, the representational function to describe experiences, images can be narrative[48] or conceptual. Focusing on this study, the conceptual representation aims at describing and/ or classifying people or things focusing on the features and identities of the participants or things. Some specific characteristics portrayed make it easier to identify conceptual representations namely, grouping things / people per categories, displaying them in relation to a part or to a whole, as well as lack or little details in the background to direct the reader's attention to the things/participants and their specific and shared features (NASCIMENTO; BEZERRA; HEBERLE, 2011).

Furthermore, these conceptual representations can take place through classification processes, due to the fact they portray combined things or individuals emphasizing their similar characteristics which define them as belonging to a specific group or category. This classification process can be implicit or explicit (NASCIMENTO; BEZERRA; HEBERLE, 2011). In the former, there is not any verbal information along with the image guiding towards it, thus the viewer needs to infer its meaning by himself, whereas, in the latter, there is both

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[45] Assign roles to the participants represented such as people, objects, things, or institutions (NASCIMENTO; BEZERRA; HEBERLE, 2011).
[46] Establish different relations among the participants in the text as well as among them and the reader.
[47] Organize all these meanings to form a coherent and cohesive text.
[48] Describe a certain experience as an event/ happening in a certain time and space.

verbal and visual elements to guide towards the image, which facilitates the analysis and interpretation of it.

In this regard, it seems to suggest that the multimodality features present in the maps can assist and contribute to language learning through the analysis of the images, in this case the maps themselves, that is, in the sense that the meanings carried by visual and verbal resources when integrated can aid and contribute to learners' comprehension of the language and content to be learned. This use of visual texts is more evident and useful when it comes to beginner levels of instruction (SALBEGO; HEBERLE; BALEN, 2015), as well as in the seven studies analyzed in this SR, which dealt with pre-intermediate and intermediate levels of learners. One possible explanation could be that the kind of language, for instance, content vocabulary portrayed in these levels tends to be more concrete than abstract. Also, it is in this level of instruction that more visual resources aids, such as images, might help to reinforce their understanding of the content. All in all, studies have shown that the analysis of the images through the "maps" along with their general visual and verbal meanings expressed can facilitate the understanding of the activities proposed, which can lead to language learning and retention. Also, the application of multimodality can be seen as potential pedagogical resource to motivate and empower learners to read and interpret images to meet the demands of the modern world. Overall, it is possible to conclude that this integration and combination of visual and verbal compositional elements based on the multimodality, when portrayed within the semantic mappings, can assist learners' understanding and analysis of the maps to be dealt with.

Additionally, this combination of visual and verbal presentation of words assists learners to develop related concept and word knowledge because of the dual mental representation of knowledge which facilitates memorization. Therefore, the use and combination of both visual and conceptual elements play an essential contribution to complement and make connection between the meaning and form[49] of the words stronger in the long-term memory. Accordingly, when the two modes of presentation (visual and verbal) are made available through the maps, the chances of remembering them are much higher (BAHADORI; GORJIAN, 2016; LIU, 2016). In Masoud and Ibrahim (2017), Shdaifat *et al.* (2019), Liu (2016), and Al-Otaibi's (2011) studies it was combined the implementation of images to illustrate the meaning of the words in the digital maps. It seems to suggest that the visual clues arranged and organized to depict the categories of semantically - related words in the digital maps may enhance the recall and retention process of vocabulary learning. In

[49] Written or spoken form of the words.

portraying information through mind mappings, the data turns into visual symbols, which assist in retrieving it afterwards (NOVAK, 1998). Additionally, it is suggested by Li, Lui and Cheng (2010) that the *visual clues* available through the maps play a significant part in the knowledge retrieval and retention processes.

Third, the structure of SM software as a teaching and learning tool, theoretically, semantic maps have a non-linear organizational structure that radiates from the center the core concept or keyword, and makes use of lines, images, arrows, words, colors, symbols, and even hyperlinks to organize the words into categories to be built upon. The lines and arrows are used to represent how vocabulary words are connected to one another, a particular category, or the main concept. And this helps because focus of SM software activities is on semantic interrelationships of concepts and words (BAHADORI; GORJIAN, 2016), which occurs in a radiating, open-ended and non-linear way of arrangement which contributes to expand and enlarge vocabulary development.

Therefore, it can be concluded that SM software plays an important part as an effective memorization tool (AL-JARF, 2015; AL-OTAIBI, 2011; LIU, 2016) because its radiant and non-linear nature enables students to visualize, manage, represent and organize vocabulary knowledge which makes learning a more memorable and meaningful experience. Moreover, its usage provides L2 learners with more meaningful repetitions (HOFLAND, 2007). Consequently, the results have shown that learners' retention of word meaning has been improved, which assisted in expanding their vocabulary. Overall, due to its open- ended nature, SM software may be acknowledged as a visual representation of knowledge (BAHADORI; GORJIAN, 2016), which can contemplate and benefit all kinds of learning styles, especially the visual learners.

In line with this finding, Ruffini (2008) mentions that this technique helps teachers to display freely interrelationships between concepts and content visually not in linear structures, that aids learners to remember better. Relating all of this, it can be suggested that SM can play a significant part when used as a memorization tool due to its structural nature which aids to reinforce word form and meaning into memory by the productive and creative use of the words.

Fourth, with regard to the semantic field theory, Semantic mappings tend to combine multiple related words to a core concept at a single point in space, that is, in the center of the map, while in texts, or lists of words or other formats the words would be spread around. By combining all relationships to a core concept in the center of the map around a single point, it may promote a more semantically integrated understanding of the target words. Thus, the semantic field application plays a part when creating the maps around a single core concept.

Semantic field can be roughly defined as a set of words under the same concept which are connected by their meanings and interact with each other (GAO; XU, 2013). Additionally, literature has shown that information is stored in the brain in categories or groups of concepts, which are linked to other words based on their relationships. For instance, the use of one new word may prompt the use of other related words, which in turn aids to combine previous vocabulary knowledge to new one.

All the studies analyzed in this SR dealt with digital maps focused on words or concepts that were semantically- related in each specific area of teaching English as a FL. Bearing that in mind, along with the implementation of the semantic field to assist in the process of vocabulary learning, SM technique justifies its use due to its dual visual[50] and conceptual[51] way of displaying, arranging, classifying, organizing concepts and words that are semantically related to each other into a non-linear and hierarchical structure. As stated by Liu, Zhao and Bo (2014) using pictorial and graphical design, mind mapping can provide a more vivid teaching atmosphere which promotes memory retention as well as the motivation of the learners. Also, it can be considered an effective way to provide L2 learners with more meaningful repetition, use and retention of the target words since it allows the productive and creative use of the words. It is possible to say that, through SM technique, semantically related concepts and words can be brought together as well as can assist learners to visualize connections between vocabulary and their own word knowledge experiences.

