UNIVERSIDAD DE QUINTANA ROO

DIVISIÓN DE CIENCIAS POLÍTICAS Y HUMANIDADES

Technology-mediated Vocabulary Learning Strategies in Engineering Students

Tesis

Para obtener el grado de
Licenciada en Lengua Inglesa

PRESENTA
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Chetumal, Quintana Roo, México, abril de 2019

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ABSTRACT

Nowadays digital competence and communicating in a second language as English language is pivotal in the educational field. Moreover, there is a huge amount of produced knowledge all over the world and most of it is in English (Foyewa, 2015). Notwithstanding, in non-speaking English countries as Mexico, the lacking or underdevelopment of these two key competences may represent a drawback in both studies and in relation to employment (Mecinas Montiel, 2016). The aim of this research project is to examine how engineering students at the University of Quintana Roo (UQRoo) learn technology-mediated vocabulary in English.

The research design is descriptive, and the method followed is quantitative. The data was collected through a questionnaire with Likert scale and open-ended questions. A sample of convenience of engineering undergraduates from 1st to 9th semester at UQRoo, campus Chetumal was used for this research.

The results yielded that engineering students tend to use discovery technology-mediated vocabulary learning strategies (TMVLS) more frequently than memorisation and note-taking strategies. To this respect, it was observed that note-taking was the least used category. Moreover, significant differences emerged in the use of TMVLS across majors, gender, and English level. Furthermore, about half (47%) of the sample (268 students) reported to have an intermediate digital competence level. Notwithstanding, employment situation did not reveal being a strong predictor of TMVLS use.

Key words: vocabulary, technology-mediated vocabulary learning strategies (TMVLS); digital divide, digital competence; Information and Communication Technologies (ICT).

CHAPTER 1 INTRODUCTION

1.1 Background

The need of digital competence and comprehending a foreign language such as English, are some of the key competences for lifelong learning. People's knowledge, skills, and attitudes are key factors in the 21st century in order to enhance their lives and being competitive in any field. In this sense, the use of Information and Communication Technologies (ICT) as part of an educational environment along with interacting and getting across in English language, are crucial at the present time.

Nevertheless, in developing countries as Mexico, the digital gap is a hindrance for accessing to digital knowledge and retrieving content, and sociocultural inclusion as well. Furthermore, digitally excluded people (Resta & Laferrière, 2015) seem to have fewer opportunities in life as regards work.

Being digitally competent and being able to understand and communicate in a second language, among other skills, is a major concern for the governments. The European Union was the pioneer in spotlighting this issue. As a result, eight key competences for lifelong learning were defined: communication in the mother tongue, communication in foreign languages, mathematical competence and basic competences in science and technology, digital competence, learning to learn, social and civic competences, sense of initiative and entrepreneurship, cultural awareness and expression that contribute to a successful life (European Parliament and the Council, 2006). In this sense, digital competence calls for

> the confident and critical use of Information Society Technology (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet. (European Parliament and the Council, 2006, p. 7)

What is more, digital competence not only refers to knowledge, skills, and attitudes to be functional in a digital environment (Ferrari, 2012, p. 3), but also by appropriating and adapting them to our ends to interact around them (INTEF, 2017, p. 11). As for the key competence of

communicating in second languages, it shares the main skills of communicating in the mother tongue such as understanding, interpreting and expressing opinions, concepts, thoughts in both oral and written form in a wide range of cultural contexts. Furthermore, it involves also intercultural understanding and mediation skills. Notwithstanding, individual's level proficiency will vary according to his needs, interests, cultural background, among others (European Parliament and the Council, 2006).

In accordance with the Common European Framework of Reference for Languages, Learning, Teaching, Assessment (CEFR), there is a set of common reference levels: Pre-A1, A1, A2, B1, B2, C1, and C2 (Council of Europe, 2018). In this tenor, engineering undergraduates at University of Quintana Roo are required to achieve a B1+ level "Intermediate English" (UQRoo, 2013), which is equivalent to the Cambridge English Preliminary (PET) proficiency level (Cambridge Assessment English, 2017).

Accordingly, since the advent of ICT in many fields as in the educational, it has reassured its capability and scope for bridging knowledge by making available for the users. As same as ICT, specific vocabulary in English has been coined and spread in many educational fields such as engineering. Nonetheless, this may represent a difficulty for learners in regard to finding an equivalent word in their mother tongue in text books or on digital content. Not to mention the fully understanding of vocabulary in general speaking for being competent not only on the work field but also in a world in which English has become part of daily-basis content on media.

1.2 Rationale

The objective of this research is to examine how engineering students at the University of Quintana Roo campus Chetumal learn technology-mediated vocabulary in English.

The outcomes of this investigation provide with relevant data related to engineering students' digital competence and the technology-mediated strategies they use for learning vocabulary in English in their studies field. In this regard, it could entail the creation of ICT courses not only oriented to engineering students but also to all the undergraduate students at University of Quintana Roo.

Likewise, this study could benefit English courses at UQRoo's Language Teaching Centre (*Centro de Enseñanza de Idiomas*, in Spanish) since digital competence may be fully included in the lesson contents. Furthermore, this research may assist in selecting ICT resources in order to enable students appropriate and actively apply new and known vocabulary according to their major such as engineering.

The results of this study could help to develop new strategies for fostering digital competence, acquiring, and appropriating new vocabulary in English. It could also prompt the creation of extracurricular activities and academic programs based on students' needs related to digital competence and the improvement of the English language level. On the top of that, it could prompt students to become independent learners so that they would not have to depend on teachers all the time for learning new vocabulary.

1.3 Objectives

1.3.1 General objective

The general objective of the research is to examine how engineering students learn technology-mediated vocabulary in English.

Moreover, the aim of this study is to describe the level of digital competence that engineering undergraduates at University of Quintana Roo have developed and the possible differences across majors, gender, level of English, and employment situation.

1.3.2 Specific objectives

1. To examine how engineering students at UQRoo learn vocabulary in English through technology-mediated strategies.
2. To state which level of digital competence prevail in engineering students at the University of Quintana Roo.

3. To explore the possible differences between the level of digital competence and the level of English in engineering students at the University of Quintana Roo.
4. To analyse the possible differences between the level of digital competence and majors, gender, and employment situation.

1.4 Research questions

RQ1. What are the most and the least frequently reported technology-mediated vocabulary learning strategies reported by undergraduate engineering students from UQRoo campus Chetumal?
RQ2. Are there any differences in the use of technology-mediated vocabulary learning strategies across majors?
RQ3. Are there any gender differences in technology-mediated vocabulary learning strategies reported by engineering students?
RQ4. Are there any English level differences in technology-mediated vocabulary learning strategies reported by engineering students?
RQ5. How engineering students self-evaluate in terms of digital competence regarding technology-mediated vocabulary learning strategies?
RQ6. Are there any employment situation differences in technology-mediated vocabulary learning strategies reported by engineering students?

In the light of technology-mediated vocabulary learning strategies vary according to students' background, whether or not employment situation may support the enhancement of English language along with digital competence.

1.5 Significance/relevance of the study

The outcomes of this research will offer a diagnosis related to digital competence of engineering students as a pedagogical resource for learning technology-mediated vocabulary. Furthermore, it will provide new data as regards how digital divide may impact on students' performance and achievement in relation to communication skills in English as foreign language.

CHAPTER 2 REVIEW OF LITERATURE

Two main strands of literature are reviewed in this study on technology-mediated vocabulary learning strategies on engineering students. This chapter outlines the scopes, definitions, theoretical frameworks, and empirical evidence of studies related to the topic upon which this research is based. The general objective of the research is to explore how engineering students learn technology-mediated vocabulary in English.

The first theoretical framework refers to digital competence which is defined by Ala-Mutka (2011), Ferrari (2013), and *Instituto Nacional de Tecnologías Educativas y de Formación del Profesorado* (INTEF Spanish acronym) (2017). The second framework is vocabulary in English and vocabulary learning strategies informed by Laufer (1998), Laufer and Nation (1999), Nation (2000, 2010, 2015), Nation and Kyongho (1995), Nation and Meara (2010), Read (2004), Ahmed (1989), Chamot (1998), Schmitt (1997, 2000, 2007), and Marin (2005). The third theoretical framework is technology-mediated vocabulary learning and strategies in which the vocabulary learning strategies follow Schmitt's (1997), Marin-Marin's (2005), and Li's (2009) taxonomy.

The research draws on studies pertaining to digital competence that supports the learning of vocabulary in English mediated by technology in college students (Clark, 2013; Wanpen et al., 2013), and on level of digital competence in English as foreign language learners (Fuentes & Cortes, 2017; Avila, 2017).

2.1 Digital competence

A general overview of digital competence, conceptual and theoretical frameworks are presented in this section. The importance and the role that information and communication technologies play in several areas (education, business, politics, etc.) has led to the creation of frameworks in order to develop and assess digital competence in people. The theoretical frameworks have been developed along the time in order to improve and implement them in specific contexts. The frameworks mentioned here were created in the European Union, who has led this field for several years. Nevertheless, these frameworks may be adopted and applied according to the needs of institutions, or even countries.

2.1.1 Digital competence in the classroom

Digital competence must be understood within the context of information and communication technologies (ICT), not to mention the Internet. The advent of ICT in the classroom or in learning environments has brought substantial benefits to learners such as reaching and sharing information; creating content; and communicating instantly. To say nothing of the Internet connectivity that plays an important role in education since it assists and at the same time provides students an opportunity to gain knowledge outside the boundaries of the classroom which is most limited by paper books.

Furthermore, the Internet gives the opportunity to search around the world since somehow the whole world becomes a school book. Students are limited by time and space; contrariwise, the use of Internet and other ICT are not limited by these two dimensions since they are virtual. Using the Internet along with ICT, gives learners the opportunity to deploy their knowledge and gain learning. Therefore, digital competence is needed for this purpose. Yet accessibility to ICT, technology-mediated environments, and a low degree or lack of digital competence may represent a drawback for enhancing knowledge or acquiring it through the use and access to these technologies.

On the other hand, attention has been drawn to digital competence as a key 21st century skill for people (European Parliament and the Council, 2006), generally speaking. Hence, its development is necessary as it facilitates people to be digitally included and be functional in any field at the present time. Erstad (2010, as cited in Ferrari, 2013) states that "digital inclusion depends more on knowledge, skills and attitudes than on access and use" (p. 7). Extrapolating this, students are required to develop their digital competence so that they can be competent in today's society.

2.1.2 Definition of digital competence

Digital competence concept has evolved along the time since the digital technology emerged: from being digital literacy to digital competence (Fuentes & Cortes, 2017). In this sense, digital competence focuses on the cognitive abilities for using technology sagaciously, whereas digital

literacy emphasizes the understanding for using technology (*idem*). One of the current definitions is provided by Ferrari (2012), who describes digital competence as

> the set of knowledge, skills, attitudes (thus including abilities, strategies, values and awareness) that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socialising, consuming, and empowerment. (p. 3-4)

This definition comprises two dimensions: the knowledge and cognitive process of the use of digital competence.

Furthermore, a broader definition of digital competence is the one provided by the *Instituto Nacional de Tecnologías Educativas y de Formación del Profesorado* (INTEF, 2017) in which the concepts appropriation, adaptation, and creativity are involved. Hence, digital competence is defined as "the creative, critical and confident use of information and communication technologies to achieve the objectives related to work, employability, learning, leisure, inclusion and participation in society" (INTEF, 2017, p. 12).

This last definition provided by INTEF (2017) is going to be used for the intended purpose in this research since it is grounded on the teaching practice. Moreover, this definition includes the areas in which students interact and develop their skills personally and professionally that may contribute to develop or implement strategies for learning technology-mediated vocabulary in English. It is worth mentioning that this definition as well as the theoretical framework proposed by INTEF (2017) has been taken into consideration in national research papers as though Fuentes and Cortes (2017), and Avila (2017) in the light of its implications on the educational arena which also promotes long-life learning.

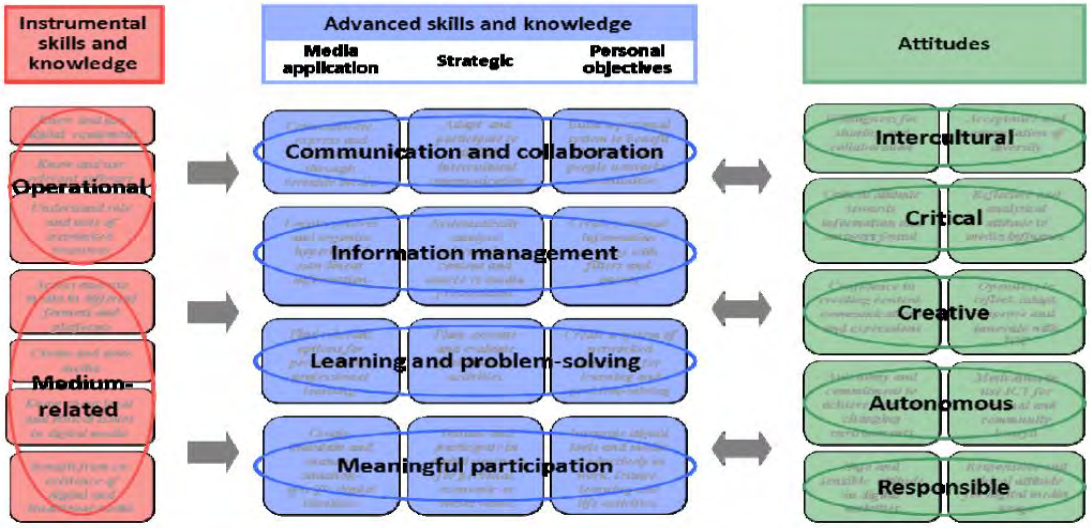
2.1.3 Theoretical-conceptual frameworks

Conceptual and theoretical frameworks have been defined in order to address the digital gap and foster the development of digital competence (Bawden, 2008; Martin & Grudziecki, 2006; van Deursen, 2010, as cited in Ala-Mutka, 2011). An initial framework called "Mapping Digital

Competence: Towards a Conceptual Understanding" (see Figure 2.1), Ala-Mutka (2011, p. 6) proposes a conceptual model in which tree main areas are considered:

1. Instrumental knowledge and skills for digital tool and media usage.
2. Advanced skills and knowledge for communication and collaboration, information management, learning and problem-solving, and meaningful participation.
3. Attitudes to strategic skills usage in intercultural, critical, creative, responsible and autonomous ways. Instrumental knowledge and skills are a precondition for developing or using more advanced skills.

Figure 2.1
Ala-Mutka's proposed digital competence conceptual model



Source: Adapted from Ala-Mutka (2011, p. 6).

In this model, Ala-Mutka (2011) states that this is a first step for building a digital competence framework in the DigComp project. This long term study "is expected to contribute to several actions under the Europe 2020 Flagship 'Digital Agenda for Europe'…" (Joint Research Centre, 2009).

Consequently, Ferrari (2013) offers "A Framework for Developing and Understanding Digital Competence in Europe", which is the result of a study of several digital competence frameworks, and the revision of Ala-Mutka's model (2011, p.6). This framework provided by Ferrary (2013, p. 4) is structured into five areas of competence:

1. **Information:** identify, locate, retrieve, store, organise and analyse digital information, judging its relevance and purpose.

2. **Communication:** communicate in digital environments, share resources through online tools, link with others and collaborate through digital tools, interact with and participate in communities and networks, cross-cultural awareness.

3. **Content-creation:** create and edit new content (from word processing to images and video); integrate and re-elaborate previous knowledge and content; produce creative expressions, media outputs and programming; deal with and apply intellectual property rights and licences.

4. **Safety:** personal protection, data protection, digital identity protection, security measures, safe and sustainable use.

5. **Problem-solving:** identify digital needs and resources, make informed decisions as to which are the most appropriate digital tools according to the purpose or need, solve conceptual problems through digital means, creatively use technologies, solve technical problems, update one's own and others' competences.

At the same time, this framework is also structured into five dimensions that reflect a different aspect of the descriptors:

Dimension 1: **competence areas** that have been identified.

Dimension 2: **competences** that are pertinent to each area.

Dimension 3: **proficiency levels** that are foreseen for each competence.

Dimension 4: **examples of the knowledge, skills and attitudes** applicable to each competence (examples are not differentiated in proficiency levels).

Dimension 5: **examples on the applicability of the competence to different purposes**. Within this report, examples for Learning and Employment are provided. Other dimensions that can be considered are: Leisure; Social; Buying and Selling; Learning; Employment; Citizenship; Well-being. (Ferrari, 2011, p. 11)

Ferrari's framework (2011) explains aspects of digital competence by means of 21 competences described in terms of key components of competence (skills, knowledge, and attitudes). It also indicates the descriptors above-mentioned that are referred to the European context that may be applied on other settings such as Mexico.

Having said that, INTEF (2017) proposed the "Common Digital Framework for Teachers". The purpose of it is to develop digital competence in teachers so that they can ensure high quality teaching in which ICT is included in the classrooms as well other digital resources and be able to assess students' digital competence.

With this in mind, it is worth mentioning that citizenship is the main focus of other frameworks (e.g. Ala-Mutka, 2011; Ferrari, 2013). The INTEF framework is an adaptation of the "DigComp 2.0" developed by Joint Research Centre (2016, as cited in INTEF, 2017). The areas of competence are as follows (see Figure 2.2):

1. **Information and data literacy:** identify, locate, retrieve, store, organize and analyse digital information, evaluating its purpose and relevance.
2. **Communication and collaboration:** communicate in digital environments, share resources through online tools, connect and collaborate with others through digital tools, interact and participate in communities and networks; Intercultural awareness.
3. **Digital Content Creation:** create and edit new content (texts, images, videos ...), integrate and re-elaborate previous knowledge and contents, perform artistic productions, multimedia contents and computer programming, know how to apply intellectual property rights and use licenses.
4. **Safety:** personal protection, data protection, digital identity protection, use of security, safe and sustainable use.
5. **Problem solving:** identify digital needs and resources, make decisions when choosing the appropriate digital tool according to the purpose or need, solve conceptual problems through digital media, solve technical problems, creative use of technology, upgrade own competence and of others. (pp. 12-13)

In this proposal the competence descriptors are presented on three proficiency levels: A (Foundation –Basic-), B (Intermediate), C (Advanced). Moreover, "The development of the descriptors subdivided into six competence levels (A1 - C2) for each of the competencies [*sic*] of each of the five areas" (INTEF, 2017, p. 34).

Figure 2.2
Areas of the Common Digital Competence Framework for Teachers

Source: Adapted from INTEF (2017, p. 36).

The framework proposed by INTEF (2017) was adopted for this study since it is grounded in the educational field. Even though it is recommended for teachers in order to ameliorate or develop their digital competence, students can also enhance it and benefit from it as well. This framework offers a suitable model that benefits both agents in the field: teachers and students.

Furthermore, this study on technology-mediated vocabulary learning strategies is done under Constructivism, drew mainly on Jean Piaget's and Lev Vygotsky's work. The main premise of Constructivism is that "humans learn by constructing knowledge; that is, by connecting new information to previously learned knowledge" (Lenters, 2013, p. 63), it also states that individuals learn as they interact with their environment. From thereon, Constructivism approach aims to facilitate development of independent thinking and problem solving on individuals.