Fifth, it is worth highlighting the role of SM software as an instructional teaching resource used for input and output. One can state that one of the effective ways for overcoming EFL learners' difficulty in retaining new vocabulary is to learn appropriate techniques to facilitate its process. According to the studies analyzed, SM software was employed as an instructional technique in order to develop learners' vocabulary in the classroom because it assisted in linking a word with its meaning. Thus, it has been used as an instructional vocabulary technique in opposition to the use of conventional (or traditional) vocabulary techniques to teach English as a FL. This data makes us aware of the availability of different pedagogical and technological tools to assist in vocabulary teaching and learning. Also, there is the need to teach vocabulary intentionally and explicitly, preferably in an EFL context due to the infrequent exposure to the target language. In line with this finding, it is possible to suggest the relevance of providing students with meaningful and multiple input and output activities through the

[50] Entails the pictorial design of geometric shapes such as boxes, circles or rectangles linked through lines and arrows.
[51] Encompasses the verbal data within such shapes.

receptive and productive skills in the classroom to develop their knowledge of words and word meanings.

By relating the role of input and output when teaching and learning vocabulary as well as the five essential steps to learning new words (HATCH; BROWN, 1995) input then, for example could occur when using studied Semantic Mapping software, in vocabulary receptive activities like in reading or listening, which would allow learners to have sources to encounter new words, get a clear image or visual (written or spoken form) and learn the meaning of the words via the visual and conceptual map exposure. Liu' (2016) and Albisthami DJ' s (2017) study showed this role when the studied maps used as input to present new lexical items to the participants.

Concerning the role of output, the possibility of enabling learners to consolidate word forms and meanings in memory to produce the maps could be addressed. That is to say, constructed semantic mapping software used in productive vocabulary activities such as in writing or speaking skills. Constructed maps would entail recalling and retrieving the words to make associations among the target words around the map. In most of studies analyzed in this SR, the authors used constructed maps, where the students produced written maps themselves. That is, by creating the maps learners were required more mental effort and level of word processing due to the decisions required to generate them, for instance determining which nodes should be placed close together, the semantic relation of the words entailed greater elaborative processing.

Lastly, based on my pedagogical perspective, all the studies shared the same objective which was to stress the role of incorporating digital technologies into the syllabus, that is, by bringing the computer to the classroom, as an alternative way to teaching and learning vocabulary in an EFL context. It is worth mentioning the affordances of CASM when generating digital maps for instance, the possibility to insert audios, videos, pictures, hyperlinks, to save, edit, post, publish, print, work individually or collaboratively in either asynchronous or synchronous modes of learning. In Masoud and Ibrahim's (2017) work, the author pointed out some positive features of using the SM software: students could insert a variety of images from any site or link, save in PDF form, save as an image, or save it as documents, and share it on Facebook, add nodes to each branch of the SM, use different shapes of branches, use available shapes of the central idea, use any shapes of flowchart inside the program. Al-Otaibi (2011) highlights that vocabulary teaching and learning enhanced with the use of computer programs such as SM software, which can facilitate students' work organization and more engagement in the activities. Shdaifat *et al.* (2019) stated that it can be

considered an effective method in teaching, due to the fact it was easier, faster and more attractive for its users. In the same vein, Bahadori and Gorjian (2016) stressed the significant role of activities with SM software as an alternative way to teach vocabulary due to its potential affordances.

The SM software based on the semantic field is a vocabulary- enhanced technique learners can use to categorize, classify and organize words into groups sharing the same semantic feature and others. That is, it visually exhibits the relationship between words under the same concept, which enables dealing with the words' hyponyms, synonyms, antonyms (e.g. breadth of the words), as well as their most common collocations. For this reason, Al-Jarf (2015) highlighted the importance of concentrating on the semantic categories to be used as a basis for grouping and organizing words in the center, add branches, sub-branches, add images, change the font color, size and case, based on the degree of relevance of the word. To get a clear and more detailed picture of Al-Jarf's semantic maps into use, check the appendix H (Mind Map for teaching prefixes and suffixes), appendix I (Mind Map for teaching singular and plural), appendix J (Mind Map for teaching Pronunciation), and appendix K (Mind Map for teaching Word Families).

In line with these findings, it can inferred that, besides the fact of the statistically positive results obtained in the tests by the users where the software efficacy was proved, SM software has been seeing as an effective way to learn English vocabulary in the EFL classroom by learners of different levels and ages around the world. This research concluded that the use of CASM as a vocabulary instructional technique had a significant impact and hence improved students' retention and learning of EFL vocabulary knowledge.

All in all, the findings presented and analyzed in this research shed some light on the role of using SM software activities for improving vocabulary acquisition in EFL, which can assist learners to enlarge their vocabulary knowledge. The wrap up of this chapter is presented next.

4.5 SUMMARY OF THE CHAPTER

This chapter aimed at presenting the analysis, results and discussion from a qualitative approach, of the 7 studies selected for this current research in relation to the implementation of SM software for EFL vocabulary acquisition. The purpose of this SR was to explore the outcomes and efficacy of CASM in the context of EFL learners' vocabulary acquisition from 2010 to 2020, by having a deep look at research findings on how it can improve learners'

vocabulary. To achieve those objectives, some steps had to be followed systematically when dealing with the analysis of the studies.

All the studies were coded aiming at identifying and recording systematically specific information of each one concerning their main aspects, for instance their design, method and results. The following step was the critical appraisal of the studies reviewed to make sure the authors included all relevant information in their articles and, for this purpose, TREND statement checklist was employed. Afterwards, the synthesis results were presented which consisted of summarizing the main results of each study by bringing them together to make associations among the parts identified in individual studies to answer the research questions proposed in this study.

Two research questions were addressed, and the results and discussion that followed were organized to answer them. Within the first research question, the main findings presented were: the nature of the tests, the comparison of treatment effects of mapping to non-mapping conditions, and the types of digital semantic mappings: studied or constructed. In the second research question the main results and conclusions pointed out were: the multimodality contribution, the structure of SM software as a teaching tool, the role of semantic field theory, the role of semantic mapping software as an instructional teaching resource used for input and output, and the role of CASM activities to assist in vocabulary learning.

The main motivation of this study was to elucidate whether and to what extent CASM application can assist learners to overcome their difficulties in memorizing and retaining new lexical items when learning English as a FL. It can be suggested that the application of the SM software along with semantic field could aid learners in brainstorming, categorizing, visualizing and recalling relationships among lexical items under the same concepts which lead to their vocabulary development. All the quantitative findings obtained in the primary research analyzed in this study from a qualitative perspective provide clear empirical evidence that SM software can work effectively in promoting EFL learners' vocabulary acquisition.

Next, the final remarks, the pedagogical implications, limitations of this study and suggestions for future studies in the realm of SM for vocabulary teaching and learning are presented.

5 FINAL REMARKS

Vocabulary knowledge is vital for communication in any language. At the same time, its development is complex and can be facilitated with the use of digital tools. This SR synthesizes 10 years of research around the efficacy of teaching and learning with SM compared to other instructional interventions. The overall results revealed that the users of the SM software significantly outperformed their counterparts in the control groups on the post-tests. It is possible to say, thus, that the implementation of SM software to generate digital maps helps learners to improve vocabulary acquisition.

By analyzing the primary studies, one can say that CASM activities aimed at language and vocabulary learning play an important part in the 21st century due to the innumerous possibilities it provides into the current educational contexts when incorporated effectively in the syllabus, it can assist in facilitating the learning process. However, when using SM software, it is crucial to have clear linguistic objectives in mind. Bearing in mind the likely advantages of CASM over paper-based SM, it is suggested to use the digital maps of words to expand, organize, categorize, classify, and present the maps of words. In other words, when one has the possibility of implementing SM software in the EFL classroom, it is advisable to get the most out of the technology potentials. For this reason, it is recommended that educators and teachers should get familiar with this digital resource before implementing it into the classroom.

When it comes to using either studied or constructed CASM, one important aspect I would you like to pinpoint is the level of student's collaboration within the language learning process. Albisthami DJ (2017) used SM software concentrated only on teacher-directed emphasis in order to present and teach vocabulary to the experimental class of students, in the sense that the maps were generated in open-group by the teacher along with learners' contributions, from the beginning up to the end. In Bahadori and Gorjian's (2016), Al-Otaibi's (2011), and Al-Jarf's (2015) studies, it was reported that after students were trained on how to use it, they also started creating and personalizing their own maps. For further information of the maps, check appendix K (Mind Map for teaching Word Families), appendix N (A student-created Semantic Map). In other words, the maps created by students in the primary research studies ranged from teacher-directed emphasis semantic maps to student- generated general semantic maps made towards the end of the treatment. Moreover, Masoud and Ibrahim (2017) went beyond and asked his students after producing the maps to use the acquired words in meaningful sentences to be sure that they could use the acquired vocabulary in correct context. Thus, according to the author the use of mind maps along with the sentence - making activity

assisted in the process of vocabulary building to enlarge learners' vocabulary acquisition. Masoud and Ibrahim's (2017) study strongly suggested that the mind mapping technique can be used to increase students' vocabulary repertoire especially in sentence construction, since building sentences must be improved significantly among the students to aid them do well in the writing skill. In the same vein, Shdaifat's *et al.* (2019) students, after being taught, were asked to create their own maps in 3 stages: pre reading, while reading, and post reading. For instance, in pre-reading stage, participants started creating E- Mind maps for each item then presenting them to get feedback. After introducing the vocabulary, they moved to while reading stage in which there was more focus on vocabulary, key ideas, sequence and outlining. Then they started creating E-Mind maps in post-reading based in the questions given after the text.

In Liu's (2016) study, the author emphasizes the benefits of employing learner-centered map approach since it involved learners' own map-building process rather than just receiving teachers' mapping guidance, which facilitated word knowledge and retention. It is possible to relate it with the fact that learner-centered approach allows students to be more active and independent on their own language learning process because it can promote their autonomy. This goes in line with Al-Otaibi's (2011) and Masoud and Ibrahim's (2017) findings that the use of the SM software allows students to have a more active role in producing the maps while the teacher's role is as a facilitator of the process by guiding and helping them. Creativity could also be triggered and developed in this process by allowing learners to apply in the maps their own personal touch, needs and interests.

Masoud and Ibrahim (2017) and Liu (2016) made very relevant contributions from a qualitative perspective (interviews were carried out with the participants) to enrich this study. The authors went beyond the quantitative pre-tests and post-tests and investigated some of the factors that significantly affected the performance of the students in the experimental groups concerning their feelings and opinions in relation to the SM software use. Masoud and Ibrahim (2017) made some brief comments based on an open-group dialogue given by the treatment group students that was conducted immediately after the vocabulary test. Based on the qualitative data collected by the author, all the participants' responses indicated they enjoyed the experience of drawing mind mappings in the lessons, also, they hoped it could be adopted and explored in the regular classes in the future. Lastly, it was stated that the participants could produce their own maps for learning vocabulary and doing their writing exercises afterwards.

On the other hand, in Liu's (2016) study, it was carried out in-depth group interviews (with groups of 5) to investigate the factors affecting the performance of the students in the experimental group. According to the qualitative data collected, most learners believe that

learning English with the assistance of the digital maps, such as SM software and the word association information enhanced their memorization and retention. Also, regarding the participants' opinions about the experiment, Liu´s students reported that the design of the maps really caught their attention in the language learning process because of its visual representation; therefore, the word memorization was enhanced.

Overall, regarding all the findings presented, SM software seemed to show a relevant and positive effect in promoting EFL learners' vocabulary acquisition, since it assisted significantly EFL learners' ability to increase their lexical repertoire and use of the target words.

This study focused on the investigation of the effectiveness of SM software for vocabulary learning in EFL contexts. Analysis of the data underscores the importance of learning with digital SM across a variety of instructional EFL contexts and, in comparison, to many traditional instructional conditions. Research is also needed to understand the cognitive process of learning through SM software and how to design more effective SM software to be able to create more effective instructional interventions. That is, future studies can elucidate why this digital resource is effective, which, in turn, could deepen our understanding about it.

Next, some pedagogical implications, limitations of the study, as well as suggestions for future studies are presented.

5.1 PEDAGOGICAL IMPLICATIONS

The aim of this research was to investigate the effectiveness of the implementation of SM software activities as an instructional technique to teach vocabulary in English as a FL. Based on all the studies' findings analyzed, the review of the literature and my own experience as an EFL researcher teacher, some issues should be taken into consideration in order to get the most of it when incorporating this technological tool to teach vocabulary. They refer to the features of the technique, the implementation of SM software, and the role of the learners in the EFL learning process.

As can be seen, SM technique along with its software affordances play a significant part as a memorization tool, which seems to facilitate and boost vocabulary acquisition and retention at a deeper level. Its effectiveness can be due to its attractive visual stimuli as well as effective visualization of information that might be important to develop students' vocabulary (BUZAN, 2000). This way, vocabulary knowledge is organized and presented in a hierarchically way from top to bottom, from macro to micro organization based on a core concept in the center of the map, that radiates branches and sub-branches all around it in a non-

linear way, and avoiding lists of lexical items to be memorized. This instructional technique can contribute to the development and expansion of vocabulary in FL, up to intermediate levels.