Moreover, Constructivism, is a learner-centred approach, hence it facilitates the interaction with technology-mediated learning environments. In this respect, Weasenforth et al. (2002) state that "constructivists have found that communication technologies can realize constructivist ideals

of learning" (p. 58) such as collaborative and active construction of knowledge in contrast to the one transferred from one person to another (Bonk & Cunningham, 1998, as cited in Weasenforth et al., 2002). Likewise, technology-mediated learning environments promote "engagement in contextualized authentic tasks as opposed to abstract instruction, and less-controlled environments versus predetermined sequences of instruction" (Weasenforth et al., 2002, p. 58), and they also "encourage thoughtful reflection and 'empower ... learners ... to assume ownership of their knowledge, rather than reproducing the teacher's' (Jonassen, 1994, p.6, as cited in Weasenforth et al., 2002, p. 58).

To that effect, technology-mediated learning and digital competence go hand in hand when it comes to constructing knowledge from the experience and interacting with one's environment, and with one another. Not to mention that both technology-mediated learning and digital competence lead to self-directed learning in which individuals develop 21st century skills.

2.2 Technology-mediated vocabulary in English

The definitions and concepts related to technology-mediated vocabulary learning and vocabulary in general terms are presented in this section. The concept of vocabulary learning in second language is presented first in order to offer a general overview of this specific matter. Then, some descriptions and levels of the concept of vocabulary and strategies for learning vocabulary are also indicated.

2.2.1 Vocabulary in English language learning

Vocabulary knowledge, generally speaking, is a pivotal aspect in language competence since it allows people to achieve comprehension. In second language learning, vocabulary is as well important because it enables students to have a major understanding of texts (e.g. listening, reading), and to produce discourse (e.g. writing, speaking). Conversely, neglecting learning vocabulary leads to low performance in the language as well impedes communication.

Learning vocabulary can be done incidentally or intentionally. Read (2004), Schmitt (2007), Nation (2000, 2015), Chung and Meara (2010) state that word knowledge is acquired incidentally

by means of extensive reading, at a slow rate. On the other hand, intentional learning is done through the activity that is focused to enhance learner's vocabulary knowledge.

According to Nation (2015), vocabulary learning in second language occurs under certain learning conditions. That is, when mental conditions are created that encourage learning. He also points out that

> vocabulary learning depends on the number of meetings with each word and the quality of attention at each meeting. The more meetings, the more likely learning is to occur. The deeper the quality of the meetings, the more likely learning is to occur. (Nation, 2015, p. 136)

In this sense, Nation (2015) mentions that extensive reading offers opportunities for learning vocabulary deliberately by looking up the meaning of words in dictionaries. Moreover, reading on a specific subject, vocabulary is repeated all through, so there is a greater opportunity to learn this vocabulary (Schmitt & Carter, 2000, as cited in Schmitt, 2007). Most importantly, vocabulary size determines reading comprehension, fluency in speech, and writing quality (Laufer, 1998). For example, learners need to reach a threshold of 3,000 words families in order to achieve comprehension of written authentic prose (Laufer, 1998; Laufer & Nation, 1999). Besides, for being able to participate in everyday oral communication, it is necessary to know the most frequent 2,000-3,000 word families in English (Schmitt, 2007). Hence, the importance of learning vocabulary.

2.2.2 Definition of vocabulary and its taxonomy

In a broad sense, vocabulary can be defined as "the knowledge of meanings of words" (Hiebert & Kamil, 2005, p. 3). By its part, Ur (2012) describes vocabulary as all the words in the language that may include items with a single-word or multi-words expressions or 'chunks'. A close definition is provided by Lessard-Clouston (2013), who states that vocabulary are

> the words of a language, including single items and phrases or chunks of several words which covey a particular meaning, the way individual words do. Vocabulary addresses single lexical items —words with specific meaning(s)— but it also includes lexical phrases or chunks. (p. 2)

With this in mind, there is a distinction between receptive and productive vocabulary (Nation, 2000; Schmitt, 2000; Hiebert & Kamil, 2005). Receptive vocabulary implicates the input of the word through listening or reading and retrieving its meaning. Whereas productive vocabulary involves the production of language by means of speaking or writing in order to convey a message. Nevertheless, receptive vocabulary is larger than productive vocabulary (Gower, Phillips, & Walters, 1995; Kamil & Hiebert, 2005).

Nation and Kyongho (1995), Nation and Meara (2010), Chung and Nation (2003, as cited in Nation, 2001) provide a division or levels of vocabulary in non-fiction texts: general or high frequency vocabulary, sub-technical vocabulary or academic, technical vocabulary, and low frequency vocabulary. General or high frequency vocabulary is described as the most frequent 2,000-word families in English. Sub-technical or academic vocabulary are the words that occur in academic texts and it contains over 800-word families. According to Chung and Nation (2003), "this vocabulary is common to a wide range of academic fields but is not what is known as high frequency vocabulary and is not technical in that it is not typically associated with just one field" (p. 104).

The subsequent classification is technical vocabulary which is related to a particular subject area. It makes up from 20-30 per cent of the running words of a text and its repetition along the text occurs frequently than in general usage (Chung & Nation, 2003, 2004). According to Nation and Meara (2010), Nation and Kyongho (1995), and Chung and Nation (2004), it occurs frequently in specialized texts. In relation to low frequency words, they consist of words "that occur with low frequency over a range of texts, that are so rare that low frequency is inevitably related to narrow range, or that are technical vocabulary of other subjects …" (Nation & Kyongho, 1995, p. 37).

For the purpose of the study, the definitions given by Lessard-Clouston (2013), and the classification of vocabulary offered by Nation and Kyongho (1995), Chung and Nation (2003, 2004) are being used in this research. Both definitions are focused on the aspects that the English courses are taught at the University of Quintana Roo through the Language Learning Centre encompass to a greater or lesser extent.

On the other hand, the Language Learning Centre offers a self-access centre (based on the student-centred approach) to students in which they can learn, practice, and enhance English by their own by means of different resources (e. g. printed books, CDs, DVDs, Internet access,

speakers' corner), so that students can become self-directed English learners. In this sense, learning vocabulary is fundamental in this learning process.

2.2.3 Vocabulary learning strategies

This section overviews some general aspects of vocabulary learning strategies indicated by Ahmed (1989), Schmitt (1997, 2000), and Marin-Marin (2005). It should be highlighted that these authors draw their attention to how students control and deal their own language learning focused on vocabulary, that is to say, vocabulary learning strategies. In this tenor, Schmitt (1997, adapted from Rubin, 1987, p. 29) describes vocabulary learning strategy as the process by which vocabulary is obtained, stored, retrieved, and practiced.

Moreover, Marin-Marin (2005) defines vocabulary learning strategies as "those conscious and unconscious, planned and unplanned steps and actions that L2 learners take to discover and consolidate the form, meaning and usage of words" (p.74). This definition will be used for the purpose of this thesis since it involves both process of the vocabulary acquisition (incidental and intentional) since it may occur in both forms.

Concerning to language learning strategies, which encompass vocabulary learning, have been early studied by O'Malley et al. (1985, as cited in Schmitt, 1997) who indicated that "training research on learning strategies with second languages has been limited almost exclusively to cognitive applications with vocabulary" (p. 561). In this respect, Chamot (1998) defines learning strategies as "the thoughts that students have and actions that they can take to assist their comprehension, recall, production, and management of their language learning" (p. 2).

Notwithstanding, most of the research done in vocabulary learning strategies was concerning to guessing from context and mnemonics (Huckin, Haynes, & Coady, 1993; Pressely, Levin, & Miller, 1982; Pressely et al., 1982a, as cited in Schmitt, 1997) but nothing that shed light on more specific vocabulary learning strategies, according to Schmitt (1997).

In a deeper research on vocabulary learning, Ahmed (1989) studied several strategies that good and under-achieving Arabic learners of English used for that purpose. In the study, Ahmed (1989) made a detailed classification of vocabulary learning strategies than the prior ones carried out by Naiman et al. (1978), Brown (1982), Rubin (1983), and Porte (1986). Ahmed (1989) classified the strategies into seven large categories:

1) **Learning some aspects of words before knowing their meaning**: writing and saying words repeatedly to learn spelling, word by heart.
2) **Sources used to get information about difficult words on first encounter:** asking classmates, guessing, asking teacher, overlooking, asking about meaning by demanding English paraphrase or a synonym, asking for an equivalent in L1, asking for a sentence demonstrating word usage, group work, dictionary.
3) **Dictionary use:** using monolingual/bilingual dictionary, looking for information about spelling/pronunciation, looking for meaning/word derivations/the grammatical class of a word, looking for information about the collocation of a word/stylistic-overtones of words/grammatical idiosyncrasies, seeking examples demonstrating word usage.
4) **Memorization of word:** writing + saying a word repeatedly, saying a word repeatedly, saying + writing word + English synonym repeatedly, writing + saying English synonyms repeatedly and then writing the word in questions once, writing + saying word + L1 equivalent repeatedly.
5) **Practice:** making use of newly-learned words in real situations, making use of newly-learned lexical items in imaginary situations, asking somebody to test oneself about particular lexical items/to verify knowledge, checking written sources to confirm knowledge, testing oneself by going through list of words.
6) **Preferred source of information:** asking somebody, group work, dictionary.
7) **Note-taking:** taking notes of words + some information about, taking notes about words in the margin, taking notes about difficult words in a separate book, organizing words alphabetically/in terms of their meaning/as encountered but continually linking words semantically, keeping information about spelling/pronunciation, listing words and their L1 equivalent only, listing words and their English meaning, listing words and their L1 equivalent and English meaning together, keeping word derivations in the entries, keeping information about the grammatical class of words in the entries, including sentences with words illustrating the usage of words. (pp. 180-182)

It is worth mentioning that Ahmed's classification (1989) included the source of information that students prefer so that they can learn new vocabulary. He noticed in his study that students used the strategy of group work, the use of dictionary, and asking classmates for this

purpose, even though some of those strategies are listed as a different category such as the use of dictionary -since this activity involves one person-, according to Ahmed (1989).

A subsequent taxonomy of vocabulary learning strategies was made by Schmitt (1997) based on Oxford's (1990) and the Determination Strategies generated by him since the lack of a comprehensive list of individual strategies on the topic. The classification made by Oxford (1990, as cited in Schmitt, 1997) includes four major categories derived mainly from general learning strategies: memory (relating new material to existing knowledge), cognitive (manipulating or transforming the language learning by the learner), metacognitive (involving a conscious overview of the learning process such as planning, monitoring, evaluating the best ways to study), and social (using interaction with others to improve language learning). Schmitt's Determination Strategies (1997) refers to the category which "describes the kind of strategies used by an individual when faced with discovering a new word's meaning without recourse to another person's expertise" (p. 23).

Schmitt's inventory (1997) contains 58 strategies, most of them based on a survey study of Japanese learners. These are listed below:

a) **Strategies for the Discovery of a New Word's Meaning:** analyse part of speech/affixes and roots, check for L1 cognate, analyse any available pictures or gestures, guess from textual context, bilingual/monolingual dictionary, word lists, flash cards, ask teacher for an L1 translation/for a paraphrase or synonym of the new word/for a sentence including the new word, ask classmates for meaning, discover new meaning through group work activity.

b) **Strategies for Consolidating a Word Once it has been Encountered:** study and practice meaning in a group, teacher checks students' flash cards or word list for accuracy, interact with native speakers, study word with a pictorial representation of its meaning, image word's meaning, connect word to a personal experience, associate the word with its coordinates, connect the word to its synonyms and antonyms, use semantic maps, use 'scales' for gradable adjectives, Peg Method, Loci Method, group words together to study them, group words together spatially on a page, use new word in sentences, group words together within a story line, study the spelling of a word/the sound of a word, say new word aloud when studying, image word form, underline initial letter of the word, configuration, use Keyword Method, remembering affixes and

roots/part of the speech, paraphrase the words meaning, use cognates in study, learn the words of an idiom together, use physical action when learning a word, use semantic feature grids, verbal/written repetition, word lists, flash cards, take notes in class, use the vocabulary section in your textbook, listen to tape of word lists, put English labels on physical objects, keep a vocabulary notebook, Use English-language media (songs, movies, newscasts, etc.), testing oneself with word tests, use spaced word practice, skip or pass new word, continue to study word over time. (pp. 10-12)

From the above list, Schmitt (1997) divided into two main categories the strategies for learning vocabulary by drawing a line between encountering a new word and those strategies for consolidating the word encountered. He also included strategies that involve group work when encountering a new word, and also pointed out the use of authentic material as a source for consolidating the knowledge of a new word whose support is by means of electronic devices.

In the same manner, Marin-Marin (2005) offers a comprehensive list of 78 vocabulary learning strategies divided into three categories and subcategories (see Marin-Marin, 2005) on the basis of his research "Extraversion and the use of vocabulary learning strategies among university EFL students in Mexico". The strategies are listed below.

a) **Dealing with unknown vocabulary:** guessing, using dictionaries an other sources, asking others.
b) **Taking Vocabulary Notes:** places where notes are kept about new words, kind of information recorded about new words, organizing notes about new words.
c) **Memorising/Retaining Vocabulary:** repetition to help retain the word, association to help retain words, further practice/consolidation of new words. (pp. 349-351)

Marin-Marin (2005) found that more extroverted learners use vocabulary learning strategies in a higher frequency than introverted learners, and that the most used strategies were the use of a dictionary to check meanings, writing down the Spanish translation, among others. As for the least used strategies were recording words on audiocassettes, keeping notes on any electronic devices or web-based dictionaries. As it can be seen, the use of Information and Communication Technologies were of low-frequent use by English learners in that time.

The vocabulary learning strategies defined by Marin-Marin (2005) were used and adapted in order to fulfil the purpose of this study since they are particularly specific and encompass many aspects of the vocabulary learning which are focused on situations, learning environments, and

technological resources in which vocabulary learning may occur. Some of the strategies presented by Marin-Marin (2005) are: checking for cognates, looking up the word on the Internet, asking the grammar of the word, keeping vocabulary notes in a computer or other electronic devices, etc. It is worth mentioning that Marin-Marin's study (2005) is one of the pioneers in the topic since it draws attention to ICT and devices or technological resources that students may use for learning vocabulary, so this study makes a link on technology-mediated vocabulary learning strategies, which is the topic of this thesis.

2.2.4 Technology-mediated vocabulary

In the past decades, there was little research on technology-mediated vocabulary learning strategies since the use of technological resources was not a common practice for this purpose. Additionally, the use of ICT was not extended to all students and it was not available or affordable at all for most of them such as students in Mexico. In the recent years, new studies related to vocabulary learning strategies have emerged since there has been some changes on how language learners apply and use ICT to learn vocabulary (Li, 2009; Liu, Lan, & Jenkins, 2014; Clark, 2013).

In order to frame what technology-mediated vocabulary learning means, which is comprised under the concept of language learning, we will first mention the concept of technology-mediated instruction. In this regard, it is defined as the use of "various devices to assist in the teaching and learning process" (Academic Senate for California Community Colleges, 1997, p. 10), in which technology supports students in achieving their goals. This definition basically involves both teacher and learner in technology-mediated environments.

As refers to learning, Alavi and Leidner (2001) indicate that technology-mediated learning is "an environment in which the learner's interactions with learning materials, peers, and/or instructor are mediated through advanced information technology" (as cited in Gupta & Bostrom, 2007, p. 688). As it can be noted, in this description technology-mediated learning can be carried out on the autonomous way by the student and or by the guidance of the teacher. A comprehensive definition of this concept is offered by Shield (2016), who explains that

> 'Technology-mediated learning' (TML) is an 'umbrella' term, incorporating different approaches to using computers in learning and teaching: computer-aided/assisted learning (CAL), computer-mediated communication (CMC), generic computer-based production

and presentation tools and computer-supported research tools. Increasingly, these tools are incorporated (in different combinations) into 'Managed Learning Environments' (MLEs) in which educators can define an environment where learners can access resources, drills, other learners and tutors, research and assessment tools. (para. 1)

This term has been extrapolated to the second language learning field. In this sense, Chapelle (2003), states that technology such as the Internet has impacted English language learning since it represents a comprehensible input for any learner in a kind of virtual immersion. In addition, she indicates that new terms on technology-use have been invented in the language learning field according to the perspectives and changes in technology such as technology-mediated second language learning, computer-assisted language learning, technology-based learning, and other collocations. In short, "a variety of terms to signify technology in applied linguistics" (Chapelle, 2003, p. 33).

With this in mind, studies on second language learning have been carried out and some of them are called under different terms such as computer-mediated, technology-based (Li, 2009), technology enhanced-support (Liu, Lan, & Jenkins, 2014; Cummins, 2003, as cited in Li, 2009), technology-enhanced/mediated (Ma, 2017). On the other hand, research on vocabulary strategies using technology "remains little understood" (Liu, Lan, & Jenkins, 2014, p. 106). Nevertheless, this topic is becoming more and more studied as technology pervades education.

In this study, the term technology-mediated vocabulary learning strategies will be used for referring to those strategies employed in the process of second language learning by means of any technology or technological device that mediates, supports, assists or/and enhances vocabulary learning incidentally and/or intentionally in an autonomous way or under teaching assistance at any kind of context, environment, and approach.

2.2.5 Technology-mediated vocabulary learning strategies

The use of technology-mediated environments in second language learning has expanded among learners over the past decade not only for spending time in but also for practicing and learning on websites tailored for this aim (White, Direnzo, & Bortolotto, 2016). In this regard, vocabulary learning strategies have also evolved in terms of technology and the interaction between device/support/e-tool/ application with learners. For example, Li (2009) indicates that one of the

vocabulary learning strategies on second language through the use of the technology that prevailed on the last decade was the use of electronic dictionaries. This strategy is called "dictionary lookup behavior" and it proved to be effective to the purpose (Laufer & Hill, 2000; Hulstijn, 1993; Knight, 1994; as cited in Li, 2009). By its part, Li (2009) conducted a study on English as second language students by using a computer program that consists on reading, writing, and grammar modes and have access to mono and bilingual dictionaries among other tools (the *e-Lective* environment) in order to build up vocabulary as well. Some of the vocabulary learning strategies used by students in the research are as follows:

a) **Using online dictionaries:** looking up for the unknown words showed on the screen by clicking mono or/and bilingual definitions.
b) **Note-taking:** taking notes while reading or after finishing, organizing the unknown words on lists, creating bilingual word-pair vocabulary lists.
c) **Guessing and inferring:** analysing sentences and paragraphs by using cue-oriented guessing strategies.
d) **Summarizing and making connections:** applying, summarizing, and manipulating phrases and words.
e) **Reading aloud:** practicing the pronunciation in words, sentences and even the whole text by paying attention to syllables and stress patterns; repeating words accurately after the computer.
f) **Discussing:** engaging actively in discussions by including repetition, quotation, recitation and making reference to the texts, switching between L1 and L2 to facilitate comprehension, translating, and reasoning.

Li (2009) observed that "the technology-enhanced scaffoldings can effectively assist students to advance their learning strategies, potentially optimizing their reading-based vocabulary acquisition" (p. 118). She also noticed that students employed a variety of strategies across social, metacognitive, compensatory, and cognitive categories while learning vocabulary. In this regard, Li (2009) classified those strategies according to Oxford's taxonomy (1990). From this research, it should be noticed that vocabulary learning strategies mediated through technology do not vary but the resources/e-tools do.