When it comes to implementing CASM or SM software activities to develop vocabulary, it is important to keep in mind that at the most general level the focus should be placed on the semantic field of the words being studied. One contribution is to map and generate digital maps related to the target words' hyponyms, synonyms, antonyms (see Appendix L[52]), and the most common collocations of related words. Chances of deep level processing of words can be higher since there is the need to organize, classify and categorize words that interplay semantically. Also, it provides the opportunity of relating old and new vocabulary knowledge to build up the map. Shdaifat *et al.* (2019) adds that the recalling of one item prompts recall of the lexical items linked to it. Thus, the word knowledge can be strengthened when the meaning, form and use interplay into productive vocabulary use in writing or speaking which contributes to the word retention in the long-term memory. Also, it can provide opportunities for multiple meaningful encounters with the target word.

SM technique integrated with any technological tool or software may go beyond the realm of paper and pen because it explores and incorporates the affordances of the SM software by adding images, sounds, videos, lines, colors to illustrate the meaning of the words, the colors and sizes of the branches, sub-branches which show the hierarchical organizational relationship among the words in relation to the core concept. Equally important is the facility to save, edit, printed, organize, archive, share, post, send the maps for feedback from the teacher and other colleagues. Overall, the focus should be given first in mapping the words which are semantically - related, and then exploring all the potential features of digital maps in better learning achievements and students' learning interests.

For effective use of the SM software, it is recommended that language teachers need to be trained in using the program as well, to get familiar with its main features and practical applications (animated and/or interactive). Regarding the CASM affordances, another important aspect worth noting is that it may not be feasible to construct the maps on smartphones or mobile phones, due to their limited screen size, conversely it may be employed for receptive vocabulary activities.

Regarding the role of the learners, Al-Otaibi (2011), Liu (2016) and Masoud and Ibrahim's (2017) pointed out that the use of SM software activities can contribute positively for learners to have more active roles in their own language learning process. From the pedagogical

[52] A Semantic Map Based on Medical Terms (AL-OTAIBI, 2011, p. 285).

perspective, Al-Otaibi (2011) and Masoud and Ibrahim (2017) propose that the use of SM software activities can assist learners to be more engaged in their own language learning process while producing the maps, while the teacher works as a facilitator by providing guidance and help and, consequently, learners can develop a more active role in building their own vocabulary knowledge. In other words, when the maps are created by the students, they can get more motivated and interested in the process of personalizing, building up, recalling the words which becomes more productive, useful and meaningful for them.

Group formation is important while producing the maps. Bahadori and Gorjian (2016) state that generating the maps collaboratively is more productive to learners than individually. Kwon and Cifuentes (2009) added maps produced collaboratively had higher quality than those produced individually. This may be because, pairing and sharing activities can be more constructive in terms of increasing the students' background vocabulary knowledge which can increase their lexical use.

Lastly, this digital instructional technique to teach vocabulary is one effective strategy among many others available nowadays, to make vocabulary learning a more memorable and creative way in a variety of contexts, to allow students to have many meaningful encounters with the same words in order to strengthen their word knowledge as well as enlarge their lexical repertoire.

5.2 LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FURTHER STUDIES

It is worth addressing some limitations which prevented me from drawing definitive conclusions from the data depicted in this study. Basically, they refer to some facts which happened along the research. First, it was not feasible to collect data with EFL participants in Brazil, due to the Covid-19 pandemic restrictions imposed. Regarding the institutional restraints, the in-person, on-campus classes did not take place at UFSC University with a pool of participating subjects, and the possibility of collecting data online in such circumstance was not recommended in my qualifying exam. Accordingly, due to these limitations, a SR research design was chosen.

Second, this SR is based on a limited number of primary research studies. Considering the time constraints of this research and its deadline, only 7 high quality studies could be located, retrieved and included to be analyzed because they met the inclusion criteria of this SR. Although an extensive literature search was performed, it might be possible that more

studies could be available in other electronic databases, since I dealt with 7 academic virtual libraries namely, Web of Science, ERIC, LISA, Scielo, Scopus, ACM Digital Library, and lastly Google Scholar.

Concerning the suggestions for further studies, in spite of the limitations of this current study, it is expected that this SR will motivate further research on the effectiveness of SM software over EFL learners and focus on some of the issues raised in this study. Future research could, for example, concentrate on applying and extending it to advanced EFL learners since it is possible they possess more vocabulary knowledge. As shown in this SR, none of the studies focused on the effectiveness of SM software for advanced learners, thus it seems to be a favorable ground for further studies on it.

Future studies could also try to include delayed posttests or conduct longitudinal studies in order to consider the long-terms effects on the application of SM software on vocabulary learning. Accordingly, to deepen our understanding on the effects of SM software application over a long period of time, such as with longitudinal studies, more research is needed.

Furthermore, this SR only reviewed primary research studies that compared learning with SM software to learning without them. Thus, more research is needed to compare studies that used paper-based SM activities in the control groups versus SM software used with experimental groups, to find out which one is more effective when it comes to vocabulary learning and retention in EFL contexts. Dilkek and Yuruck's (2013) study has shown that SM technique per se is an effective technique, and considering the studies analyzed in this research, all the control groups used only conventional or traditional techniques such as translation into L1, textbook only, list of vocabulary items text. However, none of them measured the differences between the SM paper-based technique applications in comparison to the SM software along with its technological affordances.

Lastly, in this vein, more focused theory- oriented research would compare the effects of learning with different types of graphic organizer software such as mind map, concept map, concept diagrams as well as semantic map.

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APPENDIX A- SEARCH TERMS USED ON WEB OF SCIENCE

Table 8 - Number of search terms used on Web of Science database

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
Web of Science	S1	"vocabulary acquisition" OR "vocabulary learning" OR " vocabulary development"	2,309	No	0
	S2	"semantic mapping" Filter: categories (4)	67	Yes	1
Date of search	S3	"mind mapping" Filter: categories (4)	178	Yes	1
18/10/2020	S4	"concept mapping"	423	No	0
	S5	S2 AND S7 AND S1	1	Yes	1
Filters applied in all:	S6	S1 AND S12	93	Yes	0
Publication date from:2010-2020	S7	Software*	450,065	No	0
Language: English	S8	computer-assisted	15,821	No	0
Type: article or proceedings paper	S9	computer based	169	No	0
	S10	computer program	45,605	No	0
	S11	computer software	42,055	No	0
Filter: Categories (4)	S12	"foreign language learning" OR "second language learning"	2,62	No	0
Linguistics; Language; Education;	S13	"foreign language teaching" OR "second language teaching"	1,687	No	0
Education Educational research; or	S14	"foreign language learner" OR "second language learner" OR "FL student"	119	No	0
Computer science Interdisciplinary	S15	S2 OR S3 OR S4	2,187	No	0
	S16	S8 OR S10 OR S11	28,857	No	0
	S17	S3 AND S7 AND S1	2	Yes	2

Table 3- Number of search terms used on Web of Science database (concluded)

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
	S18	S3 AND S12	3	Yes	0
	S19	S8 AND S4 AND S1	1	Yes	1
	S20	S3 AND S13	4	Yes	0
	S21	S4 AND S11	2	Yes	0
	S22	S9 AND S2	1	Yes	0
	S23	S9 AND S3	3	Yes	0
	S24	S1 AND S11	1	Yes	0
	S25	S9 AND S4. Filter: categories (4)	25	Yes	1
	S26	S4 AND S7 AND S1	1	Yes	1

Source: Data generated by the researcher.