Likewise, Marin-Marin (2018) conducted a survey in order to know university students' vocabulary learning strategies nowadays. The strategies he observed are as follows:

a) **Meeting new vocabulary:** looking for the meaning on mobile apps on/offline, looking for the meaning and examples on the Internet, searching on Google or asking to an English language speaker, using a translator online, using a student's dictionary.
b) **Keeping vocabulary notes:** writing down the words on a paper notebook or on the mobile, making word lists and underlining the unknown words, word lists on paper or on the edge of the notebooks, using the notes app on the tablet, making word lists (history) on the offline dictionary, making notes on the notebook or on the mobile (notes app).
c) **Memorising/retaining new words:** relating the word to a picture, making metal dialogues with themselves or "answering letters on *Slowly*", relating the word with the context, repeating the words aloud and using the new vocabulary on conversations, making word lists and study them, associating words with a situation or phrase.

The vocabulary learning strategies students use on the survey are not only digital resources or tools but also "traditional" resources for this purpose such as making word lists or writing notes on paper/notebooks.

In a previous paper, Dalton and Grisham (2011), proposed ten strategies to engage students to build up vocabulary. Those were designed to support the teaching of the words by using technology drew on research-based principles of vocabulary instruction. Dalton and Grisham (2011) used the term *eVoc* to refer the strategies that "rely on digital tools and resources and to suggest the evoking of learning potential that is possible when technology and media are part of the instructional mix". The Internet resources they presented are free digital tools which most of them are still available for learners. It should be mentioned that the strategies provided by Dalton and Grisham (2011) were firstly focused on build up vocabulary in English (L1) in order to develop the advanced literacy levels in children, but they are also helpful for English language learners of all ages so that they can learn new vocabulary. The *eVoc* strategies are as follows:

1) **Learning from visual displays of word relationship within text:** It refers to graphic organizers and visual displays as word clouds and mapping tools such as Wordle and Wordsift.
2) **Taking a digital vocabulary field trip:** It allows learners to "visit several teacher-selected websites and gain knowledge about words through multiple exposures in

different contexts and through different media, including reading, viewing, writing, and conversation" such as TrackStar.

3) **Connecting fun and learning with online vocabulary games:** On specific websites a variety of activities such as "crossword puzzles, picture-word matches, word scrambles, and 8 Letters in Search of a Word" are offered such as Vocabulary Games and Vocabulary.
4) **Having students use media to express vocabulary knowledge:** These are through digital stories, photo essays (for example, by using Power Point as a media format), podcasts, on wikis or word blog. On these activities students work collaboratively.
5) **Taking advantage of online word reference tools that are also teaching tools:** These are online distribution platforms such as Visual Thesaurus website, or Dictionary.com that "links to Facebook, has an iPhone application, a free toolbar application, a word of the day that is communicated on Twitter or as a text message on your mobile phone, and a free weekly word explorer audio podcast on iTunes".
6) **Supporting reading and word learning with just-in-time vocabulary reference support:** It refers to Internet-based dictionaries which include audio pronunciations of the word since they provide visual/spatial and linguistic channels of input (Mayer, 2011, as cited in Dalton & Grisham, 2011). For example, Reference.com, Merriam-Webster, etc.
7) **Using language translators to provide just-in-time help for ELLs:** "… It supports learning words as they occur naturally in authentic text and allows students to view bilingual versions of a text side by side so that they can use their first-language knowledge to develop their English vocabulary". For example, BabelFish, Google translate, Bing Translator.
8) **Increasing reading volume by reading digital text:** Free content on the Internet and digital texts at different reading levels and learners' interests are resources for expanding the vocabulary. Some quality sites are Time for Kids, National Geographic Kids, etc.
9) **Increasing reading volume by listening to digital text with a text-to-speech (TTS) tool and audio books:** It allows learners to listen to a digital text with a TTS tool (TTS tools as NaturalReader), or to audio narration. It is recommended for struggling readers

since it basically increases their reading speed, and reduces stress (Elkind & Elkind, 2007, as cited in Dalton & Grisham, 2011) as Learning Through Listening website.

10) **Combining vocabulary learning and social service:** Free Rice promotes social learning besides learning vocabulary in English by using Web 2.0 technology.

In short, Dalton and Grisham (2011) draw attention to the integration of digital tools and resources in order to develop vocabulary in English. They also point out that knowing how to use online resources "is part of becoming a strategic learner", which in this sense, it is essential nowadays to be an autonomous learner. On another note, the *eVoc* strategies do not follow the classical taxonomies such as Oxford's (1990), nor Schmitt (1997), but the specific purposes of the digital resources for supporting word learning such as expanding wide reading and incidental word learning, and developing strategic digital readers with on-demand vocabulary help.

Correspondingly, Tyson (2013; 2016) presents four categories of digital resources for support word learning:

1) **Reference Tools:** Lingro, Lexipedia, Shahl, Snappy Words, Visual Dictionary Online, Word Hippo, Wordnik, Your Dictionary, MathWords, A Math Dictionary for Kids
2) **Word Clouds:** Wordle, WordSift, Tagxedo, WordArt
3) **Games and Review:** Flashcard Stash, Vocabulary Games, Vocabulary Spelling City, VocabAhead, Free Rice
4) **Word Walls and Virtual Field Trips:** Padlet, ThinkLink, TrackStar

Moreover, Tyson (2016) indicates that digital tools have several advantages such as allowing students to:

- Hear pronunciations.
- Read words in a variety of authentic examples.
- View photos and images related to words (important for English language learners).
- Reinforce word learning through interactive games.
- Play with and manipulate language.
- Discover rhyming words.
- Collaborate with classmates to create virtual word walls.

Online tools as the ones she showed "provide a broader array of information about words and word meanings" (Tyson, 2013). It should be mentioned that those digital resources not only

support vocabulary in English in native speakers but also assist for word learning in English language learners.

According to the literature reviewed, it can be seen that technology-mediated vocabulary learning strategies (TMVLS) follow almost the classical strategies presented by Oxford (1990), Schmitt (1997), and Marin-Marin (2005) in regards the learning process and classification, but it makes them different since the resources/tools/supports/devices are digital or technological.

In this regard, Ma (2017) mentions that there are many ways to learn vocabulary anywhere, and anytime through online technologies such as watching videos on YouTube, using dictionary Apps, etcetera given the ubiquitous nature of these. Furthermore, Ma (2017) categorizes applications and tools intended for vocabulary learning according to the stages in second language acquisition. The four-stage internal memory-based strategies for vocabulary learning that Ma (2014a, as cited in Ma, 2017) proposes are as follows:

> First, the new word form in visual or auditory input needs to be noticed by the brain, which could take place when the learner meets the new word either in reading or listening. Second, the meaning of the new word needs to be accessed from the mental lexicon; this could be made possible by looking up the word in a dictionary (paper or electronic) or guessing. Third, the new word needs to be established as a new L2 lexical entry in the mental lexicon by connecting the existing meaning (initially in L1 translation and later in L2 meaning) with the new word form via repetition, imagery or rhyming, etc. Lastly, each time the newly learned word is retrieved from the mental lexicon for receptive or productive use, the memory trace for this item will be strengthened. (p. 47)

With this in mind, according to Ma (2017), the two categories of tools and applications for learning vocabulary in second language are:

a) **Lexical tools:** They provide the meaning or use pattern of the new word encountered. Hence, they represent the two first stages in L2 vocabulary acquisition: discovering the new word, and obtaining the meaning. These are divided into three categories:
    - E-dictionaries (web-based, online dictionary, installed locally on desktop, apps on mobile devices).
    - Open-online resources such as Google, Wikipedia, thesauruses, and other search engines for looking up for meaning of unknown words.

- Lexical concordancers whose main purpose "is to discover how language or a word is used in real life by observing the pattern of use (e. g. collocations) from surrounding contextual clues" (p. 52). For example, corpus.byu.edu, The Word Neighbors, Lexical Tutor, etc.

b) **Lexical applications:** They provide "the major platform whereby learners' attention is attuned to the combination of the meaning, form and use of the item, which completes the last two stages of L2 vocabulary learning" (p. 52), which are mapping the word meaning with form, and consolidating the word. There are four categories:

- Technology-mediated incidental learning with textual, aural or visual input. "Incidental learning may take place when learners deal with listening or video-based input (…) The main function of this type of application is to execute the learner's command" (p.53) (play, pause or go back).
- Technology-mediated communication-based lexical learning. Learners can practice using the previously learned words by means of communication-oriented task/tools. For example, WhatsApp or WeChat on mobile devices in which learners interact with textual and aural information. "This type of meaning-focused communication-oriented lexical task enables learners to pay more attention to the vocabulary forms (spelling or pronunciation) than the previous incidental type of learning" (p. 54).
- e-Vocabulary lists/flashcards/exercises. Their purpose is "to consolidate the mapping of the word form and meaning in stage 3 of vocabulary learning" (p-54) such as SuperMemo, Anki, Word Engine, and iKnow!
- Dedicated lexical applications. These applications comprise all the stages involved in vocabulary learning. "In this type of application, vocabulary learning is both contextualized and itemized; attention is paid to both meaning (implicit learning) and form (explicit learning). The dedicated lexical applications often combine tutor functions with tool functions, providing the initial learning contexts as well as subsequent rehearsals or consolidated use" (p. 55).

As can also be seen in this section, TMVLS use specific lexical tools and applications (tool and tutor) for dealing/meeting with new words, accessing to their meaning, mapping the meaning and form of the item, and consolidating the word use.

2.3 Empirical evidence of studies of digital competence, vocabulary learning, and technology-mediated vocabulary learning strategies

Some studies related to the strands of this research are offered in this section. Firstly, empirical evidence of digital competence and the use of information and communication technologies (ICT) on students. Secondly, some studies related to vocabulary learning in English, and strategies. Lastly, some researches of technology-mediated language learning and vocabulary learning strategies (TMVLS).

2.3.1 Previous studies on digital competence

International and national studies focused on digital competence are presented in this part. At the international level, digital competence and its level of development in students has been broadly studied. Some of these researches are focused on digital competence as a "tool" for improving students' academic achievement, as well as performing a task on technology-mediated environments, or for learning vocabulary in English. For example, in Spain, Gutierrez et al. (2017) investigated the level of development of digital competence in students. Whereas Ramanau et al. (2010) studied the appropriation of ICT in college students in England. In the case of Mexico, Ambriz (2014) carried out a study for determining the level of digital competence in engineering students. Likewise, Fuentes and Cortes (2017).

2.3.1.1 International studies about digital competence in college students

Gutierrez et al. (2017) conducted a research project for building a questionnaire aimed to study the Digital Competence in students of Higher Education (CDAES, in Spanish) in Andalusian universities. The results showed that CDAES is an instrument with evidence of reliability and validity for exploring the technological skills.

On the other hand, Ramanau et al. (2010) carried out a longitudinal study on first-year college students in England. The objective of the research was to find out whether or not students from "the Net Generation would appropriate more ICT time for both social life and leisure, and

study purposes than older students, as this forms the basis for many Net Generation and Digital Natives claims about young people use of technology" (p. 1). The outcomes showed that students combined time for social life and leisure, and study purposes by at least 1 hour per day. Another interesting finding was that younger generation students used ICT for social life and leisure more frequently, in contrast older students used it for study.

2.3.1.2 National studies about digital competence on college students

In relation to national studies in digital competence, Ambriz (2014) studied the level of development of digital competence in engineering freshmen at the Superior School of Mechanical and Electrical Engineering of the National Polytechnic Institute (ESIME IPN, in Spanish*)* through a quantitative research. The research findings showed that the most developed digital competence in students was information at the basic level in the majority of them. The theoretical framework used in this research was the one developed by Ministry of Education in Chile.

Similarly, Fuentes and Cortes (2017), conducted a research in order to determine the digital competence developed by students of the major in English Language Teaching at the University of Quintana Roo. The study had a quantitative exploratory descriptive design and a questionnaire with scale Likert was applied. The results showed that the most developed digital competence was communication followed by information management. As for the least developed digital competence was creating content followed by collaborative work. The outcomes also revealed that the higher the semester, the more developed digital competence is in students.

2.3.2 Previous studies on vocabulary learning and strategies

A series of studies in learning vocabulary in English are presented in this section. The main focus of these researches is to study whether or not learners apply strategies for learning vocabulary in English and if their level of studies impact on the amount of learnt vocabulary they possess. International studies are presented by Wasuntarasophit (2008), who conducted a study aimed to measure the students' knowledge of technical and academic vocabulary. In the same manner,

Wanpen et al. (2013) carried out a study to determine vocabulary proficiencies and vocabulary learning strategies on engineering students.

Marin-Marin (2005), along with Chan and Trejo (2014) present studies related to vocabulary learning in English as foreign language that were carried out in Mexico. Marin-Marin (2005) studied the vocabulary learning strategies on college students. Similarly, Chan and Trejo (2014), conducted a research to determine the importance of vocabulary on English language major students.

A distinction should be made between English as Second Language (ESL) and English as Foreign language (EFL) in this section. ESL refers to "the teaching of English to speakers of other languages who live in a country where English is an official or important language" (Cambridge Dictionary, 2017). Unlike ESL, EFL "is the teaching of English to students whose first language is not English" (*Idem*).

2.3.2.1 International studies related to vocabulary learning

Wasuntarasophit (2008) conducted a quantitative research aimed to measure the students' knowledge of technical and academic vocabulary in Thailand. The outcomes of the study revealed that electrical engineering students' knowledge of vocabulary was dissimilar in different types of vocabulary (technical, general, and academic). Therefore, it rebounded their knowledge of vocabulary. In addition, it was showed that those students knew more technical words than academic words and technical phrases. The findings revealed that students who have a higher study level tent to possess a higher knowledge of vocabulary despite the fact that all of them had a different knowledge in relation to vocabulary types. Hence, the higher study level students had, the more vocabulary they knew.

In Thailand as well, Wanpen, Sonkoontod, and Nonkukhetkhong (2013) investigated the strategies that engineering students use for learning technical vocabulary in English and their differences according to students' education background (high school). The results revealed students "with the educational backgrounds in vocational stream had higher technical proficiencies than students whose educational backgrounds were in general education stream" (p. 317). According to Wanpen et al. (2013), it may be due to the fact that those students with vocational background had taken English for Specific Purposes in engineering contexts. In reference to

vocabulary learning strategies, students with general education reported using higher frequency of strategies than the ones with vocational education. The findings also show that the most used vocabulary learning strategies were metacognitive for both education streams. The results indicate that students with general education employed determination, cognitive, and memory strategies more often than students with vocational background.

2.3.2.2 National studies related to vocabulary learning and strategies

Marin-Marin (2005) conducted a research intended to investigate extraversion as a personality variable and its relationship with the use of vocabulary learning strategies among Mexican students enrolled in the English Major at the University of Quintana Roo. The results of the research revealed that "more extraverted learners that reported higher frequency use of vocabulary strategies, perhaps influenced by their personality traits" (p. 309). This study shed light on vocabulary learning strategies students use according to their personality. Moreover, it is one of the first studies that were conducted in Mexico in the realm of vocabulary learning and strategies.

In like manner, Chan and Trejo (2014) studied the importance of vocabulary in English and vocabulary learning strategies among students of the English Language Major at the University of Quintana Roo. The results showed that students in the first years of university gave more importance to learning vocabulary. Another outcome of this research is that learners who acquire vocabulary through media (listen to CD-ROM dictionaries, movies) have a high lexical proficiency. It can be noticed in this study that technology-mediated vocabulary learning strategies enhance language learning and supports lexical proficiency.

2.3.3 Previous studies on technology-mediated vocabulary learning and strategies

In this section some related studies are presented. The first two are international, and the last two are national researches. First, Clark (2013) conducted a study to determine whether or not technology-mediated resources such as *iPads* are useful for enhancing vocabulary learning. Second, Wu (2015), carried out a research to determine whether a computer-based task could

enhance English as foreign language students' vocabulary learning strategies and self-directed vocabulary learning.

Third, in Mexico, Avila (2017) studied the development of digital competence and the use of mobile devices as tools that support the learning of English as foreign language. Last, González (2017) conducted a pre-experiment on college students to determine the effects of videos on learning vocabulary in English and the strategies they use for learning words in technology-mediated environments.

2.3.3.1 International studies related to technology-mediated vocabulary learning and strategies

Clark (2013) carried out a study in New York, in order to determine "whether or not available technological resources are useful in improving English learners reading ability, specially vocabulary knowledge" (p. 3). The results shed light on the use of technology (iPad) for developing vocabulary in English so it could increase learners' motivation and engagement. They also revealed that the use of technology alone did not support vocabulary development, but in combination with explicit teaching helped to increase vocabulary and retention. The results of this study offer an example of the use of technologies and its implications for developing vocabulary in English learners.

On another note, Wu (2015) conducted an empirical research in order to determine whether the application of a computer-based system (*Learning Vocabulary in Domain* developed specifically for the purpose) could enhance the use of vocabulary learning strategies on Chinese engineering students and improve their self-directed vocabulary learning in English. The study revealed that the computer-mediated task on vocabulary helped students to engage their strategy use and "was more effective in helping students to maintain long-term retention of target word knowledge that the printed material" (p. 208) administered on the control group. The outcomes of this research show that technology-mediated tasks have positive effects on vocabulary learning and students can retain longer the items learned through the use of digital tools and technological devices.

2.3.3.2 National studies related to technology-mediated vocabulary learning and strategies

Avila (2017) carried out a correlational descriptive research on English learners at the University of Quintana Roo. The objective of the study was to determine the relationship between mobile phones applications ("Apps") and learning English language, as well as to determine the development of digital competence in students. The results showed that most types of mobile applications used by participants were related to communication and video storage. As for applications for language learning, bilingual and monolingual English dictionaries were the most used among students. The outcomes revealed also that the most developed digital competence in students was safety, and the least developed was communication. As it can be noted, technological devices and digital tools supports both the development of language learning and digital competence on learners.

Likewise, González (2017) conducted a pre-experimental study to determine the benefits of videogames on language learning for enhancing vocabulary instruction. Furthermore, the objective was "to explore students' attitudes towards the practice of using videogames as a source of learning new vocabulary" (p. 4) on English language college students at University of Quintana Roo. Results indicate that videogames have a positive effect on building up vocabulary. Nevertheless, new words most be consolidated through practice. Moreover, the study reveals that students prefer the use of digital resources related to "free time activities and communication rather than educational purposes" (González, 2017, p. 57). As for vocabulary learning strategies, the outcomes show that the use of bilingual dictionaries and identifying the word by context were the most frequent strategies used by the students. Based on the results of this research, the use of digital tools and resources are helpful for developing vocabulary in English; and videogames "can be a useful way to learn new vocabulary in a language" (González, 2017, p. 61).

On the whole, this review of literature discusses digital competences, technology-mediated learning and its implications for learning vocabulary in English. It examines both the level of development of digital competence and its relation for building vocabulary. Nonetheless, a gap has been identified between these two topics since there are almost no researches conducted under strategies for learning technology-mediated vocabulary and the use of digital competence approach. Whereas the studies conducted on digital competence are related to learning vocabulary

in ESL yet not on technology-mediated vocabulary learning. Though studies aimed at learning vocabulary in EFL do not refer to digital competence development as support for learning vocabulary under the approach of technology-mediated vocabulary learning strategies.