APPENDIX B- SEARCH TERMS USED ON ERIC PROQUEST

Table 9 - Number of search terms used on ERIC Proquest database

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
ERIC Proquest	S1	"vocabulary acquisition" OR "vocabulary learning" OR " vocab. development"	4,49	No	0
	S2	"semantic mapping"	22	Yes	2
Date of search	S3	"mind mapping"	77	No	0
21/11/2020	S4	"concept mapping"	1,352	No	0
	S5	S2 AND S7	1	Yes	0
Filters applied:	S6	S1 AND S12	5,803	No	0
Publication date: 2010-2020	S7	software*	10,19	No	0
Language: English	S8	computer-assisted	7,338	No	0
Type: (journal) article;	S9	computer based	1,567	No	0
proceedings; dissertation/thesis;	S10	computer program	167	No	0
	S11	S9 AND S4	27	No	0
	S12	"foreign language learning" OR "second language learning"	22,895	No	0
	S13	"foreign language teaching" OR "second language teaching"	486	No	0
	S14	"foreign language learner" OR "second language learner"	57	No	0
	S15	S3 AND S7	6	Yes	0
	S16	S3 AND S12	7	Yes	0
	S17	S4 AND S7 AND S1	3	Yes	0
	S18	S8 AND S4 AND S1	3	Yes	1

Table 4- Number of search terms used on ERIC Proquest database (concluded)

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
	S19	S3 AND S1	2	Yes	1
	S20	S4 AND S10	1	Yes	0
	S21	S9 AND S3	1	Yes	0
	S22	S1 AND S14	5	Yes	0
	S23	S2 AND S1	10	Yes	2

Source: Data generated by the researcher.

APPENDIX C- SEARCH TERMS USED ON ACM DIGITAL LIBRARY

Table 10 -Number of search terms used on ACM Digital Library database

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
ACM Digital Library	S1	"vocabulary acquisition" OR "vocabulary learning" OR " vocab. development"	265	No	0
	S2	"semantic mapping"	325	No	0
Date of search	S3	digital*	250,662	No	0
26/11/2020	S4	"concept mapping"	314	No	0
	S5	S2 AND S7	218	No	0
Filter applied:	S6	S3 AND S2	275	No	0
Publication date:2010-2020	S7	software*	155,134	No	0
	S8	computer-assisted	2,618	No	0
	S9	computer based	3,485	No	0
	S10	computer program	1,813	No	0
	S11	S9 AND S2	323	No	0
	S12	"foreign language learning" OR "second language learning"	279	No	0
	S13	"foreign language teaching" OR "second language teaching"	76	No	0
	S14	"foreign language learner" OR "second language learner"	17	No	0
	S15	S3 AND S4	257	No	0
	S16	S2 AND S1	314	No	0

Table 5- Number of search terms used on ACM Digital Library database (concluded)

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
	S17	S2 AND S7 AND S1	209	Yes	1
	S18	S8 AND S2 AND S1	302	No	0
	S19	S8 AND S2	312	No	0
	S20	S1 AND S12	50	Yes	1
	S21	"mind mapping"	164	No	0
	S22	S2 OR S21	489	No	0
	S23	S3 AND S21	146	Yes	1

Source: Data generated by the researcher.

APPENDIX D- SEARCH TERMS USED ON LISA PROQUEST

Table 11- Number of search terms used on LISA Proquest database

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
LISA Proquest	S1	"vocabulary acquisition" OR "vocabulary learning" OR " vocab. development"	128	No	0
	S2	"semantic mapping"	53	No	0
Date of search	S3	"mind mapping"	114	No	0
27/11/2020	S4	"concept mapping"	271	No	0
	S5	S2 AND S7	30	Yes	0
Filters applied:	S6	S1 AND S12	10	Yes	0
Publication date:2010-2020	S7	software*	29,283	No	0
Language: English	S8	computer-assisted	1,319	No	0
	S9	computer based	1,854	No	0
	S10	computer program	17,912	No	0
	S11	S9 AND S4	26	No	0
	S12	"foreign language learning" OR "second language learning"	174	No	0
	S13	"foreign language teaching" OR "second language teaching"	32	No	0
	S14	"foreign language learner" OR "second language learner"	8	No	0

Table 6- Number of search terms used on LISA Proquest database (concluded)

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
	S15	S3 AND S7	64	No	0
	S16	digital*	46,67	No	0
	S17	S16 AND S3	68	Yes	2
	S18	S2 AND S7 AND S1	1	Yes	0
	S19	S8 AND S2	2	No	0
	S20	S9 AND S3	12	Yes	1

Source: Data generated by this researcher.

APPENDIX E- SEARCH TERMS USED ON SCIELO

Table 12 - Number of search terms used on Scielo database

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
Scielo	S1	"vocabulary acquisition" OR "vocabulary learning" OR " vocab. development"	42	No	0
	S2	"semantic mapping"	0	No	0
Date of search	S3	"mind mapping"	1	Yes	0
07/12/2020	S4	"concept mapping"	22	No	0
	S5	S1 AND S12	0	No	0
Filters applied:	S6	S2 OR S3 OR S4	7	Yes	2
Publication date: 2010-2020	S7	software*	3,828	No	0
Language: English	S8	computer-assisted	157	No	0
	S9	computer based	57	No	0
	S10	computer program	90	No	0
	S11	S4 AND S7	3	Yes	0
	S12	"foreign language learning" OR "second language learning"	40	No	0
	S13	"foreign language teaching" OR "second language teaching"	42	No	0
	S14	"foreign language learner" OR "second language learner"	3	No	0
	S15	S2 AND S1	0	No	0
	S16	S2 AND S7 AND S1	0	No	0

Source: Data generated by this researcher.