CHAPTER 3 METHOD

This chapter explains the research design, approach, setting, population, and procedure that was used in this study. Additionally, the data collection and analysis procedures are thoroughly described.

3.1 Research Design

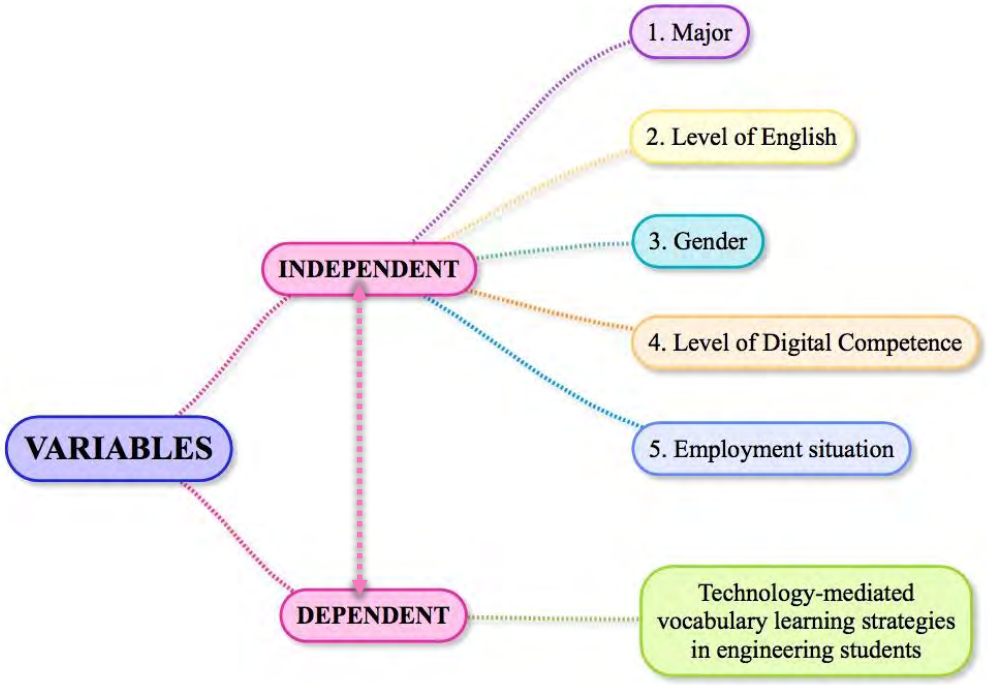
This study is conducted under a descriptive research design to examine how engineering students at University of Quintana Roo learn vocabulary in English through technology-mediated. As this is a descriptive study, the findings are reliable with the data and reflect the viewpoints of the participants (Ellis, 2012). In accordance with Best (1970, as cited in Moffat, 2015), a descriptive research "often analyses the existing relationships; prevailing practices; beliefs, views, or attitudes; on-ongoing processes; or developing trends" (p. 52).

Moreover, Seliger and Shohamy (1989) indicate that a descriptive study is a type of research that "refers to investigation which utilizes already existing data or non-experimental research with preconceived hypothesis" (p. 117). Additionally, Seliger and Shohamy (1989) state that in a descriptive study the research questions are decided at the beginning of it, thus it "only focuses on certain aspects of the possible data available in the language learning context being described" (*Idem*), and this type of research "involves a collection of techniques used to specify, delineate, or describe naturally occurring phenomena without experimental manipulation" (Seliger & Shohamy, 1989, p. 124).

The present research has five independent variables: major, gender, self-evaluation of level of English, self-evaluation of level of digital competence, and employment situation (see Figure 3.1).

Figure 3.1

Variables of the study



Source: Original

3.2 Setting

The research was conducted at the University of Quintana Roo, campus Chetumal. In this campus, the university offers four engineering bachelor programs that belong to the School of Science and Engineering. These programs are Environmental Engineering (144 students), Network Engineering (157 students), Energy Systems Engineering (100 students), and Natural Resources Management (103 students). In total, there are 504 students enrolled in the engineering bachelor programs, according to the Department of Monitoring and Evaluation at the University of Quintana Roo (Department of Monitoring and Evaluation, 2019).

3.3 Participants

The target population for this study was comprised by a sample of 268 engineering students, both genders between 18 and 30 years old, who were distributed in morning and evening shifts from 1st to 9th semester at the University of Quintana Roo, campus Chetumal. Table 3.1 indicates the frequency per semester and major of engineering students who participated in this research. According to the data, the semester with a higher number of participants is the first semester (F= 68), followed by the fifth semester (F= 63), then the seventh semester (F= 50).

Table 3.1
Distribution of participants by major and semester

Semester	Environmental Engineering	Network Engineering	Energy Systems Engineering	Natural Resources Management	Frequency	Percent
1st	15	18	17	18	**68**	**25.4**
3rd	12	16	12	8	**48**	**17.9**
5th	21	20	11	11	**63**	**23.5**
7th	18	12	11	9	**50**	**18.7**
9th	12	11	8	8	**39**	**14.6**
Total	**78**	**77**	**59**	**54**	**268**	**100.0**

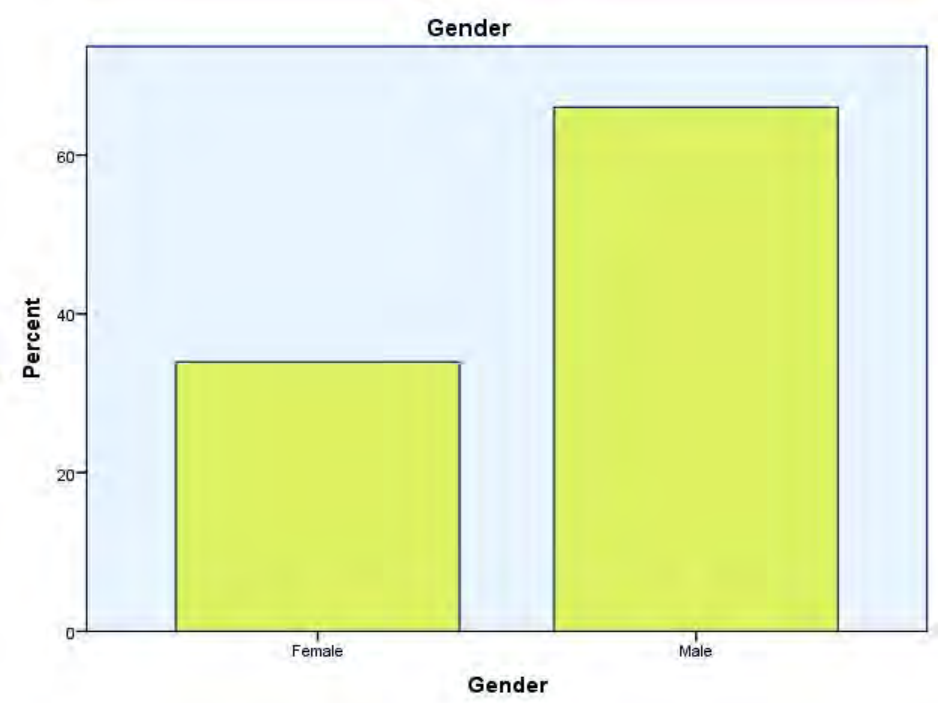
Source: Original

The sample of students was of convenience, which is a type of "nonprobability or non-random sampling where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study" (Dörnyei, 2007, as cited in Etikan et al., 2016). Hence, the participants were chosen without any additional requirements. Therefore, the population was selected based on availability. As mentioned before, the size of the sample consisted of 268 participants out of 504 engineering students who compose the whole population of the Engineering bachelor programs (Department of Monitoring and Evaluation, 2019).

It is worth mentioning that the sample of convenience for this research was firstly calculated approximately of 219 students, with a margin of error of 5%, and a confidence level of 95% (Calculator Raosoft, 2004). Though, the availability of participants ended up with a higher number of participants.

From the sample, 91 are females (34%), and 177 are male (66%) (see Figure 3.2). It can be noted that this ratio is a common tendency in engineering programs in Mexico (González, 2018). Nevertheless, this gender distribution did not affect the study. Likewise, these percentages emerged in terms of working situation. To that effect, 177 students do not work (66%), and 91 reported having a job (34%).

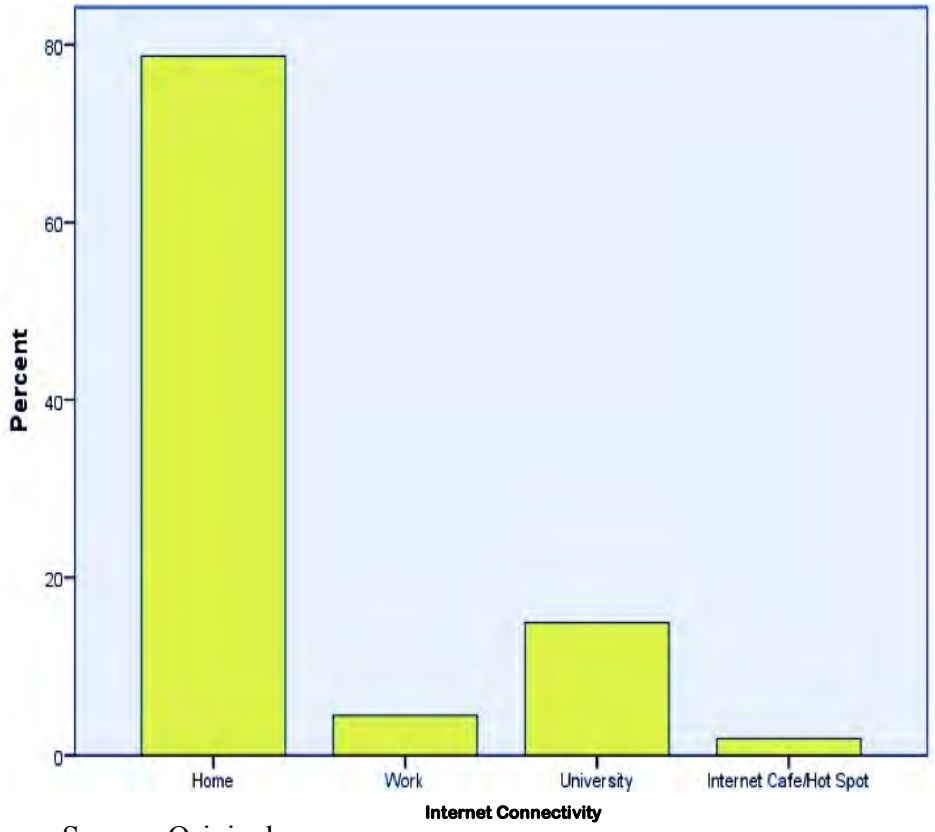
Figure 3.2
Distribution of students by gender



Source: Original

In relation to ICT use and pertinence, the majority of the participants (79%) connects to the Internet at home, meanwhile 15% of the respondents at University, over 4% at work, and only 2% at the Internet café/hot spot, as shown in Figure 3.3.

Figure 3.3
Distribution of students regarding Internet connectivity



Source: Original

The sample of this study encompasses students with different language proficiency levels. Additionally, at the moment of the data collection they were either enrolled in one of the five English courses offered at the Language Teaching Centre, or they had already completed the levels as required on their study programs. It should be mentioned that among the participants, there were four English native speakers who reported having attained the levels after taking an exam. Though, this did not affect the research.

The English levels taught at university are Introductory, Basic, Pre-Intermediate, Intermediate, and Post-Intermediate. The distribution of the sample across the English courses is as follows: 22% of the students were enrolled in Introductory, 18% in Basic, 16% in Pre-Intermediate, 33% in Intermediate, and 11% in Post-Intermediate level (this percentage also includes the English native speakers). As can be seen, about half of the participants (44%) possess an Intermediate level of English or upper.

3.4 Instrument

This research is intended to examine how students learn vocabulary in English through technology-mediated learning strategies as well as to describe their self-evaluation of level of digital competence across major, level of English, gender, and employment situation.

The quantitative data collection for this study was done through a self-administered and printed-out questionnaire sample which was translated to students' mother tongue (Spanish). It was elaborated by adapting some suitable questions from other instruments presented on theses, research papers and documents/frameworks that fit the purpose of this study.

The questionnaire is divided into four sections (see Appendix A). The first section is related to TMVLS with the purpose of knowing what strategies students use for learning vocabulary in English through technology. The vocabulary learning strategies were adapted from Marin-Marin (2005) and up-dated to the use of technological tools and applications. This section contains 33 closed-ended questions with Likert scale, where 1 represents the lowest frequency of use of TMVLS and 4 the most frequently used. The second part corresponds to self-evaluation of level of competence of English language. For this section, five levels of proficiency (Pre-A1 - B2) were taken into consideration since they are equivalents to the ones taught at the university. In this case, the students had to choose the level they believe they possess. The description of the levels of English were adapted from the *European Framework of Languages: Learning, Teaching, Assessment* (Council of Europe, 2018). The third part is associated to self-evaluation of digital competence. Similarly, students had to choose the level of digital competence they consider they possess, which is described in three: basic, intermediate, and advanced. The description of the levels was adapted from the *Common Digital Competence Framework for Teachers* (INTEC, 2017). Finally, the fourth part is focused on demographic data: English course, genre, major, semester, student number, working situation, and Internet connectivity. As regards the variables semester and student number, these were requested in order to avoid the risk of duplication of participants. That is to say, to discard participants who might had already taken the questionnaire.

3.4.1 Instrument piloting

The piloting was carried out in the summer term of 2017. The objective of this was to verify the timing for answering the instrument, to discover any errors or ambiguity in the instructions or questions, as well as to observe participants' attitudes towards the administration of the questionnaire.

The validating and piloting phase of the questionnaire was conducted as follows: First, it was validated by experts in the field and some changes were suggested. Second, a written permission was requested at the university board to be showed to the teacher in which the questionnaire was applied. Next, it was piloted on a sample of 26 students of different majors from the target population (*Derecho* students) at the beginning of the class. However, four samples were discarded due to one or two missing answers. The time it took for students to answer the questionnaire was from 11 to 15 minutes. Finally, the reliability for Likert scale was evaluated by means of Cronbach's Alpha. The reliability obtained was .864 (see Table 3.2).

Table 3.2
Cronbach's Alpha Analysis

Estadísticas de fiabilidad

Alfa de Cronbach	N de elementos
,864	33

Source: Original

After the piloting, we decided to include "student number" in the Demographics data section of the questionnaire (section IV) in order to avoid repetition of the participants in the gathering data phase, and controlling the samples better. Additionally, some minor modifications were made in regards to instructions in section II and III of the instrument.

3.5 Procedure

As mentioned above, the main instrument for this study was a semi-structured questionnaire and cross-sectional in nature. It was administered to a convenience sample of 268 students of the engineering bachelor program at the University of Quintana Roo, campus Chetumal. The data was collected in the autumn term of 2018 in both morning and evening shifts. We selected 20 different engineering classes for administering the questionnaires (one class for each semester of each engineering major).

In order to protect the confidentiality and right of the participants' data, ethical issues were taken into consideration (Seliger & Shohamy, 1989). As well an institutional board permission for conducting the study was asked for. The administration of the questionnaires to students was carried out on site at the beginning of the classes, prior consent requested to the teachers.

3.6 Data analysis

For answering the six research questions of this study, both descriptive and inferential statistics were employed. Such quantitative data was analysed with IBM Social Package for the Social Sciences (SPSS) version 25. Initially, preliminary data was captured in an Excel file and then it was exported to SPSS.

In terms of descriptive statistics, mean frequency ratings from the TMVLS were considered along with some frequencies for the personal variables such as self-evaluation of English level and level of digital competence, gender, major, and working situation. For the sake of inferential statistics, the following tests were used: One-way ANOVA with the Bonferroni adjustment and Independent samples t-test. As stated before, such analysis was done considering individual TMVLS.

CHAPTER 4 RESULTS AND DISCUSSION

Having introduced the topic of this research, the theoretical framework, literature review, and described the method used, we proceed to present the outcomes in relation to the research questions. These results were obtained from the technology-mediated vocabulary learning strategies (TMVLS) Questionnaire indicated in the last chapter, followed by a discussion.

This chapter is organised into six main sections. Accordingly, they are presented on the basis of the research questions given in the Chapter 1, and reported in the same order as shown in that section. Section one provides the most and the least frequently used TMVLS. Section two is concerned with the differences in the use of TMVLS across majors. Similarly, section three is focused on gender differences on TMVLS. Then, section four presents TMVLS across English levels reported by students. Section five describes the level of digital competence regarding TMVLS. Additionally, this section indicates the top five of the most frequently used and least-used TMVLS across digital competence levels. Finally, section sixth indicates the employment situation differences in TMVLS.

4.1 The most and the least frequently reported technology-mediated vocabulary learning strategies

The results of this research question are divided into two sections. The first part is about the ten most frequently reported TMVLS; the second one presents the ten least used TMVLS. For fulfilling this purpose, we took the means of the thirty-three TMVLS sorted in a descending order. To that effect, we selected the first ten items and the last ten from the frequency list which are referred on their respective top ten table.

4.1.1 The most frequently reported technology-mediated vocabulary learning strategies

Descriptive statistics were used to answer this research question. Based on the data obtained, we observed that students reported using differently TMVLS for increasing their vocabulary in English. Nevertheless, the results yielded that the most frequently used TMVLS are those ones concerned with discovery strategies. The top ten TMVLS are shown in Table 4.1.

Table 4.1
Top ten of the most frequently reported TMVLS

Rank	Items/ TMVLS	N	Minimum	Maximum	Mean	Std. Deviation
1	7. Use online translators to know the meaning in Spanish (Google translate, Babylon, DeepL, Bing translator, etc.).	268	1	4	3.27	.804
2	29. Watch movies/series with audio and/or subtitles in English on streaming media (Netflix, Amazon, YouTube, Vimeo, etc.).	268	1	4	3.19	.902
3	1. Guess meaning by context in sentence shown online.	268	1	4	3.13	.708
4	2. Guess meaning by pictures related to the text online.	268	1	4	3.09	.771
5	5. Look up word on online/Apps bilingual dictionaries (Cambridge, Collins, WordReference, etc.).	268	1	4	2.96	.978
6	24. Associate new word found online with similar known word in L1.	268	1	4	2.74	.937
7	23. Look up word pronunciation on specific Apps/websites to pronounce it accurately and memorise it (Google translate, Cambridge Dictionary, Oxford, etc.).	268	1	4	2.69	.946
8	28. Listen to online radio stations/podcasts, and or watch online videos related to students' interests or study field (BBC World, YouTube, Vimeo, etc.).	268	1	4	2.67	1.083
9	26. Use new words on social networks (Messenger, WhatsApp, Facebook, Instagram, Blogs, etc.).	268	1	4	2.60	.983
10	12. Look up examples of sentences of the word on the Internet.	268	1	4	2.57	.923

Note: the item number corresponds to the one from the instrument.
Source: Original

Table 4.1 indicates that the most frequently reported TMVLS fit in the discovery strategies/dealing with unknown vocabulary, along with memorisation and further consolidation strategies. The mean frequency rating found among the strategies ranged from 2.57 to 3.27 in which the higher mean score refers to the item (7)* using online translators to know the meaning in Spanish, and the lower average score relates to the item (12) looking up examples of sentences of the word on the Internet. These results show that when it comes to use TMVLS, engineering students tend to learn new vocabulary in English by looking up the translation of the word in their mother tongue (Spanish) on online translators, and search for example sentences demonstrating new word usage on the Internet, among other TMVLS as shown in Table 4.1.