APPENDIX F- SEARCH TERMS USED ON SCOPUS (ELSEVIER)

Table 13 - Number of search terms used on Scopus (Elsevier) database

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
Scopus (Elsevier)	S1	"vocabulary acquisition" OR "vocabulary learning" OR " vocab. development"	2,882	No	0
	S2	"semantic mapping"	874	No	0
Date of search	S3	"mind mapping"	460	No	0
07/12/2020	S4	"concept mapping"	2,026	No	0
	S5	S1 AND S12	141	Yes	0
Filters applied:	S6	S2 OR S3 OR S4	3,342	No	0
Publication date: 2010-2020	S7	software*	782,17	No	0
Language: English	S8	computer-assisted	468,775	No	0
	S9	computer based	17,911	No	0
	S10	computer program	57,56	No	0
	S11	S8 AND S2	1	Yes	0
	S12	"foreign language learning" OR "second language learning"	3,228	No	0
	S13	"foreign language teaching" OR "second language teaching"	1,508	No	0
	S14	"foreign language learner" OR "second language learner"	2,08	No	0
	S15	S3 AND S7	78	Yes	0
	S16	S2 AND S1	7	Yes	0
	S17	S8 AND S4 AND S1	1	Yes	0
	S18	S3 AND S1	5	Yes	4
	S19	S4 AND S10	20	No	0

APPENDIX G- SEARCH TERMS USED ON GOOGLE SCHOLAR

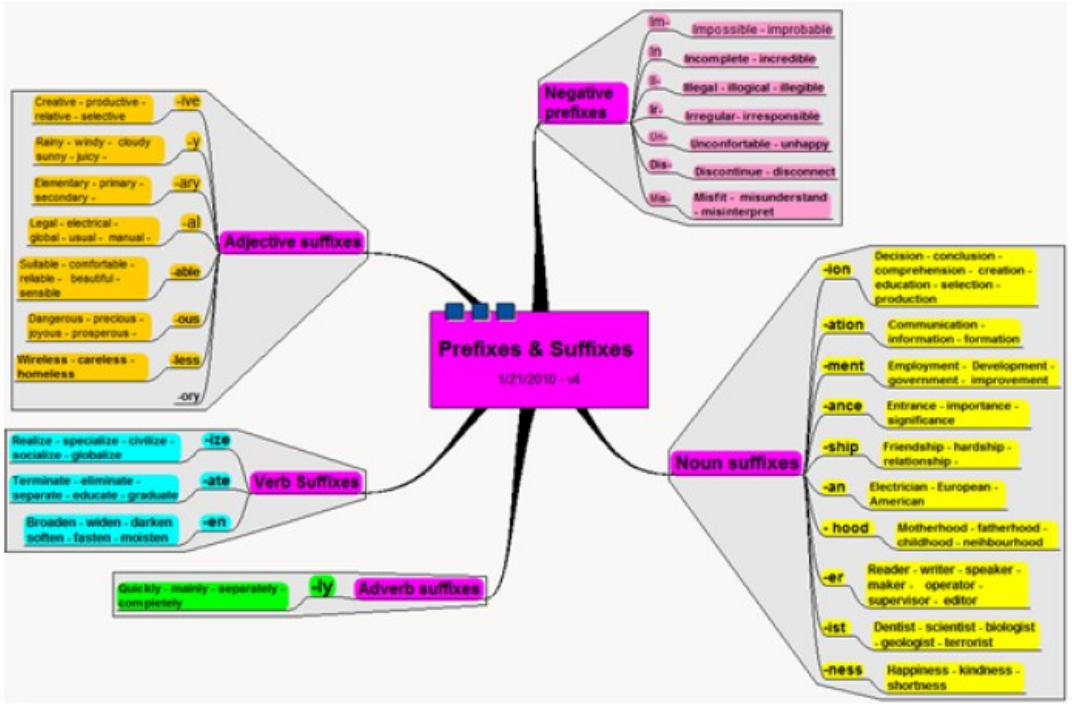
Table 14 - Number of search terms used on Google Scholar database

Database	Number of Search Terms	Search options	Results from Search	Reviewed by author	Number of studies used in SR
Google Scholar	S1	"semantic mapping" for vocabulary acquisition	12,600	Yes	1
Date of search	S2	"computer-assisted semantic mapping"	18	Yes	0
12/01/2021 à 21/01/ 2021	S3	"mind mapping software" for vocabulary acquisition	1,440	Yes	1
Filter applied:					
Publication: 2010-2020					

Source: Data generated by this researcher.

APPENDIX H - MIND MAP FOR TEACHING PREFIXES AND SUFFIXES

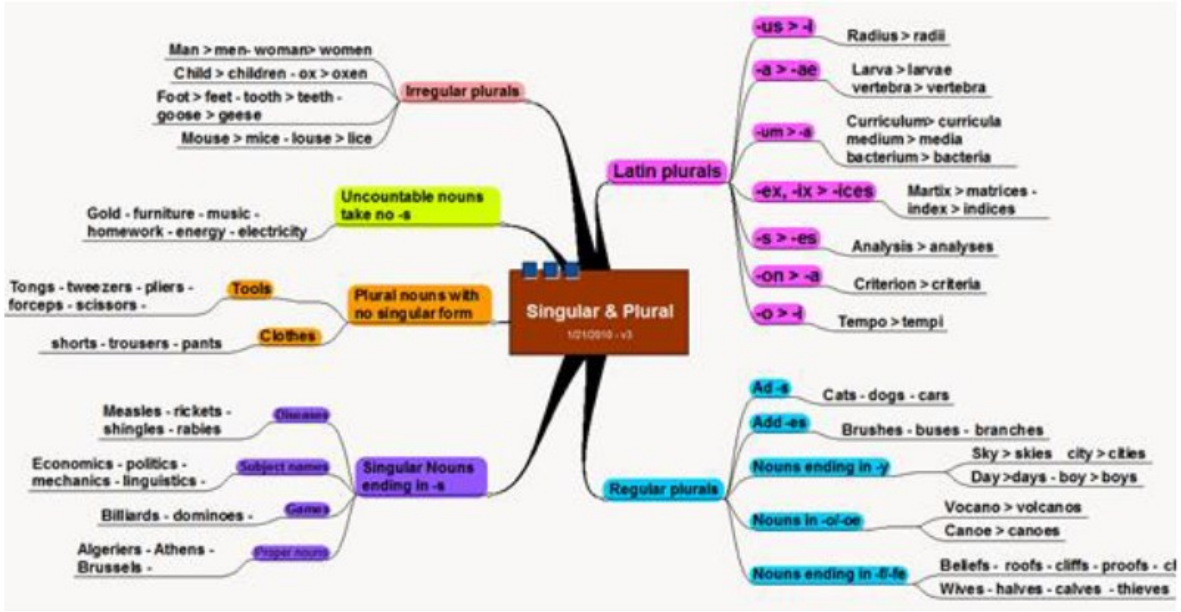
Figure 7- Mind Map for teaching Prefixes and Suffixes



Source: Al-Jarf (2015, p.514)