First of all, this tendency might be the result of the easiness and time-saving that represents getting the translation of the word in English onto Spanish rather than its explanation. Consequently, it facilitates the understanding of the text/sentence in English. By its part, Schmitt (1997) considers that this strategy makes "possible the transfer of all the knowledge a student has of the L1 word (collocations, associations, etc.) onto the L2 equivalent" (p. 15). Additionally, word learning is faster by conveying the word meaning through L1 translation (Nation, 2000).

Secondly, the use of the strategy (12) looking up examples of sentences of the word on the Internet can be the result of the students' eagerness to know in which context or how the word can be used in different situations in order to use this new vocabulary. Contrastingly, this strategy was one of the least used by English learners as mentioned by Marin-Marin (2005). Thus, it can be observed that the use of TMVLS has become more and more common among English learners nowadays.

As mentioned above, the most frequently discovery strategies/dealing with unknown vocabulary reported by students are (7) using online translators (M= 3.27); (1) guessing meaning by context in sentence shown online (M= 3.13); (2) guessing meaning by pictures related to the text online (M= 3.09); (5) looking up word on online/Apps bilingual dictionaries (M= 2.96); and (12) looking up examples of sentences of the word on the Internet (M= 2.57). As for the TMVLS related to memorisation/retaining vocabulary strategies are (29) watching movies/series with audio and/or subtitles in English on streaming media such as Netflix, Amazon, YouTube, Vimeo, and so on (M= 3.19); (24) associating new word found online with similar known word in L1 (M= 2.74);

* The number in brackets indicates the item of the correspondent TMVLS and it will be shown henceforth for this purpose.

(23) looking up word pronunciation on specific Apps/websites to pronounce it accurately and memorise it (M= 2.69); (28) listening to online radio stations/podcasts, and or watch online videos related to students' interests or study field (M= 2.67); and (26) using new words on social networks (M= 2.60).

The results also show that engineering students make extensive use of lexical tools/online/Apps dictionary-related strategies since four of them are ranked among the top ten (see Table 4.1). Likewise, Marin-Marin (2005) found that English-language major students also reported a high tendency of using dictionary-related strategies since three of the vocabulary learning strategies "ranked among the top five strategies" (p. 189). In the same manner, Chan and Trejo (2014), indicated that English learners also informed the use of dictionary among the top ten vocabulary learning strategies. In a prior study, Schmitt (1997) found that the use of dictionaries was extensively used by Japanese learners. It should be point out that these dictionary-related strategies were mostly carried out on paper-based dictionaries due to the context of those researches. In a recent study, González (2017), confirmed this pattern as well among English learners but including electronic, and online dictionaries besides printed ones. Conversely, it must be mentioned that Marin-Marin (2005) indicated that the use of dictionary-related strategies by means of the use of technology ranked among the least-used VLS.

It is noteworthy that the strategy (29) watching movies/series with audio and/or subtitles in English on streaming media, which is a memorisation/consolidation strategy, was ranked second in the list. It might be suggested that engineering students learn incidentally new vocabulary while watching movies/series that are not necessarily related to their study field, as Ma (2017) pinpoints. Besides, this activity seems to be carried out on the self-directed way since technology and technological resources have become more accessible to most of the students and it may be carried out without the guidance of the tutor/teacher, which "is part of becoming a strategic learner", according to Dalton and Grisham (2011). In this respect, Chan and Trejo (2014), found that English language major students reported watching movies (without subtitles) in the target language as one of the most used vocabulary learning strategies. It can be seen that this strategy is gaining popularity among the majority of the students as reported in Table 4.1 for the reason that technology has become ubiquitous, and in a certain way it creates opportunities to meet new words, hence it may assist in the second language learning.

In contrast to the receptive strategy (29) watching movies/series with audio and/or subtitles in English on streaming media, we found that (28) listening to online radio stations/podcasts, watching online videos related to students' interests or study field -which also implicates inputs of new words-, ranked eighth in the top ten. A possible reason for this may be that engineering students prefer watching on-demand movies/series since they can choose specific content –not necessarily related to their studies-, stop, go back, and play the media, thus they can retrieve the meaning of the unknown word easier than listening to the radio/podcasts/videos related to their interests/study field. It should be noticed that in the case of radio and podcasts, it might be the case that some words could be missed/misunderstood, therefore that might lead to comprehension difficulties. To this respect, the strategy (28) listening to the radio/podcasts… requires a great degree of understanding and having a certain knowledge not only high frequency vocabulary but also academic and technical vocabulary. Thereon, Ur (2012) pinpoints that English classes (textbooks/audios) do not prepare students for real-life listening since the speech on the aural texts is typically informal for which she recommends plenty of exposure to texts slightly above the level. Nevertheless, we can notice students reporting using these two TMVLS that prompt them to increase their vocabulary and become self-directed learners.

Interestingly enough, the strategy (1) guessing meaning by context in sentence shown online, which ranked three in the list (see Table 4.1), follows also a pattern indicated by Ahmed (1989), Schmitt (1997), Marin-Marin (2005), and Gonzalez (2017) as one of the most used vocabulary learning strategies. It must be mentioned that this strategy referred by those authors is about guessing the meaning by context in sentence/ paragraph in printed texts/books. Thus, that strategy differs only on the support of the text (paper versus electronic tools/devices).

4.1.2 The least-used technology-mediated vocabulary learning strategies

After having analysed the most frequently used TMVLS band, we proceed to indicate the least-used strategies for which we selected the last ten items from the descriptive statistics. As a result, the TMVLS that students reported using less were predominantly memorisation/retaining vocabulary, followed by note-taking instances, and lastly dealing with unknown vocabulary

(social/asking others) strategies as shown in Table 4.2. In fact, these last two categories of strategies were only reported in these top ten of the least-used TMVLS.

Table 4.2
Top ten of the least reported TMVLS

Rank	Items/ TMVLS	N	Minimum	Maximum	Mean	Std. Deviation
33	33. Create a word cloud by using generators on websites (Wordle, Tagxedo, Phoetic, Word Salad, etc.).	268	1	4	1.51	.791
32	32. Create mind maps by using Apps or software (Mindomo, MindMeister, Litpen, Freemind, etc.).	268	1	4	1.55	.784
31	22. Store/file the new word and its picture on electronic devices.	268	1	4	1.62	.837
30	21. Record voice notes about new vocabulary on electronic devices to memorise them.	268	1	4	1.64	.821
29	14. Ask teacher for the word definition on social networks (WhatsApp, Telegram, Facebook, etc.).	268	1	4	1.82	.923
28	13. Ask teacher for translation of the word on social networks (WhatsApp, Telegram, Facebook, etc.).	268	1	4	1.87	.974
27	18. File the word meaning on web bookmarks.	268	1	4	1.88	.928
26	30. Use vocabulary practice on Apps/web resources (FreeRice, Kahoott!, Quizlet, etc.).	268	1	4	1.91	.958
25	9. Use glossaries online of technical words (sapiensman.com, vocabulario.com.mx, iate.europa.eu, etc.).	268	1	4	1.95	.894
24	17. Make word list of unknown vocabulary on note taking Apps (Evernote, etc.).	268	1	4	2.00	.950

Note: The item number corresponds to the one from the instrument.
Source: Original

Table 4.2 shows that the mean frequency emerged among the least-used TMVLS ranged from 1.51 to 2.00. The most infrequently used strategies among engineering students are concerned with memorisation/retaining vocabulary. In this respect, we found that (33) creating a word cloud by using generators on websites (M= 1.51); and (32) creating mind maps by using Apps or software (M= 1.55) ranked first and second respectively on the top ten of the least-used strategies. This tendency was also observed in (30) using of vocabulary practice on Apps/web resources (M=1.91). The low frequency use of these strategies might be due to their low popularity among students,

since these are not usually taught in English classes, or the lack of knowledge of this kind of lexical applications. Another plausible reason is that these applications are time-consuming for learning/practicing vocabulary. A disadvantage of this situation is that students miss the opportunity to consolidate the learning of vocabulary "since such systematic rehearsal is necessary for keeping the words in long-term memory" (Ma, 2017, p. 54).

The results also showed that note-taking strategies prevailed among the most infrequently used strategies (four out of ten). We found that (22) storing/filing the new word and its picture on electronic devices (M= 1.62); (21) recording voice notes about new vocabulary on electronic devices to memorise them (M= 1.64); (18) filing the word meaning on web bookmarks (M= 1.88); and (17) making word list of unknown vocabulary on note taking Apps (M= 2.00) are hardly never used by students. A possible explanation to this predisposition is that engineering students look up the unknown word as they get it from the inputs, that is to say, they search the word on demand by using lexical tools/applications but they do not register it for further review or recalling. To this respect, the use of electronic devices among students is more common than before, but it seems it is not as important to file or note-taking the new vocabulary as using online/Apps dictionaries. This low frequency use in note-taking strategies is also reported in other studies as in Liu's et al. (2014). In a prior study, Marin-Marin (2005) found that several note-taking strategies were among the least used strategies. This pattern is also confirmed by Stoffer (1995, as cited in Marin-Marin, 2005), who indicated a low frequency use "in recording words on tapes, keeping words on the computer, and drawing pictures of new words" (p. 193). In despite of these results, Ahmed (1989) indicated that note-taking strategies are practical in terms of organization. Not to mention that these are considerable resources for students who prefer a more aural approach to learning as Schmitt (1997) suggested in the case of recording word lists.

In reference to the social/asking other strategies, we found that asking the teacher for the definition or translation of the word on social networks was infrequently used by engineering students. This might be because students prefer making use of lexical tools and applications for searching a word, looking up for word meaning/definition, or getting the word translated instantly on electronic devices, to choosing strategies that involve the teacher and certainly waiting time to get an answer. These results also suggest that students may be autodidacts when it comes to wanting to get the meaning of the new word.

In a similar vein, Avila (2017) found that English learners used at a low frequency rate voice social network Apps to exchange audios, note-taking Apps, and podcast (audio and video) Apps on mobile electronic devices for learning English. What is more, her results concur with the outcomes of this research in reference to the technological tools/devices and their frequency that students use for learning English. In this sense, using social communication tools such as Facebook, WhatsApp, or Telegram "can be employed for learners to practice using the previously learned lexical items" Ma (2017, p. 53).

Finally, (9) using glossaries online of technical words (sapiensman.com, vocabulario.com.mx, iate.europa.eu, etc.) (M= 1.95) was also among the least-used TMVLS, contrary to it was expected. In this regard, engineering students meet technical words or technical lexical units at a great frequency rate in the literature of their study field. Hence, as it was stated before, at some point of their studies they encounter technical vocabulary in English for which they might use-dictionary strategies on specific sources as the web sites afore mentioned. The frequency of use of technical vocabulary in engineering corpus was observed by Wasuntarasphit (2008). He found that "electrical engineering corpus uses more technical lexical units than other kinds of lexical units" (p. 114). A part from that, this low use tendency among engineering students may be due to the kind of texts/inputs in English they access/get on the Internet or on other technological resources. It seems that these students learn new vocabulary in English not precisely related to their studies during leisure activities, thus, searching for technical vocabulary meaning may not be required as estimated.

Altogether, the ten most used TMVLS are related to dictionary use and other sources (4 out 10), guessing meaning by context/picture (2 out of 10), and single instances of memorisation and further consolidation strategies (4 out of 10). This suggests that discovery/dealing with unknown vocabulary strategies are the most used among engineering students (in total 6 out of 10). Conversely, note-taking strategies are found within the ten least used strategies (4 out of 10) followed by some instances of memorisation and further consolidation strategies (3 out of 10). It turned out to be that three discovery/dealing with unknown vocabulary strategies (asking others and dictionary use strategies) showed also this pattern (3 out of 10). Broadly speaking, the results show that engineering students use regularly discovery and memorisation/further consolidation strategies for learning vocabulary through the use of technology.

To sum it up, the outcomes of this section indicate that there is a lack of students' knowledge in terms of TMVLS and instruction in lexical applications. This issue might be due to some factors. On the one hand, English teachers do not teach explicitly some of these TMVLS as well as the technological resources for increasing students' word knowledge. Thus, students should be encouraged to use infrequently-employed TMVLS as Liu et al. (2014) stated. On the other hand, students should raise their awareness and being more interested on what ways they could gain the most for learning vocabulary through the use of technology.

4.2 Differences in the use of technology-mediated vocabulary learning strategies across majors

In order to answer this question one-way between-groups ANOVA was performed with the Bonferroni adjustment for multiple comparisons. The results showed that statistically significant differences were found in the use of five out of thirty-three TMVLS across the engineering majors in which the students who participated in this research are enrolled in (see Table 4.3).

Table 4.3
ANOVA test in differences in the use of TMVLS across engineering majors

Item/TMVLS	Majors	N	Mean	ANOVA Results
5. Look up word on online/Apps bilingual dictionaries (Cambridge, Collins, WordReference, etc.).	Environmental Engineering	78	3.17	F= 3.248, df=3, p=.022
	Network Engineering	77	2.74	
	Energy Systems Engineering	59	3.10	
	Natural Resources Management Engineering	54	2.83	
	Total	268	2.96	
9. Use glossaries online of technical words (sapiensman.com, vocabulario.com.mx, iate.europa.eu, etc.).	Environmental Engineering	78	2.24	F=5.355, df=3, p<.001
	Network Engineering	77	1.71	
	Energy Systems Engineering	59	1.81	
	Natural Resources Management Engineering	54	2.00	
	Total	268	1.95	
18. File the word meaning on web bookmarks.	Environmental Engineering	78	1.97	F=3.332, df=3, p=.020
	Network Engineering	77	1.68	
	Energy Systems Engineering	59	1.78	
	Natural Resources Management Engineering	54	2.15	
	Total	268	1.88	
21. Record voice notes about new vocabulary on electronic devices to memorise them.	Environmental Engineering	78	1.67	F=5.078, df=3, p=.002
	Network Engineering	77	1.52	
	Energy Systems Engineering	59	1.44	
	Natural Resources Management Engineering	54	1.98	
	Total	268	1.64	
20. Take screenshots of word meaning and file them on the mobile phone or other electronic devices.	Environmental Engineering	78	2.59	F=4.505, df=3, p=.004
	Network Engineering	77	2.17	
	Energy Systems Engineering	59	2.08	
	Natural Resources Management Engineering	54	2.52	
	Total	268	2.34	

Note: The item number corresponds to the one from the instrument.
Source: Original

Table 4.3 shows that, in general terms, the major does make a difference in use of the TMVLS. It can be noticed that Network and Energy Systems engineering students reported using fewer TMVLS than Environmental and Natural Resources Management engineering students.

Moreover, after performing the Bonferroni adjustment, we found significant differences across majors as follows: Network and Environmental; Network/Energy Systems and Environmental; Network and Natural Resources; Network/Energy Systems and Natural Resources; Network/Energy Systems and Environmental.

The wide range differences among the TMVLS lie on: (5) looking up word on online/Apps bilingual dictionaries ($F= 3.248$, $df=3$, $p=.022$); (18) filing the word meaning on web bookmarks ($F=3.332$, $df=3$, $p=.020$), and (20) taking screenshots of word meaning and filing them on the mobile phone or other electronic devices ($F=4.505$, $df=3$, $p=.004$). In the narrow range of differences, we found the strategies (9) using glossaries online of technical words ($F=5.355$, $df=3$, $p<.001$), and (21) recording voice notes about new vocabulary on electronic devices to memorise them ($F=5.078$, $df=3$, $p=.002$). These differences can be due to many reasons.

In the first instance, differences were found between Environmental and Network engineering students in the use of (5) looking up word on online/Apps bilingual dictionaries such as Cambridge, Collins, WordReference, etc. In this sense, Environmental engineering students had the highest mean ($M= 3.17$). It might be suggested that Environmental students get a substantial amount of inputs in English such as articles, texts, documentaries, etc. in their classes since they have to be able to understand this kind of texts as stated in the graduate profile. Thus, using online dictionaries may reduce the time while meeting new words (Li, 2009). Besides, looking up words in dictionaries increase learning (Knight, 1994, as cited in Nation, 2000).

Another distinction was found between Environmental and Network as well as Energy Systems engineering students in (9) using of glossaries online of technical words such as sapiensman.com, vocabulario.com.mx, iate.europa.eu, etc. Then again, Environmental students had the highest mean ($M= 2.24$). This might be due to Environmental engineering students are intended to understand technical texts in English about their studies field, according to the major curriculum (UQROO, 2019a). Hence, Environmental students relatively look up for technical words on glossaries more frequently than the rest of the engineering students. Otherwise, students "may not only lose some information but potentially misunderstand the text as a whole" (Wasuntarasophit, 2008, p. 140) concerning these low frequency words.

One more significant variation was revealed between Natural Resources Management and Network engineering students. In this case, Natural Resources Management students had the highest mean ($M= 2.15$) in the use of (18) filing the word meaning on web bookmarks. This might

be the result of developing organisational skills and study habits since Natural Resources Management undergraduates are prompted to be self-directed learners during their courses since it is one of the goals in the curriculum (UQROO; 2019b). Therefore, under this constructivism approach, students may explore and use strategies for reviewing the new vocabulary with regards to organisation in order to success in the English language (O'Malley & Chamot, 1990, as cited in Ahmed, 1989).

In a quite similar manner, another variation was found among Natural Resources Management and Network as well as Energy Systems engineering students. Natural Resources Management had the highest mean (M= 1.98) in (21) recording voice notes about new vocabulary on electronic devices to memorise them. It is worth mentioning that this strategy was one of the least frequently used in engineering students, similarly as revealed by Schmitt (1990), and Marin-Marin (2005). Thought Natural Resources Management students reported to use it significantly more than the other engineering students. A possible explanation for this may due to the social interactions and study habits Natural Resources Management students have developed along their classes. These students also take some subjects on socio-anthropologist sciences and economics so they might develop more social skills as well. It can be suggested that they might be more extroverted than the other engineering students, however, some research needs to be done to confirm this. Somehow, it should be noted that this TMVLS which is a verbal note-taking strategy goes along with memorisation skills. In a study on vocabulary learning strategies (VLS), Marin-Marin (2005) suggested the use of memorisation skills (repetition and association strategies) to extraversion. Additionally, in a prior research Schmitt (1990) reported that Japanese learners relied on saying the new word aloud and verbal repetition to consolidate meaning. Thus, this strategy seems to be more effective for Natural Resources Management students.

Finally, the results also yielded a significant difference among Environmental, Network, and Energy Systems engineering students. It turned out again that Environmental students had the highest mean (M= 2.59) in the use of (20) taking screenshots of word meaning and filing them on the mobile phone or other electronic devices. This note-taking strategy seems to be a practical strategy for Environmental students in order to recall new vocabulary items. To this extend, "Jones (2004) found that those who accessed the pictorial and written multimedia resources outperformed those who did not have access to the system in the immediate and delayed vocabulary tests" (Liu,

2014, p. 108). Therefore, encouraging students to use this strategy may increase their vocabulary in English.

It can be seen that Environmental engineering students reported using significantly more the strategies (5) looking up word on online/Apps bilingual dictionaries, (9) using glossaries online of technical words, and (20) taking screenshots of word meaning and filing them on the mobile phone or other electronic devices than the rest of the other engineering students. It is also noticeable that Natural Resources Management engineering students reported using more the strategies (18) filing the word meaning on web bookmarks, and (21) recording voice notes about new vocabulary on electronic devices to memorise them than the rest of the engineering students.

Concerning Energy Systems and Network engineering students we could observe that they reported using less frequently the above five mentioned TMVLS. Therefore, it can be due to the fact that these students might be exposed to lesser number of sources in English, thus they are not in the need to use some of these TMVLS. Besides, the publications and literature related to their field might be mostly in their native tongue, hence it reduces the opportunities to meet new vocabulary in English.

4.3 Gender differences in technology-mediated vocabulary learning strategies

With the purpose of answering this question, a Student's t-test for independent-samples was implemented. The results indicated significant differences between genre and the use of six TMVLS: (17) making word list of unknown vocabulary on note-taking Apps ($t=2.419$, $df=266$, $p=.016$); (18) filing the word meaning on web bookmarks ($t=2.506$, $df=266$, $p=.013$); (19) filing vocabulary notes on the computer, mobile phone, or other electronic devices ($t=2.071$, $df=266$, $p=.039$); (20) taking screenshots of word meaning and filing them on the mobile phone or other electronic devices ($t=2.474$, $df=266$, $p=.014$); (23) looking up word pronunciation on specific Apps/websites to pronounce it accurately and memorise it ($t=2.724$, $df=207.051$, $p=.007$); (31) playing videogames online concerning vocabulary ($t=3.357$, $df=221.584$, $p<.001$) (see Table 4.4).

Table 4.4
Student's t-test Gender differences in the use of TMVLS

Items/TMVLS	Gender	N	Mean	Student's t-test
17. Make word list of unknown vocabulary on note taking Apps (Evernote, etc.).	Female	91	2.20	t=2.419, df=266, p=.016
	Male	177	1.90	
18. File the word meaning on web bookmarks.	Female	91	2.08	t=2.506, df=266, p=.013
	Male	177	1.78	
19. File vocabulary notes on the computer, mobile phone, or other electronic devices.	Female	91	2.24	t=2.071, df=266, p=.039
	Male	177	1.98	
20. Take screenshots of word meaning and file them on the mobile phone or other electronic devices.	Female	91	2.55	t=2.474, df=266, p=.014
	Male	177	2.24	
23. Look up word pronunciation on specific Apps/websites to pronounce it accurately and memorise it (Google translate, Cambridge Dictionary, Oxford, etc.).	Female	91	2.90	t=2.724, df=207.051, p=.007
	Male	177	2.59	
31. Play videogames online concerning vocabulary (Deponia, The Whispered World, etc.).	Female	91	1.78	t=3.357, df=221.584, p<.001
	Male	177	2.20	

Note: The item number corresponds to the one from the instrument.
Source: Original

Table 4.4 indicates the significant differences in the use of TMVLS by genre. It reveals that women reported using more TMVLS in which most of them concern to note-taking and dictionary use. It is noticeable that female engineering students had the higher mean in four note-taking strategies (items 17 to 20), and one in dictionary-use strategy (item 23). Meanwhile male students had the higher mean in memorisation and further consolidation strategies related to videogames (item 31).

According to the outcomes, it was found that female students reported using more note-taking strategies (items 17 to 20) than males. Similarly, this tendency emerged in Nakamura's (2000), Gu's (2002), and Jimenez-Catalan's (2003) as mentioned by Marin-Marin (2005). To that effect, Marin-Marin (2005) suggested that "women tend to use more note-taking strategies because they generally seem to be more organised and more concerned about consolidation meaning through writing words down" (p. 253). Reasons for which we also concur.

Additionally, it can be seen that female students keep using these strategies in the current digital era version. Notwithstanding, Marin-Marin (2005) reported that men learners used more frequently the strategy keeping vocabulary records on computers/electronic devices than women. It is noteworthy that this pattern has been overturned by women in this present study. Accordingly, this may be the result of the Internet penetration and the access to electronic devices among students, in which women reported using more frequently these technologies for learning vocabulary than men did.

The results of this study also showed that female reported using more frequently dictionary-use for checking pronunciation on Apps, specific websites, or on dictionaries online. Conversely, Marin-Marin (2005) revealed on his research that gender was not a predictable variable for using dictionary-use for checking pronunciation since "it seems to be used by all learners… regardless of gender…" (p. 243). According to this, it seems that the use of this TMVLS is arising among female students and reversing that tendency as technology pervades students' life.

These findings suggest that dictionary-use strategies in general are used more by female than male as stated by Marin-Marin (2005) concerning the use of electronic dictionaries. This current tendency can be due to female students consider pronunciation as an important aspect within the second language learning. In this sense, Ballote (2011, as cited in Avila, 2017) suggested that women benefit more from the use of the ICT in academic contexts than men. Thus, it might be the case regarding this strategy.

On the other hand, the results yielded that male students reported using more frequently TMVLS focused on gaming (videogames) than female. To this respect, Avila (2017) indicated that men used more mobile gaming Apps overall. Likewise, in a prior study, Ballote (2011, as cited in Avila, 2017) found that male students tended to use more frequently ICT as videogames for leisure than female. Hence, we could suggest that this tendency of playing online videogames has been taken for vocabulary learning by male engineering students. Where this is concerned, playing videogames is "an effective source of vocabulary learning" (Palmberg, 1988a, as cited in Nation, 2000) which occurs incidentally.

4.4 Technology-mediated vocabulary learning strategies across English levels

To determine if there is any difference concerning students' self-evaluation of their English level and the use of TMVLS one-way between-groups ANOVA was used with the Bonferroni adjustment for multiple comparisons. As a result, we found that the English level does determine the use of thirteen out of thirty-three TMVLS (see Table 4.5).

This section reflects students' self-evaluation in terms of English proficiency. The language levels are organised on five levels according to the Common European Framework of Reference for Languages. These are described in TMVLS Questionnaire (see Appendix A, section II). It must also be mentioned that four native English speakers were discarded from this analysis since they use other strategies; situation that goes far beyond this study.

Table 4.5
ANOVA test in differences in English level and the use of TMVLS

Item/ TMVLS	English Level	N	Mean	ANOVA Results
1. Guess meaning by context in sentence shown online.	PRE-A1	39	2.69	F=13.389, df=4, p<.001
	A1	42	2.86	
	A2	75	3.09	
	B1	75	3.32	
	B2	33	3.64	
	Total	264	3.13	
3. Skip word whose meaning cannot be guessed.	PRE-A1	39	2.72	F=6.166, df=4, p<.001
	A1	42	2.50	
	A2	75	2.09	
	B1	75	2.20	
	B2	33	1.88	
	Total	264	2.25	
4. Look for text/e-book in L1 (Spanish) to avoid having to deal with vocabulary in English.	PRE-A1	39	2.97	F=7.158, df=4, p<.001
	A1	42	2.50	
	A2	75	2.43	
	B1	75	2.44	
	B2	32	1.81	
	Total	263	2.45	

Item/ TMVLS	English Level	N	Mean	ANOVA Results
13. Ask teacher for translation of the word on social networks (WhatsApp, Telegram, Facebook, etc.).	PRE-A1	39	2.10	F=3.254, df=4, p=.013
	A1	42	2.24	
	A2	75	1.69	
	B1	75	1.84	
	B2	33	1.64	
	Total	264	1.88	
14. Ask teacher for the word definition on social networks (WhatsApp, Telegram, Facebook, etc.).	PRE-A1	39	2.05	F=2.513, df=4, p=.042
	A1	42	2.10	
	A2	75	1.69	
	B1	75	1.81	
	B2	33	1.58	
	Total	264	1.83	
16. Ask classmates/friends/relatives for the word definition on social networks (WhatsApp, Telegram, Facebook, etc.).	PRE-A1	39	2.46	F=2.673, df=4, p=.033
	A1	42	2.50	
	A2	75	2.09	
	B1	75	2.31	
	B2	33	1.91	
	Total	264	2.25	
21. Record voice notes about new vocabulary on electronic devices to memorise them.	PRE-A1	39	1.90	F=3.139, df=4, p=.015
	A1	42	1.86	
	A2	75	1.64	
	B1	75	1.49	
	B2	33	1.39	
	Total	264	1.64	
25. Practice vocabulary on specific websites/Apps (Duolingo, Rosseta Stone, FluentU, etc.).	PRE-A1	39	2.64	F=5.328, df=4, p<.001
	A1	42	2.67	
	A2	75	2.44	
	B1	75	2.25	
	B2	33	1.79	
	Total	264	2.37	

Item/ TMVLS	English Level	N	Mean	ANOVA Results
26. Use new words on social networks (Messenger, WhatsApp, Facebook, Instagram, Blogs, etc.).	PRE-A1	39	2.33	F=7.291, df=4, p<.001
	A1	42	2.21	
	A2	75	2.56	
	B1	75	2.73	
	B2	33	3.27	
	Total	264	2.61	
27. Read blogs/wikis/articles on magazines/books online or web sites of my interest to learn new words.	PRE-A1	39	2.15	F=6.881, df=4, p<.001
	A1	42	2.12	
	A2	75	2.32	
	B1	75	2.36	
	B2	33	3.15	
	Total	264	2.38	
28. Listen to online radio stations/podcasts, and or watch online videos related to students' interests or study field (BBC World, YouTube, Vimeo, etc.).	PRE-A1	39	2.28	F=7.342, df=4, p<.001
	A1	42	2.33	
	A2	75	2.57	
	B1	75	2.79	
	B2	33	3.42	
	Total	264	2.66	
29. Watch movies/series with audio and/or subtitles in English on streaming media (Netflix, Amazon, YouTube, Vimeo, etc.).	PRE-A1	39	2.90	F=5.529, df=4, p<.001
	A1	42	2.83	
	A2	75	3.21	
	B1	75	3.32	
	B2	33	3.64	
	Total	264	3.19	
33. Create a word cloud by using generators on websites (Wordle, Tagxedo, Phoetic, Word Salad, etc.).	PRE-A1	39	1.72	F=2.534, df=4, p=.041
	A1	42	1.69	
	A2	75	1.36	
	B1	75	1.40	
	B2	33	1.64	
	Total	264	1.51	

Note: The item number corresponds to the one from the instrument
Source: Original

Table 4.5 indicates the significant differences between engineering students' English level and the use of TMVLS that reached a level of significance ($p < .05$). Based on these results, the items (1) guessing meaning by context in sentence shown online, (3) skipping word whose meaning cannot be guessed, (4) looking for text/e-book in L1 (Spanish) to avoid having to deal with vocabulary in English, (25) practicing vocabulary on specific websites/Apps, (26) using new words on social networks, (27) reading blogs/wikis/articles on magazines/books online or web sites of my interest to learn new words, (28) listening to online radio stations/podcasts, and or watch online videos related to students' interests or study field, and (29) watching movies/series with audio and/or subtitles in English on streaming media indicated a wide range of significant difference $p < .001$. As for the TMVLS (13) asking teacher for translation of the word on social networks, (14) asking teacher for the word definition on social networks, (16) asking classmates/friends/relatives for the word definition on social networks, (21) recording voice notes about new vocabulary on electronic devices to memorise them, and (33) creating a word cloud by using generators on websites reached a significance $p < .05$.

The findings revealed that there is a difference in items 1 and 28 between the English levels Pre-A1 (M= 2.69, M= 2.28) and B2 (M= 3.64, M= 3.42). Likewise, in the items 26, 27, and 29 the difference is between levels A1 (M= 2.21, M= 2.12, M= 2.83) and B2 (M= 3.27, M= 3.15, M= 3.64). We can suggest that the higher the English level is, the more frequently students use these TMVLS. We can assume that students who reported having a B2 level are able to understand aural or written texts without difficulties, as well as applying new vocabulary/producing texts on social networks in contrast to Pre-A1/A1 students (Council of Europe, 2018). It can be suggested that B2 level students know more words than the low level of language proficiency students (Laufer & Nation, 1999). Accordingly, for being able to comprehend written authentic texts is necessary to have reached a threshold of 3,000 word families (Laufer, 1998). This figure denotes the 85.2% of text coverage (Nation, 2000) which enables students to guess meaning by context (Schmitt, 2007), and using vocabulary in communication activities. Not to mention that vocabulary size matters for performing other activities such as listening to the radio, and watching movies/videos –in which vocabulary is gained incidentally- as B2 students reported doing. Based thereon, Nation (2000) indicates that "learners would need at least 95% coverage of the running words in the input in order to gain reasonable comprehension and to have reasonable success at guessing from context" (p. 188). In this regard, he indicates that a vocabulary of around 2,000 word families can provide

this coverage percentage in colloquial spoken language (Schonell, et al., 1956, as cited in Nation, 2000).

Conversely, in items 3, 4, and 21 there is a difference between English levels B2 (M= 1.88, M= 1.81, M= 1.39) and Pre-A1 (M= 2.72, M= 2.97, M= 1.90). Another similar distinction was found in items 13, 14, 16, and 25 between levels B2 (M= 1.64, M= 1.58, M= 1.91, M= 1.79) and A1 (M= 2.24, M= 2.10, M= 2.50, M= 2.67). We can notice that the lower the English level is, the more frequently students use these TMVLS.

In the case of items 3, 4, and 21 it can be suggested that low language proficiency students lack word knowledge which impedes a proper reading comprehension for the reasons previously mentioned with regard to vocabulary size (Laufer, 1998; Nation, 2000; Schmitt, 2007). Thus, it may represent an inconvenient for these students trying to understand the word's meaning or the whole content. The TMVLS (3) skipping the word might be because of students prefer looking up the word's meaning later. Another possibility as Marin-Marin (2005) suggested is that students consider unknown words "not important or because simply they failed to notice them" (p. 198). As for item 4, it might be that students have not developed enough language competencies for dealing with new vocabulary yet, hence they opt to look for the text in the Spanish version. In relation to item 21, it may represent an opportunity for students to recall and rehearse orally and aurally in order to gain vocabulary knowledge despite the fact that they might not have a good pronunciation.

Concerning items 13, 14, 16, it might be due to students with low language proficiency (Pre-A1, A1) do not know about the existence of Apps or websites for consulting their doubts about vocabulary/word's meaning so they tend to rely on the teacher or classmates/friends/relatives. It is worth noticing that these students ask slightly more to classmates/friends/relatives than to the teacher. It may be because they feel more confident communicating through social networks with classmates, etc. than with the teacher. This learner-learner interaction is also observed in Marin-Marin (2005). As regards item 25, these low level language proficiency students might consider practicing vocabulary in Apps such as *Duolingo* since it is an option to build up vocabulary in their leisure time. It might be the case that students at this level might be eager to look for TMVLS besides to feel motivated to learn new words and at the same time to be rewarded since these applications give learners engaging challenges and the possibility to surpass levels according to their performance. It has been suggested that using this

TMVLS can assists in gaining and consolidating vocabulary through practice (Dalton & Grisham, 2011; Tyson, 2016). The advantage of these applications is that there is word exposure along with its picture until it is learnt.

Interestingly, in item 33 there is a narrow difference between the English levels A2 (M= 1.36) and Pre-A1 (M= 1.72) in relation to level B2 (M= 1.64). We can suggest that engineering students of all English levels reported using this TMVLS, even though it emerged as the least-used strategy by these students (see section 4.1). It might be the case that they are not aware of these existing lexical applications. Nevertheless, word clouds represent an opportunity to practice spelling and support vocabulary learning (Tyson, 2013, 2016). Consequently, English teachers should encourage students to use these applications for reviewing vocabulary.

With the purpose of exploring further statistically significant differences among the thirteen TMVLS mentioned above, one-way ANOVA multiple comparisons with the Bonferroni adjustment was carried out. Table 4.6 shows these differences.

Table 4.6
Significant differences through the Bonferroni adjustment for multiple comparisons among TMVLS and English levels

Dependent Variable	(I) English Level	(J) English Level	Mean Difference (I-J)	Std. Error	Sig.
1. Guess meaning by context in sentence shown online.	PRE-A1	A2	-.401*	.126	.017
		B1	-.628*	.126	.000
		B2	-.944*	.151	.000
	A1	B1	-.463*	.123	.002
	B2	PRE-A1	.944*	.151	.000
		A1	.779*	.149	.000
		A2	.543*	.133	.001
3. Skip word whose meaning cannot be guessed.	PRE-A1	A2	.625*	.167	.002
		B1	.518*	.167	.022
		B2	.839*	.201	.000
	B2	PRE-A1	-.839*	.201	.000
		A1	-.621*	.197	.018

Dependent Variable	(I) English Level	(J) English Level	Mean Difference (I-J)	Std. Error	Sig.
4. Look for text/e-book in L1 (Spanish) to avoid having to deal with vocabulary in English.	PRE-A1	A2	.548*	.180	.026
		B1	.534*	.180	.033
		B2	1.162*	.218	.000
	B2	PRE-A1	-1.162*	.218	.000
		A1	-.688*	.214	.015
		A2	-.614*	.193	.016
		B1	-.628*	.193	.013
13. Ask teacher for translation of the word on social networks (WhatsApp, Telegram, Facebook, etc.).	A1	A2	.545*	.185	.035
25. Practice vocabulary on specific websites/Apps (Duolingo, Rosseta Stone, FluentU, etc.).	PRE-A1	B2	.853*	.224	.002
	B2	PRE-A1	-.853*	.224	.002
		A1	-.879*	.220	.001
		A2	-.652*	.198	.011
26. Use new words on social networks (Messenger, WhatsApp, Facebook, Instagram, Blogs, etc.).	PRE-A1	B2	-.939*	.221	.000
	B1	A1	.519*	.180	.042
	B2	PRE-A1	.939*	.221	.000
		A1	1.058*	.217	.000
		A2	.713*	.195	.003
27. Read blogs/wikis/articles on magazines/books online or web sites of my interest to learn new words.	PRE-A1	B2	-.998*	.224	.000
	B2	PRE-A1	.998*	.224	.000
		A1	1.032*	.221	.000
		A2	.832*	.198	.000
		B1	.792*	.198	.001
28. Listen to online radio stations/podcasts, and or watch online videos related to students' interests or study field (BBC World, YouTube, Vimeo, etc.).	PRE-A1	B2	-1.142*	.243	.000
	B2	PRE-A1	1.142*	.243	.000
		A1	1.091*	.239	.000
		A2	.851*	.215	.001
		B1	.638*	.215	.033
29. Watch movies/series with audio and/or subtitles in English on streaming media (Netflix, Amazon, YouTube, Vimeo, etc.).	PRE-A1	B2	-.739*	.205	.004
	A1	B1	-.487*	.167	.038
	B2	PRE-A1	.739*	.205	.004
		A1	.803*	.201	.001

* The mean difference is significant at the 0.05 level.

Source: Original

Table 4.6 contains the nine subtle significant differences in the use of TMVLS and English levels after the Bonferroni adjustment. English levels Pre-A1, A1, and B2 differ significantly across the language levels on the reported use of TMVLS (items 1, 3, 4, 13, 25, 26, 27, 28, and 29). As a matter of fact, in items 14, 16, 21, and 33 there was not subtle significant differences among these TMVLS and English levels. As it can be observed, in Table 4.6 there are sub specific differences across the English levels. It can be suggested that English level might determine the use of TMVLS between groups besides the results shown in Table 4.5. Finally, we detected that higher language level students reported using strategies differently from those whose language level is lower (Chamot, 1998). It should be mentioned that these generalisations are similar in Liu's et al. (2014).