APPENDIX I - MIND MAP FOR TEACHING SINGULAR AND PLURAL FORMS

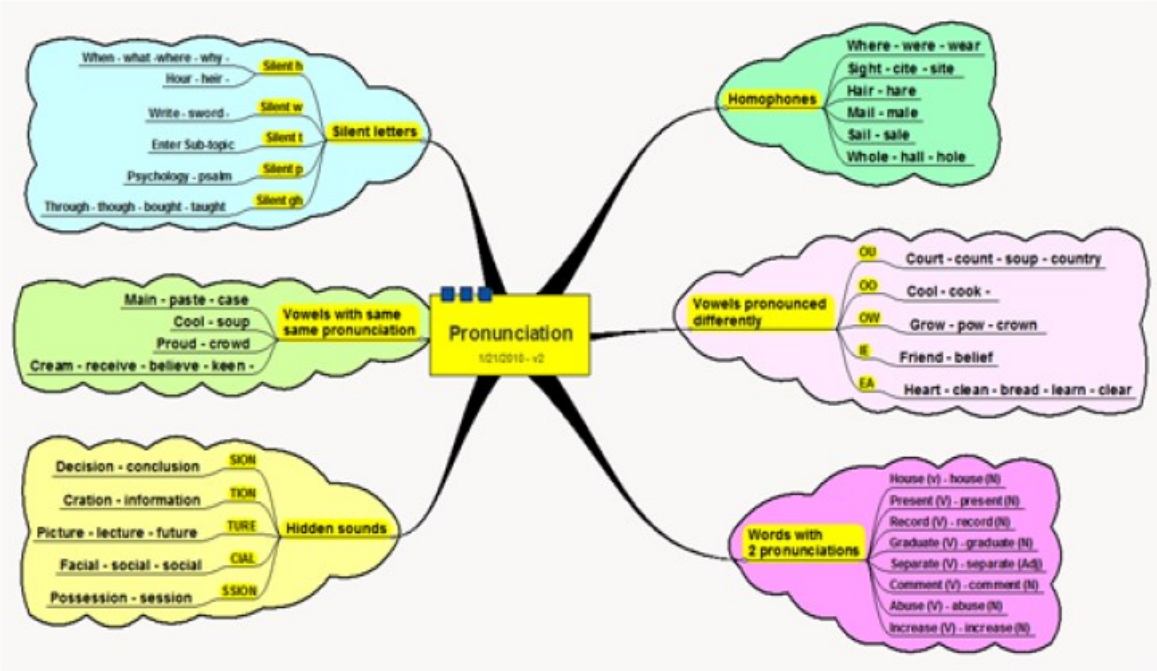
Figure 8- Mind Map for Teaching Singular and Plural Forms



Source: Al-Jarf (2015, p.515)

APPENDIX J - MIND MAP FOR TEACHING PRONUNCIATION

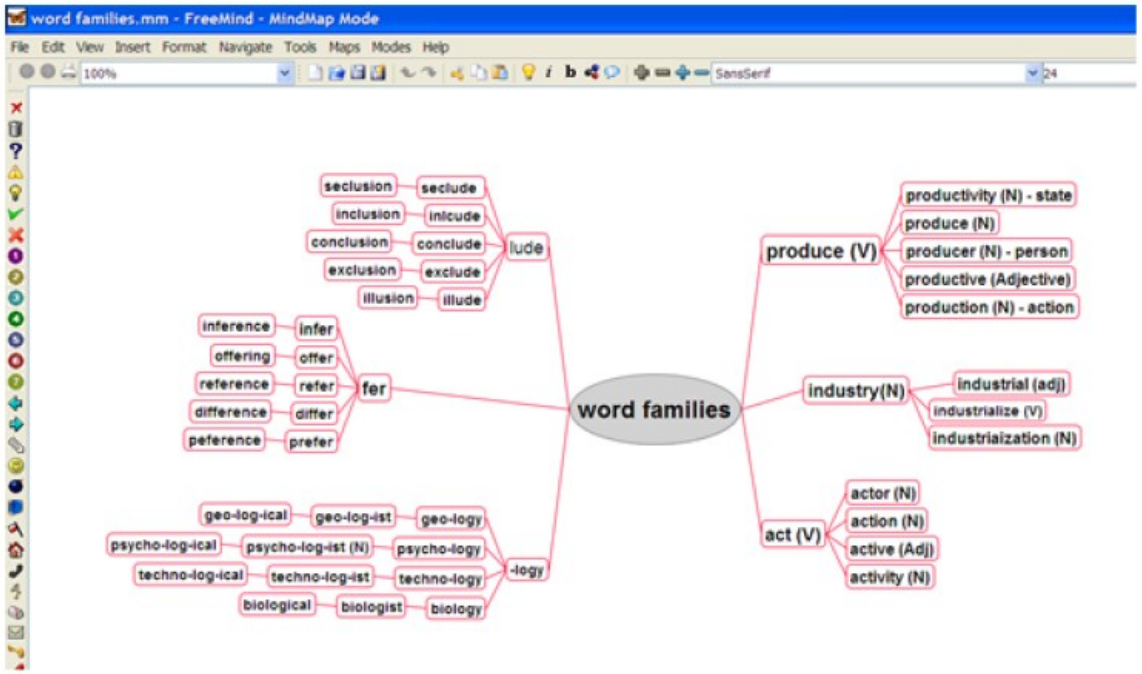
Figure 9- Mind Map for Teaching Pronunciation



Source: Al-Jarf (2015, p.516)

APPENDIX K - MIND MAP FOR TEACHING WORD FAMILIES

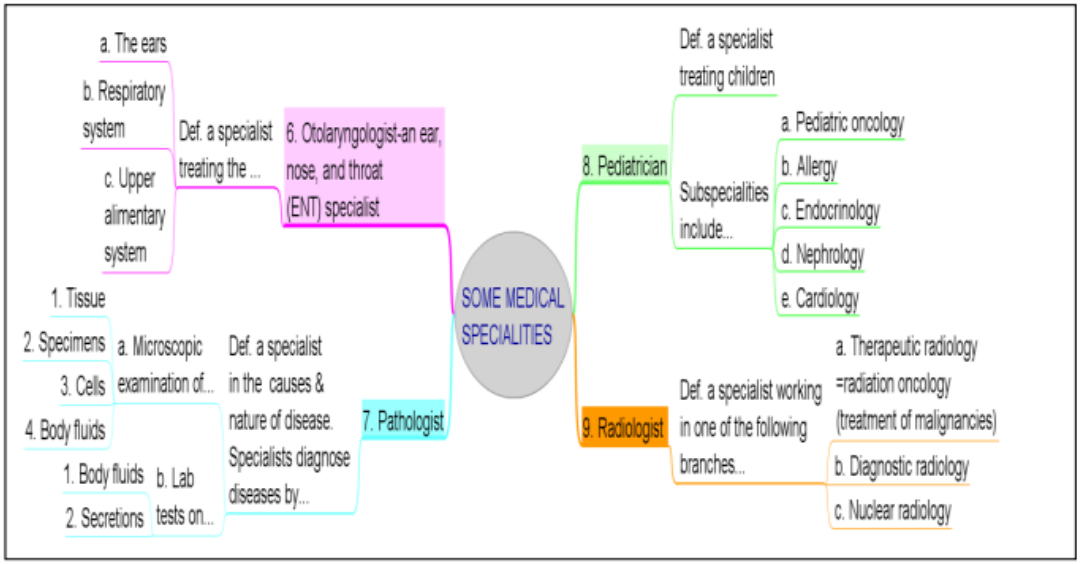
Figure 10- Mind Map for Teaching Word Families



Source: Al -Jarf (2015, p.517)..