4.5 Students' self-evaluation in terms of digital competence regarding technology-mediated vocabulary learning strategies

To answer this question, descriptive statistics were carried out. It should be point out that it reflects students' self-evaluation on digital competence organised into three levels (basic, intermediate, and advanced). These are described in TMVLS Questionnaire (see Appendix A, section III). The results are indicated in Table 4.7 and Figure 4.1.

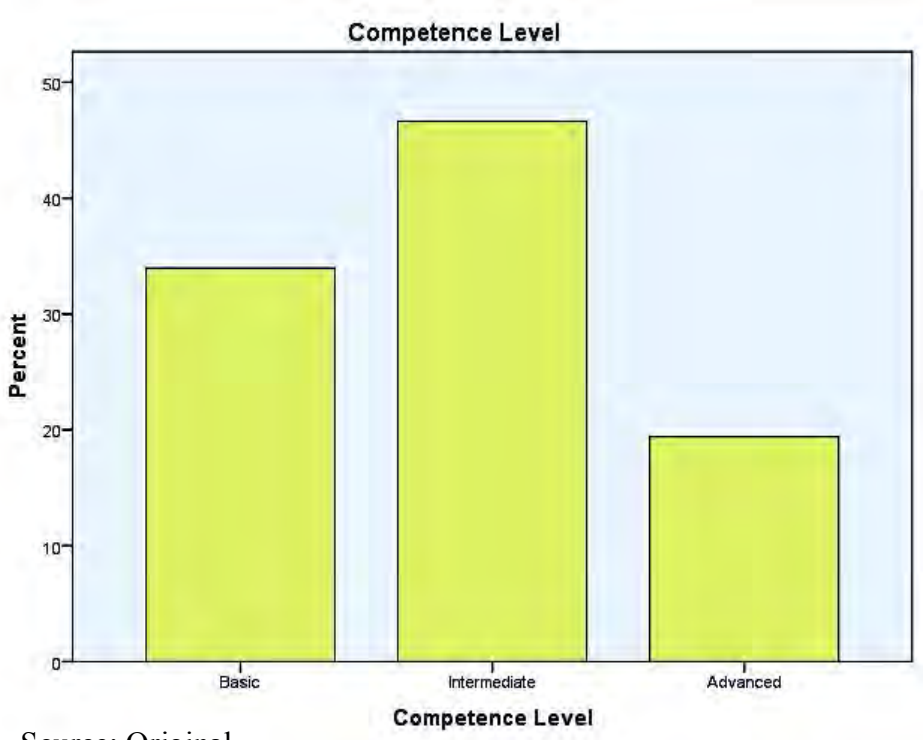
Table 4.7
Students' self-evaluation in digital competence regarding TMVLS

Digital Competence Level		Frequency	Valid Percent
Valid	Basic	91	34.0
	Intermediate	125	46.6
	Advanced	52	19.4
	Total	268	100.0

Source: Original

Table 4.7 shows that nearly two-sixths (34%) of the sample (268 students) reported to have a basic level in digital competence; about the half (47%) reported intermediate; and over one-sixth (19%) reported advanced level. Likewise, Ambriz (2014) found that 40% of freshmen engineering students possessed nearly such level of digital competence; nevertheless 56% of the students had basic level, and only 4% of them had advanced level.

Figure 4.1
Students' self-evaluation in digital competence regarding TMVLS



Source: Original

Figure 4.1 shows the percentages of students as regards their level of digital competence. From these results we can assume that students who reported having a basic level (34%) are able to find some data, information, and digital content with search engines; create simple digital content (texts, tables, images, audio); and modify the basic configurations of software and applications. It can be suggested that these students possess the elemental competence of data literacy, digital content creation and programming, among other skills (INTEF, 2017). Digital

divide might play a role in this case, besides the lack of ICT training as well as awareness of the importance of technology as a learning resource.

Students who reported having an intermediate level (47%) are able to browse Internet to locate data, digital content, and information; produce digital content in different formats (multimedia, audio, etc.); and make various advanced modifications to programs and applications (INTEF, 2017). Taking into account the results of students' self-evaluation, this is an average level of digital competence. Notwithstanding, students could improve it since technology and digital resources evolve as time goes by and it is required for functioning in the present-day digital society.

Students who reported having an advanced level (19%) use web bookmarks, filters, and advanced searching tools for finding data, information, and digital content on the Internet; digital content formats, platforms, and different environments (videos, wikis, multimedia, etc.); and make various modifications to programs an applications and encode and program digital devices (INTEF, 2017). We can suggest that these students might be aware of the importance of developing and improving their digital competence. Moreover, an advanced level could be advantageous for them so that they could use more learning strategies not only for TMVLS but also for their engineering courses, not to mention for their future working field.

We can also suggest then that students' level of digital competence might be related to the use of TMVLS. We have noticed that some of these strategies are not used at all as students reported. Otherwise, it could be helpful for boosting significantly students' language proficiency. Hence, it is necessary to foster digital competence in the first place by arising students' awareness. This could be done through surveys or questionnaires in relation to level of digital competence and learning strategies such as TMVLS and *Ikanos self-assessment test* (Ikanos, 2019). According to the results, it can also be seen that students need to be more aware of ICT resources and become more self-directed as this concern has already been expressed in countries such as Spain (Gutiérrez et al., 2017; INTEF, 2017; Ikanos, 2019), and England (Ramanau et al., 2010).

On another note, a cross-tabulation analysis was performed to reveal the level of digital competence in majors (see Table 4. 8). According to the results, Network engineering major had the highest percentage of students reporting an advanced level of digital competence (37%), followed by Environmental engineering (27%), and Energy Systems engineering (21%). Natural Resources Management engineering reported the lowest percentage of students with this advanced level (15%). Following this pattern, Network engineering major had the highest percentage of

students reporting a basic level of digital competence among majors (29%), and Natural Resources Management engineering reported the lowest percentage of students with this level (21%).

Table 4.8
Cross tabulation contingency table. Level of digital competence in engineering majors

Cross Tabulation Frequency Percent			Digital Competence Level			Total
			Basic	Intermediate	Advanced	
Major	Environmental Engineering	% within Major	32.1%	50.0%	17.9%	100.0%
		% within Competence Level	27.5%	31.2%	26.9%	29.1%
	Network Engineering	% within Major	33.8%	41.6%	24.7%	100.0%
		% within Competence Level	28.6%	25.6%	36.5%	28.7%
	Energy Systems Engineering	% within Major	35.6%	45.8%	18.6%	100.0%
		% within Competence Level	23.1%	21.6%	21.2%	22.0%
	Natural Resources Management Engineering	% within Major	35.2%	50.0%	14.8%	100.0%
		% within Competence Level	20.9%	21.6%	15.4%	20.1%
Total		% within Major	34.0%	46.6%	19.4%	100.0%
		% within Competence Level	100.0%	100.0%	100.0%	100.0%

Source: Original

Interestingly, the half (50%) of the respondents of Environmental as well as Natural Resources Management engineering reported having an intermediate level of digital competence; and about the half (42%, 46%) of the students of Network and Energy Systems engineering reported having this level. It can be observed that intermediate level predominated within the students and the majors as well.

Conclusively, it was expected to get these results regarding Network engineering students because of the nature of their major. Nevertheless, it is pivotal that engineering students -regardless their major- improve their digital competence level in order to enhance their learning and develop the necessary skills for being able to function in nowadays society. It is also important for them to take into account the instrumental use of technology and take advantage of it as a didactic resource for becoming self-directed learners not only for being digitally competent but also proficient in

second language as part of the key competences for lifelong learning as it is desirable for 21st century citizens (European Parliament and the Council, 2006).

Furthermore, in order to detect the frequency use of TMVLS across the levels of digital competence reported by students, descriptive statistics were carried out. To this respect, Table 4.9 shows the most frequently used TMVLS whereas Table 4.10 indicates the least-used TMVLS, both of them across the levels of digital competence.

In accordance with the results shown in Table 4.9, the five most frequently used TMVLS across the three levels of digital competence are items (1) guess meaning by context in sentence shown online, (2) guessing meaning by pictures related to the text online, (5) looking up word on online/Apps bilingual dictionaries, (7), using online translators to know the meaning in Spanish, and (29) watching movies/series with audio and/or subtitles in English on streaming media. These correspond to the discovery strategies (items 1, 2, 5, 7), together with memorisation and further consolidation strategies (item 29).

In the basic level, the mean frequency rating ranged from 2.74 to 3.19. As for the intermediate level, it ranged from 3.06 to 3.31. Whereas in the advanced level, its mean frequency ranged from 3.02 to 3.37. It can be noticed that the highest frequency mean obtained corresponds to the advanced level of digital competence (M=3.37 in item 29).

It is worth highlighting that these five TMVLS shown in Table 4.9 are common to all the levels of digital competence as reported by students. Hence, it can be suggested that digital competence level is not a strong predictor in the use of TMVLS but it can be slightly when it comes to the frequency of use. To the best of our knowledge, no results were found in order to compare them with the findings emerged from this research.

Table 4.9
Top five of the most frequently reported TMVLS across levels of digital competence

Digital Competence Level	Rank	Item/TMVLS	N	Minimum	Maximum	Mean	Std. Deviation
Basic	1	7. Use online translators to know the meaning in Spanish (Google translate, Babylon, DeepL, Bing translator, etc.).	91	1	4	3.19	.855
	2	2. Guess meaning by pictures related to the text online.	91	1	4	3.10	.761
	3	1. Guess meaning by context in sentence shown online.	91	1	4	2.98	.666
	4	29. Watch movies/series with audio and/or subtitles in English on streaming media (Netflix, Amazon, YouTube, Vimeo, etc.).	91	1	4	2.92	.980
	5	5. Look up word on online/Apps bilingual dictionaries (Cambridge, Collins, WordReference, etc.).	91	1	4	2.74	.941
Intermediate	1	29. Watch movies/series with audio and/or subtitles in English on streaming media (Netflix, Amazon, YouTube, Vimeo, etc.).	125	1	4	3.31	.797
	2	7. Use online translators to know the meaning in Spanish (Google translate, Babylon, DeepL, Bing translator, etc.).	125	1	4	3.30	.721
	3	1. Guess meaning by context in sentence shown online.	125	1	4	3.18	.685
	4	2. Guess meaning by pictures related to the text online.	125	1	4	3.12	.747
	5	5. Look up word on online/Apps bilingual dictionaries (Cambridge, Collins, WordReference, etc.).	125	1	4	3.06	.936
Advanced	1	29. Watch movies/series with audio and/or subtitles in English on streaming media (Netflix, Amazon, YouTube, Vimeo, etc.).	52	1	4	3.37	.908
	2	7. Use online translators to know the meaning in Spanish (Google translate, Babylon, DeepL, Bing translator, etc.).	52	1	4	3.33	.901
	3	1. Guess meaning by context in sentence shown online.	52	1	4	3.27	.795
	4	5. Look up word on online/Apps bilingual dictionaries (Cambridge, Collins, WordReference, etc.).	52	1	4	3.13	1.085
	5	2. Guess meaning by pictures related to the text online.	52	1	4	3.02	.852

Note: The item number corresponds to the one from the instrument.
Source: Original

With regard to the five least-used TMVLS across the levels of digital competence (see Table 4.10), we found that memorisation and further consolidation (items 32, 33) along with note-taking (items 21, 22) strategies were of common use in the three levels.

On the other hand, students who reported having basic level of digital competence informed using another note-taking strategy (item 18), whereas the ones having intermediate as well as an advanced level indicated using one discovery strategy (item 14 –social/asking others strategies-).

Table 4.10
Top five of the least-used TMVLS across levels of digital competence

Digital Competence Level	Rank	Item/TMVLS	N	Minimum	Maximum	Mean	Std. Deviation
Basic	33	33. Create a word cloud by using generators on websites (Wordle, Tagxedo, Phoetic, Word Salad, etc.).	91	1	4	1.54	.779
	32	32. Create mind maps by using Apps or software (Mindomo, MindMeister, Litpen, Freemind, etc.).	91	1	4	1.58	.804
	31	22. Store/file the new word and its picture on electronic devices.	91	1	4	1.70	.863
	30	21. Record voice notes about new vocabulary on electronic devices to memorise them.	91	1	4	1.80	.897
	29	18. File the word meaning on web bookmarks.	91	1	4	1.86	.877
Intermediate	33	33. Create a word cloud by using generators on websites (Wordle, Tagxedo, Phoetic, Word Salad, etc.).	125	1	4	1.53	.819
	32	32. Create mind maps by using Apps or software (Mindomo, MindMeister, Litpen, Freemind, etc.).	125	1	4	1.58	.786
	31	21. Record voice notes about new vocabulary on electronic devices to memorise them.	125	1	4	1.58	.764
	30	22. Store/file the new word and its picture on electronic devices.	125	1	4	1.63	.848
	29	14. Ask teacher for the word definition on social networks (WhatsApp, Telegram, Facebook, etc.).	125	1	4	1.81	.922

Digital Competence Level	Rank	Item/TMVLS	N	Minimum	Maximum	Mean	Std. Deviation
Advanced	33	33. Create a word cloud by using generators on websites (Wordle, Tagxedo, Phoetic, Word Salad, etc.).	52	1	4	1.42	.750
	32	32. Create mind maps by using Apps or software (Mindomo, MindMeister, Litpen, Freemind, etc.).	52	1	4	1.44	.752
	31	22. Store/file the new word and its picture on electronic devices.	52	1	3	1.46	.753
	30	21. Record voice notes about new vocabulary on electronic devices to memorise them.	52	1	4	1.48	.779
	29	14. Ask teacher for the word definition on social networks (WhatsApp, Telegram, Facebook, etc.).	52	1	4	1.67	.901

Note: The item number corresponds to the one from the instrument.
Source: Original

It can be observed in Table 4.10 that the mean frequency rating in the basic level ranged from 1.54 to 1.86; in the intermediate level it ranged from 1.53 to 1.81; and the advanced level it ranged from 1.42 to 1.67 (the lowest mean frequency range). From these results, we can suggest anew (as in section 4.1.2) that these TMVLS are used infrequently because students are not familiar with these despite their level of digital competence. Even though, these findings represent an opportunity for raising awareness among students in order to build their vocabulary through the use of technology and at the same to develop ICT skills.

4.6 Employment situation differences in technology-mediated vocabulary learning strategies

To deal with this research question, a t-test for independent-samples was carried out. The results showed that there are significant differences (see Table 4.11) between employment situation and the use of three TMVLS: (1) guessing meaning by context (t= 2.305, df= 266, p= .022), (4) looking for text/e-book in Spanish (t= -2.229, df= 265, p= .027), and (9) using glossaries online of technical words (t= 1.921, df=266, p= .049). For clarifying, in item 9, the *p* value was taken from *Equal variances not assumed* in the *Independent Samples Test* table (on the borderline).

Table 4.11
Student's t-test Employment situation differences in the use of TMVLS

Item/TMVLS	Work	N	Mean	Student t-test
1. Guess meaning by context in sentence shown online.	No	177	3.20	t= 2.305, df= 266, p= .022
	Yes	91	2.99	
4. Look for text/e-book in L1 (Spanish) to avoid having to deal with vocabulary in English.	No	176	2.34	t= -2.229, df= 265, p= .027
	Yes	91	2.62	
9. Use glossaries online of technical words (sapiensman.com, vocabulario.com.mx, iate.europa.eu, etc.).	No	177	2.02	t= 1.921, df=266, p= .049
	Yes	91	1.80	

Note: The item number corresponds to the one from the instrument.
Source: Original

Table 4.11 reveals that the variable employment situation does not determine differences at all in the use of TMVLS, bar in three of these. We can notice that students who do not work obtained the higher means in items 1 (M= 3.20), and 9 (M= 2.02). This might be due to the allotted time they devote to study and enhance their vocabulary. Contrariwise, students who reported a working situation obtained the higher mean in item 4 (M= 2.62). We can suggest that students who work might have not enough time to deal with new vocabulary in English, hence they opt for the equivalent texts or books in Spanish. To the best of our knowledge, no results were found in other studies to be compared with the ones provided in this section. Thus, further research needs to be done in this regard since employment situation is an important variable that might determine differently or similarly the use of TMVLS due to the fact that it prompts whether or not the development of ICT skills and English language learning.

The previous results answered the research questions posed in this study. Similarly, these were discussed under the Constructivism theory and related to the literature review as well. Thereupon, next chapter presents the conclusions.

CHAPTER 5 CONCLUSIONS

This section refers to the most relevant outcomes and conclusions that emerged from the research questions that led this study. It also describes the limitations of the study, recommendations for future research, and pedagogical implications.

5.1 Relevant findings and conclusions

The objective of this research was to examine how engineering undergraduates at UQRoo learn technology-mediated vocabulary in English and to describe the level of digital competence that they have developed along with the possible differences across majors, gender, working situation, and level of English. The sample was composed of 268 students from the 1st to 9th semester who are enrolled either in Environmental, Network, Energy Systems, or Natural Resources Management major.

The relevant results are indicated by following the same order as the research questions, which are as follows:

RQ1. What are the most and the least frequently reported technology-mediated vocabulary learning strategies reported by undergraduate engineering students from UQRoo campus Chetumal?

RQ2. Are there any differences in the use of technology-mediated vocabulary learning strategies across majors?

RQ3. Are there any gender differences in technology-mediated vocabulary learning strategies reported by engineering students?

RQ4. Are there any English level differences in technology-mediated vocabulary learning strategies reported by engineering students?

RQ5. How engineering students self-evaluate in terms of digital competence regarding technology-mediated vocabulary learning strategies?

RQ6. Are there any employment situation differences in technology-mediated vocabulary learning strategies reported by engineering students?

The main findings of the study indicated that the most frequently reported TMVLS was (7) using online translators (Google translate, Babylon, DeepL, Bing translator, etc.), followed by (29) watching movies/series with audio and/or subtitles in English on streaming media (Netflix, Amazon, YouTube, Vimeo, etc.), (1) guessing meaning by context in sentence shown online, (2) guessing meaning by pictures related to the text online, as well as (5) looking up word on online/Apps bilingual dictionaries (Cambridge, Collins, WordReference, etc.). Additionally, other frequently used strategies involves memorisation/further consolidation strategies and dictionary-use, that is, (24) associating new word found online with similar known word in L1, (23) looking up word pronunciation on specific Apps/websites to pronounce it accurately and memorise it (Google translate, Cambridge Dictionary, Oxford, etc.), (28) listening to online radio stations/podcasts, and or watching online videos related to students' interests or study field (BBC World, YouTube, Vimeo, etc.), (26) using new words on social networks (Messenger, WhatsApp, Facebook, Instagram, blogs, etc.), and (12) looking up examples of sentences of the word on the Internet.