APPENDIX L - A SEMANTIC MAP BASED ON MEDICAL TERMS

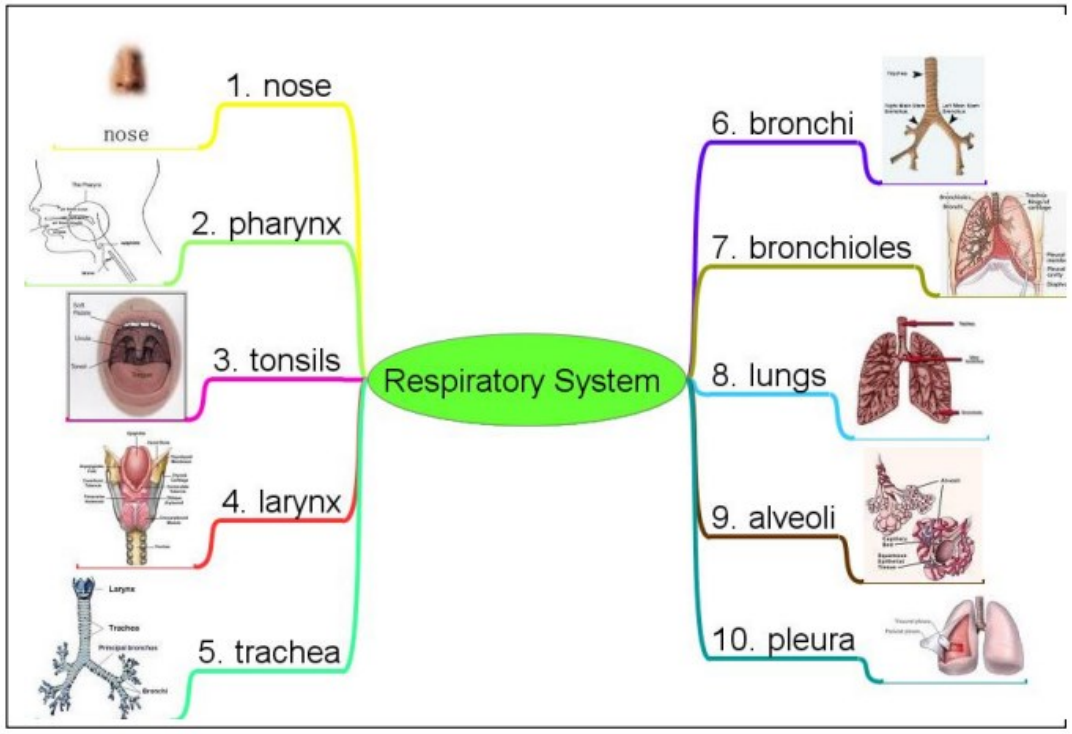
Figure 11- A Semantic Map showing some words and their definitions



Source: Al-Otaibi (2011, p.285).

APPENDIX M - A MAP OF THE RESPIRATORY SYSTEM

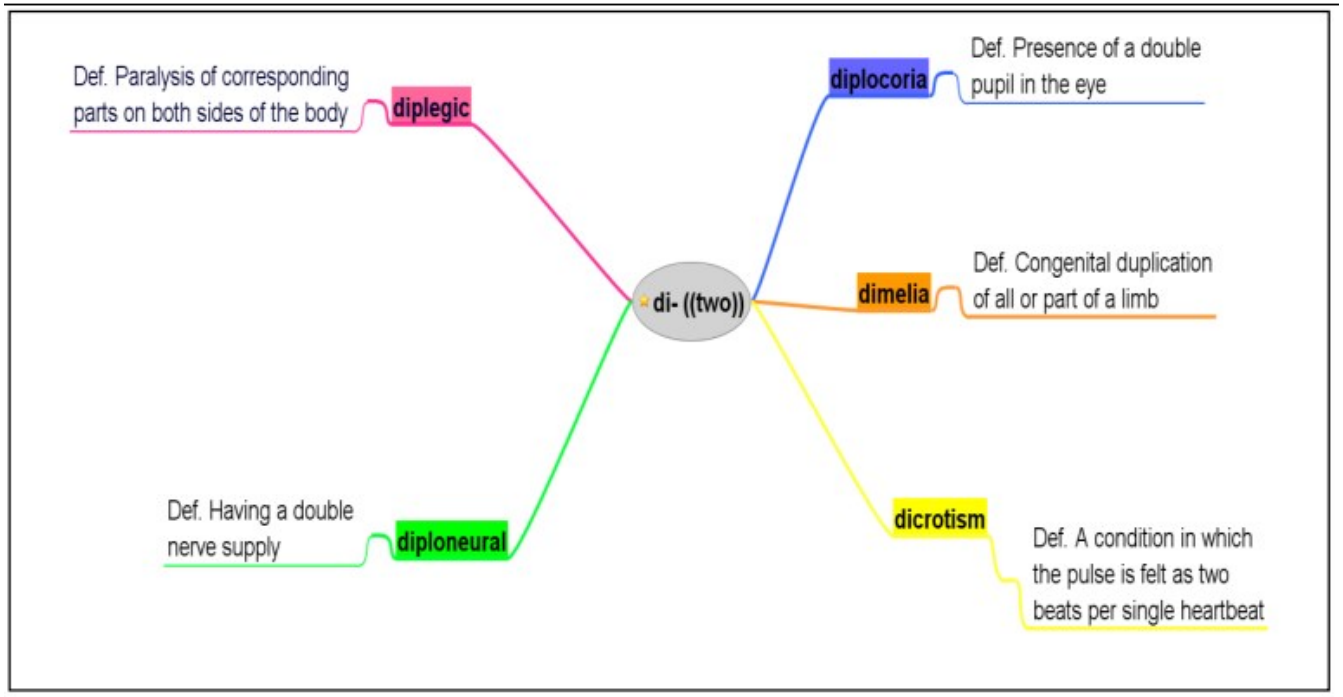
Figure 12- A Semantic Map of the Respiratory System and its Organs



Source: Al-Otaibi (2011, p.286).

APPENDIX N - A STUDENT- CREATED SEMANTIC MAP

Figure 13- A Student- created Semantic Map showing words that share the same prefix



Source: Al-Otaibi (2011, p.286).