In contrast, the least-used TMVLS was (33) creating a word cloud by using generators on websites (Wordle, Tagxedo, Phoetic, Word Salad, etc.), along with (32) creating mind maps by using Apps or software (Mindomo, MindMeister, Litpen, Freemind, etc.), (22) storing/filing the new word and its picture on electronic devices, (21) recording voice notes about new vocabulary on electronic devices to memorise them. Likewise, students reported using at low frequency the strategies (14) asking teacher for the word definition on social networks besides (13) asking teacher for translation of the word on social networks (WhatsApp, Telegram, Facebook, etc.). Finally, other strategies with a low frequency use were (18) filing the word meaning on web bookmarks, (30) using vocabulary practice on Apps/web resources (FreeRice, Kahoott!, Quizlet, etc.), (9) using glossaries online of technical words (sapiensman.com, vocabulario.com.mx, iate.europa.eu, etc.), and (17) making word list of unknown vocabulary on note taking Apps (Evernote, etc.).

In relation to the differences in the use of TMVLS across majors, it was found that major does matter when it comes to use them. The results showed that Environmental engineering as well as Natural Resources Management students reported using more TMVLS than Network and Energy Systems students. The TMVLS that emerged with a significant different across majors were (5) looking up word on online/Apps bilingual dictionaries (Cambridge, Collins,

WordReference, etc.), (9) using glossaries online of technical words (sapiensman.com, vocabulario.com.mx, iate.europa.eu, etc.), (18) filing the word meaning on web bookmarks, (21) recording voice notes about new vocabulary on electronic devices to memorise them, and (20) taking screenshots of word meaning and filing them on the mobile phone or other electronic devices.

Apart from this, significant differences were found between gender and the use of six TMVLS. In this respect, female students reported using more strategies (i. e. five) than male students (i. e. one). The TMVLS that female students tended to use more frequently as reported were (17) making word list of unknown vocabulary on note taking Apps (Evernote, etc.), (18) filing the word meaning on web bookmarks, (19) filing vocabulary notes on the computer/mobile phone or other electronic devices, (20) taking screenshots of word meaning and filing them on the mobile phone or other electronic devices, (23) looking up word pronunciation on specific Apps/websites to pronounce it accurately and memorise it (Google translate, Cambridge Dictionary, Oxford, etc.). The TMVLS used more by male students was (31) playing videogames online concerning vocabulary (Deponia, The Whispered World, etc.).

Another finding was in regards to the use of TMVLS across English levels. The results yielded that students' English proficiency does determine the use of thirteen TMVLS. Hence, the lower the English language level (Pre-A1, A1 vs B2), the more frequently students reported using [Pre-A1] (3) skipping word whose meaning cannot be guessed, (4) looking for text/e-book in L1 (Spanish) to avoid having to deal with vocabulary in English, (21) recording voice notes about new vocabulary on electronic devices to memorise them; [A1] (13) asking teacher for translation of the word on social networks (WhatsApp, Telegram, Facebook, etc.), (14) asking teacher for the word definition on social networks (WhatsApp, Telegram, Facebook, etc.), (16) asking classmates/friends/relatives for the word definition on social networks (WhatsApp, Telegram, Facebook, etc.), and (25) practicing vocabulary on specific websites/Apps (Duolingo, Rosseta Stone, FluentU, etc.). On the other hand, the higher the English level (B2 vs Pre-A1, A1), the more frequently students reported using [B2 vs Pre-A1] (1) guessing meaning by context in sentence shown online, (28) listening to online radio stations/podcasts, and/or watching online videos related to students' interests or study field (BBC World, YouTube, Vimeo, etc.); [B2 vs A1] (26) using new words on social networks (Messenger, WhatsApp, Facebook, Instagram, Blogs, etc.), (27) reading blogs/wikis/articles on magazines/books online or web sites of my interest to learn

new words, and (29) watching movies/series with audio and/or subtitles in English on streaming media (Netflix, Amazon, YouTube, Vimeo, etc.). Lastly, the use of the strategy (33) creating a word cloud by using generators on websites (Wordle, Tagxedo, Phoetic, Word Salad, etc.) was reported being used slightly more by A2 level students than Pre-A1 level students.

With respect to ICT use and pertinence, students reported having different levels of digital competence after self-evaluating on this matter. In general terms, 34% of the students reported a basic level; 47% reported an intermediate level; and 19% reported an advanced level. The level of digital competence across majors is as follows: over 30% of students of Environmental, Network, Energy Systems, and Natural Resources Management reported having a basic level; whereas 50% of students of Environmental as well as Natural Resources Management reported having an intermediate level, while over 40% of Network and Energy Systems reported having this level too; 25% of Network students reported having an advanced level, followed by 19% of Energy Systems, then 18% of Environmental students, and lastly 15% of Natural Resources Management.

The most used TMVLS across basic, intermediate, and advanced levels of digital competence were (1) guessing meaning by context in sentence shown online, (2) guessing meaning by pictures related to the text online, (5) looking up word on online/Apps bilingual dictionaries (Cambridge, Collins, WordReference, etc.), (7) using online translators to know the meaning in Spanish (Google translate, Babylon, DeepL, Bing translator, etc.), and (29) watching movies/series with audio and/or subtitles in English on streaming media (Netflix, Amazon, YouTube, Vimeo, etc.). It was noted that the frequency of use of these TMVLS was higher in students who reported having an advanced and intermediate level of digital competence than the ones with basic level.

While the least-used TMVLS across the three levels of digital competence were of common use (21) recording voice notes about new vocabulary on electronic devices to memorise them, (22) storing/filing the new word and its picture on electronic devices, (32) creating mind maps by using Apps or software (Mindomo, MindMeister, Litpen, Freemind, etc.), (33) creating a word cloud by using generators on websites (Wordle, Tagxedo, Phoetic, Word Salad, etc.). Besides, (18) filing the word meaning on web bookmarks was unfrequently used by students with basic level of digital competence, meanwhile (14) asking teacher for the word definition on social networks (WhatsApp, Telegram, Facebook, etc.) were also less used by students with intermediate and advanced level. Although, it is noteworthy that items 33 and 32 had higher means of frequency in

students with basic and intermediate level of digital competence than in the ones with advanced level.

Finally, almost no differences were found in employment situation and the use of TMVLS. The only significant differences were found in (1) guessing meaning by context in sentence shown online, (4) looking for text/e-book in L1 (Spanish) to avoid having to deal with vocabulary in English, and (9) using glossaries online of technical words (sapiensman.com, vocabulario.com.mx, iate.europa.eu, etc.). From these outcomes, students who reported not working obtained the higher frequency of use in items 1 and 9, whereas students who reported having a working situation obtained a higher frequency in item 4.

On the whole, the use TMVLS is not a practice totally spread on engineering students. Besides, the use of TMVLS is differently in regards to students' English level. What is more, major does determine the use and frequency of TMVLS, as well as gender. On the other hand, digital competence level is not a strong predictor in the use of TMVLS but it can be slightly when it comes to the frequency of use. In addition, there is a lack of ICT training in about 80% of the students along with disesteem for looking for learning strategies that imply the use of technology. Moreover, employment situation does not determine strongly the use of TMVLS.

5.2 Limitations of the study

The drawbacks of this piece of research were basically four. To begin with, time was constrained. The initial idea for this research encompassed a qualitative approach too. In this regard, the gathering data phase took longer than anticipated; thus it did not allow us to continue with. High rate of absenteeism in some of the selected classes, suspension of classes, as well as class rescheduling impeded us to follow the stipulated project schedule. Hence cutting the project ensued after this time consuming/draining experience. Although some considerations were taken into account when planning the project, those were far beyond what had been scheduled.

The second limitation was students' attitude towards answering the questionnaire administered. This issue was noticed in some senior students (9^{th} semester) of some majors who did not complete -by their own choice- the instrument provided, though they were told about the importance of their participation and its confidentially. Therefore, we respected their decision, and

those questionnaires were discarded from the sample, thus the data to be analysed. Nevertheless, the size of the sample was over reached at the end of that process for the sake of this research.

The next downside of carrying out this piece of research was the access to some of the specialized literature concerning technology-mediated vocabulary learning strategies either in journals or books. Most of it was under payment for being able to read it online or download it. Due to this fact, it was not possible to consult up-to date information and studies for conducting a deeper literature review as well as comparing results.

Finally, the fourth limitation was the type of sample. As a sample of convenience was used for this study, its own nature limited the capacity for drawing general conclusions based on the findings about the type of participants and setting different from engineering students at UQRoo.

5.3 Recommendations for future research

According to the limitations encountered and gaps detected during the process of this endeavour, we suggest for future research carrying out a qualitative approach in regards TMVLS considering more time and resources so that a deeper understanding of the phenomenon can be obtained. We also advice to conduct this type of study in other settings and populations in order to attain other results and compare how students learn vocabulary through the use of technology.

Additionally, there are some other aspects that could be included in researches to come for covering other aspects of the use of TMVLS. For example, the relationship between semester and the use of TMVLS; the relationship among level of digital competence, level of English and major; and the differences in use of TMVLS among English level and level of digital competence.

Lastly, future researches should be carried out transversally to observe how students have learnt, developed, and evolved their TMVLS along the time, besides ICT use and level of digital competence. On another note, an online administered questionnaire is not advisable for undertaking a similar research because not all the students possess the same level of digital competence and the collaboration/willingness to answer or deal with an instrument of this nature.

5.4 Pedagogical implications

The outcomes of this research contribute to having a better understanding about how engineering students at UQRoo use and appropriate technological resources not only for learning vocabulary but also for increasing their English proficiency. At the same time, it provides an overview of students' shortcomings as well in regards to digital literacy and learning strategies in general, in which ICT may play or not a central role in their studies.

The results of this research draw attention and raise awareness to the existing gaps concerning students' ICT competence and attitudes towards technology, which represent an opportunity for fostering students' self-directed learning and not mention for bridging the digital divide when is that the case.

For concluding, these discoveries also benefit university board and decision makers so that they can create academic programs or integrate content based on these results for students to develop more their level of digital competence and improve second language learning by using technology-mediated strategies. A general course or some classes devoted to teaching learning strategies and ICT use would be of great benefit for students. In other words, implementing ICT training and integrating TMVLS teaching in English courses such as technological resources and lexical applications at beginner levels would prompt students' self-directed learning.

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APPENDIX A

Universidad de Quintana Roo · Licenciatura en Lengua Inglesa

Cuestionario de estrategias de aprendizaje de vocabulario en inglés mediado por la tecnología en estudiantes de ingeniería

Estimado/a estudiante:

El objetivo de este cuestionario es conocer de qué forma aprendes vocabulario en inglés con el uso de tecnologías de la información y la comunicación (TIC) así como el desarrollo de tus competencias digitales, con fines de mejora continua. La información que proporciones se manejará de manera anónima, confidencial y objetiva.
El cuestionario está dividido en cuatro secciones y no hay respuestas correctas e incorrectas.

I. Estrategias de aprendizaje de vocabulario en inglés

Instrucciones:
Lee cada oración y elige una respuesta marcando con una "**X**" el número del **1 al 4** que más se aplique a tu experiencia. **Por favor no dejes reactivos sin contestar**.

Ejemplo de escala:

1= Nunca	2= Casi nunca	3= Regularmente	4= Siempre

Para aprender una palabra en inglés:	1	2	3	4
1. Deduzco su significado según el contexto de la oración que está en línea.				
2. Deduzco su significado de acuerdo con las imágenes que acompañan al texto en línea.				
3. Dejo pasar la palabra si no puedo suponer su significado.				
4. Busco en Internet el texto o libro en idioma español para no tener que lidiar con el vocabulario en inglés.				
5. Busco su significado en diccionarios bilingüe en línea o en Apps (Cambridge, Collins, WordReference, etc.).				
6. Busco su significado en un diccionario monolingüe (inglés-inglés) en línea o en Apps (Cambridge, Collins, Oxford, Dictionary.com, etc.).				
7. Utilizo traductores en línea para saber el significado (Google translate, Babylon, DeepL, Bing translator, etc.).				
8. Utilizo diccionarios bilingües en línea que incluyan indexadores web especializados para buscar oraciones/palabras similares procedentes de documentos publicados en línea (Linguee, Reverso, WordReference, etc.).				
9. Consulto glosarios de palabras técnicas en inglés en línea (sapiensman.com, vocabulario.com.mx, iate.europa.eu, etc.).				
10. Busco en Google o en otros buscadores imágenes o dibujos relacionados con la palabra desconocida.				

11. Busco en diccionarios/tesauros en línea o en Apps los sinónimos en inglés de la palabra desconocida.				
12. Busco en Internet ejemplos de oraciones utilizando el nuevo vocabulario.				
13. Pregunto al profesor/a la traducción de la palabra a través de WhatsApp, Telegram, Facebook, etc.				
14. Pregunto al profesor/a la definición de la palabra a través de WhatsApp, Telegram, Facebook, etc.				
15. Pregunto a mis compañeros, amigos o familiares la traducción de la palabra a través de WhatsApp, Telegram, Facebook, etc.				
16. Pregunto a mis compañeros, amigos o familiares la definición de la palabra a través de WhatsApp, Telegram, Facebook, etc.				
17. Escribo una lista de palabras desconocidas en las notas del celular, Evernote o en una App similar.				
18. Guardo el significado de la palabra en marcadores de sitios web.				
19. Guardo notas de vocabulario en la computadora, celular o en otros dispositivos electrónicos.				
20. Guardo capturas de pantalla del significado de la nueva palabra en mi celular u otro dispositivo electrónico.				
21. Hago notas de voz del vocabulario nuevo en mi celular o en otro dispositivo electrónico para poder memorizarlo.				
22. Registro electrónicamente la nueva palabra junto con un dibujo o imagen que la represente.				
23. Busco la pronunciación de la nueva palabra en sitios de Internet específicos o en Apps (Google translate, Cambridge Dictionary, Oxford, etc.) para pronunciarla correctamente y memorizarla.				
24. Asocio la palabra que encuentro en línea con otra que ya conozco.				
25. Practico vocabulario en inglés en sitios específicos como Duolingo, Rosseta Stone, FluentU, etc.				
26. Aplico el vocabulario aprendido en mis conversaciones en línea o en publicaciones de redes sociales (Messenger, WhatssApp, Facebook, Instagram, blogs, etc.).				
27. Leo blogs, wikis, artículos, revistas, libros en línea o sitios web de mi interés para conocer nuevas palabras.				
28. Escucho estaciones de radio en Internet en inglés (BBC World, etc.), podcasts, y/o videos en línea (YouTube, Vimeo, etc.) de temas de mi interés o de mi área de estudio.				
29. Veo series y/o películas en línea con audio y/o subtítulos en inglés en Netflix, Amazon, YouTube, Vimeo, etc.				
30. Utilizo recursos web o Apps enfocadas a vocabulario (FreeRice, Kahoott!, Quizlet, etc.).				
31. Uso videojuegos en línea referentes a vocabulario (Deponia, The Whispered World, etc.).				
32. Creo mapas mentales de vocabulario referente a un tema utilizando Apps o software (Mindomo, MindMeister, Litpen, Freemind, etc.).				
33. Creo una nube de palabras (en Wordle, Tagxedo, Phoetic, Word Salad, etc.) para resaltar las nuevas palabras que he aprendido o que quiero aprender.				

☞ Por favor verifica que hayas respondido <u>todos</u> los reactivos de esta sección ☺

II. Autopercepción referente al nivel inglés

Instrucciones:
Marca con una **"X" la columna** que represente el nivel de inglés que consideras que tienes.

¿Cuál crees que sea tu nivel de inglés?				
Pre-A1	**A1**	**A2**	**B1**	**B2**
Comprendo preguntas, así como afirmaciones simples. Reconozco palabras que me son familiares y que son enunciadas lentamente, o bien, acompañadas de dibujos o de lenguaje corporal. Puedo escribir información personal, tal vez con el uso de un diccionario.	Comprendo y utilizo expresiones cotidianas de uso muy frecuente, así como frases sencillas acerca de gente y lugares. Puedo presentarme a mí mismo y a otros; así como pedir y dar información básica de mi domicilio, mis pertenencias, mascotas, gustos, etc.	Comprendo textos simples, frases y expresiones básicas relacionadas con información personal y familiar, compras, lugares de interés, ocupaciones, hábitos, etc. Puedo dar una descripción o presentación de estos temas. Puedo redactar una serie de frases simples y oraciones usando *but, and, because*.	Comprendo los puntos principales, así como detalles específicos de información hablada de temas conocidos y de textos relacionados con mi área de estudio e interés. Puedo producir textos sencillos y coherentes sobre temas conocidos o que son de mi interés.	Puedo entender las ideas principales de textos complejos, incluso si son de carácter técnico siempre y cuando estén dentro de mi área de estudio tanto en revistas, libros, Internet, radio, Tv, así como en presentaciones en vivo, etc. Puedo redactar y dar presentaciones, así como descripciones detalladas de temas de mi interés con un grado suficiente de fluidez y naturalidad.

Note. Adapted from *European Framework of Reference for Languages: Learning, Teaching, Assessment*, by Council of Europe, 2018. Retrieved from https://rm.coe.int/cefr-companion-volume-with-new-descriptors-2018/1680787989
Marco Común Europeo de Referencia para las Lenguas: Aprendizaje, Enseñanza, Evaluación, by Consejo de Europa, 2002. Retrieved from https://cvc.cervantes.es/ensenanza/biblioteca_ele/marco/cvc_mer.pdf

III. Autopercepción sobre competencia digital

Instrucciones:
Marca con una **"X" la columna** que represente el nivel de competencia digital que consideras que tienes.

¿Cuál crees que sea tu nivel de competencia digital?		
Básico	**Intermedio**	**Avanzado**
Soy capaz de buscar solamente cierta información, datos y contenido digital red mediante en buscadores. Puedo crear contenidos digitales sencillos (texto, tablas, imágenes, o audio). Puedo modificar algunas funciones sencillas de software y de Apps (configuración básica).	Sé navegar por Internet para localizar información, datos y contenido digital. Puedo producir contenidos digitales en diferentes formatos como multimedia, audio, tablas, imágenes, etc. Puedo realizar varias modificaciones avanzadas de programas y Apps.	Uso indexadores, filtros, marcadores u otras herramientas de búsqueda avanzada para encontrar información, datos y contenido digital en Internet. Puedo producir contenidos digitales en formatos, plataformas y entornos diferentes (videos, wikis, multimedia, etc.). Puedo realizar varias modificaciones de programas y Apps, así como codificar y programar dispositivos digitales.

Note. Adapted from *Common Digital Competence Framework for Teachers*, by Instituto Nacional de Tecnologías Educativas y de Formación del Profesorado, 2017, España: Ministerio de Educación, Cultural y Deporte. Retrieved from https://www.slideshare.net/educacionlab/common-digital competence-framework-for-teachers

IV. Datos sociodemográficos

Instrucciones:
Para cada enunciado escribe o encierra la opción que mejor describe tu situación. **Por favor no dejes reactivos sin contestar.**

1. Nivel de inglés que cursas actualmente: a) Introductorio b) Básico c) Pre Intermedio d) Intermedio e) Post Intermedio
2. Género: a) Femenino b) Masculino
3. Licenciatura que cursas:
4. Semestre:
5. Matrícula:
6. ¿Te encuentras trabajando actualmente? a) Sí b) No
7. ¿Desde dónde accedes <u>mayormente</u> a Internet? (Elige solamente una opción) a) Casa b) Trabajo c) Universidad d) Sitios públicos/Café Internet

☞ Por favor verifica que hayas respondido <u>todos</u> los reactivos de esta sección ☺

¡Muchas gracias por tu colaboración y sinceridad! 👍