

WHEN READING GOES DIGITAL: CONCEPTUAL AND METHODOLOGICAL REVIEWS  
ON TECHNOLOGY AND L2 VOCABULARY LEARNING

A Dissertation

by

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## ABSTRACT

Existing research syntheses on technology and second language acquisition have called for further systematic investigation of the theoretical frameworks and methodologies used in research of this field. Additionally, although vocabulary has been one of the most popular areas in technology-integrated second language acquisition research, a majority of the previous studies have examined college students or other adult populations. To fill these gaps, this dissertation systematically reviewed the theoretical and methodological trends in research on technology-integrated L2 vocabulary learning for PreK-12 learners of English. A total of 60 studies published between 2008 and 2018 were selected for analysis. The types of vocabulary knowledge, affordances of technology, and major theoretical frameworks were analyzed to uncover conceptual and theoretical trends; study context, participant demographics, research design, and outcome measures were analyzed for the methodological characteristics of the selected studies.

The theoretical review showed that the current research on technology-integrated L2 vocabulary learning for young learners was mostly guided by information/cognitive processing theories, social constructivism, and sociocognitive theories. However, a large body of the studies indicated a lack of direct reference to a theoretical framework, which demonstrated a need to strengthen the connections among theory, research, and practice in this field. The analysis of methodological characteristics has revealed several areas for further improvement, such as more complete reporting of the participant's English proficiency level, consistent reporting of study duration and length of treatment, and more research in English as second language contexts.

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## NOMENCLATURE

CALL	Computer assisted language learning
EFL	English as a foreign language
ELL	English language learner
EFL	English as a foreign language
L2	Second language
MALL	Mobile assisted language learning

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# CHAPTER I

## INTRODUCTION

### **Background**

The critical role of vocabulary development in text comprehension has been widely acknowledged, and research has demonstrated that a large vocabulary size is needed for effective reading comprehension in another language (Laufer & Ravenhorst-Kalovski, 2010; Nation, 2013; Schmitt, 2008). Previous research has found that a large variance (64%) in L2 learners' reading scores was accounted for by their vocabulary size, which indicated that vocabulary is a major factor in reading comprehension (Laufer & Ravenhorst-Kalovski, 2010). As Nation (2013) suggested, 6,000 to 9,000 word families are needed for learners to understand 98% of the text in English, as one word in 50 should be a manageable amount of unknown words in reading. Thus, a great emphasis is placed on expanding learner's vocabulary size when developing reading skills.

In addition to vocabulary size, the depth of vocabulary knowledge also contributes to reading comprehension. Vocabulary knowledge is multi-dimensional, and the acquisition process is complex (Schmitt, 2008). Multiple aspects of vocabulary knowledge need to be learned to fully acquire a word. In addition, the vocabulary learning process is influenced by a number of factors for second language (L2) learners, such as learners' previous first language (L1) experience, their L2 proficiency, how the word is taught or learned, and the intrinsic difficulty of the word (Nation, 1990). Therefore, L2 vocabulary learning approaches should be tailored to specific aspects of vocabulary knowledge and learners' needs.

Vocabulary learning has been one of the most popular areas in technology-mediated second language acquisition (SLA) research (Burston, 2015; Duman, Orhon, & Getik, 2015; Taj,

Sulan, Sipla, & Ahmad, 2016). Modern technologies enhance conditions for language acquisition, such as the exposure to comprehensible input and language production during collaborative dialogues, which have been supported by psycholinguistic and sociocultural perspectives of SLA theories (Peterson, 2010). Digital platforms provide L2 learners with additional opportunities for authentic language production, and, at the same time, they receive real-time feedback not only from peers, but also possibly from computers or mobile applications. According to self-efficacy theory, feedback in the process of task completion informs learners of the progress in achieving their learning goals, which increases learners' self-efficacy and motivates them to work on the task. Self-efficacy is also sustained when learners set appropriate learning goals and observe their progress towards the goals (Schunk & Swartz, 1993). When learners receive ongoing feedback from multiple sources in multimedia learning, they can constantly adjust their learning goals and strategy use, which adjustment enhances subsequent performance. As a result, technology allows for more engaging and personalized language learning experiences based on L2 learners' individual needs and proficiency levels (White, 2011).

Although technology-mediated L2 vocabulary learning has received increasing attention in research and practice, findings from previous research syntheses have indicated a need to further systematically investigate the theoretical framework, methodology, and learning outcomes in this field. While a series of research syntheses have explored the outcomes of technology-mediated L2 vocabulary learning with varied scopes, these research syntheses have yielded mixed conclusions (e.g., Abraham, 2008; Perez, Noortgate, & Desmet, 2013; Yun, 2011). The disparity of findings primarily focused on what factors influence the outcome of technology-mediated vocabulary learning, and to what extent those factors produce such

influences. Moreover, findings from previous studies were mostly based on adult learners, which makes younger learners in PreK-12 grades underrepresented in research on technology-mediated vocabulary learning. The inconsistent findings may be also associated with the study's theoretical basis and methodology, which are additional areas needing systematic investigation. Since theory is the fundamental rationale for research design and instructional practice, it is crucial to understand what theoretical frameworks support the integration of technology in L2 vocabulary learning, how innovative instructional approaches are designed based on those theories, and what factors may influence the effectiveness of implemented instructional approaches.

The purpose of the present study, therefore, is to provide comprehensive reviews on the theoretical and methodological trends of research on technology-mediated L2 vocabulary learning for PreK-12 English language learners (ELLs) over the past ten years. Two systematic reviews were conducted to fulfill the purpose. Study 1 reviewed the conceptual and theoretical trends in technology-mediated L2 vocabulary learning, and study 2 examined methodological characteristics of the selected studies.

This dissertation consists of six chapters. Chapter 1 provides a background overview and introduces the concepts of vocabulary knowledge and technology. Chapter 2 presents the theoretical framework of the studies and reviews previous research syntheses on the theories, methodologies, and effectiveness of technology in L2 vocabulary learning. Chapter 3 summarizes the methodologies to be used for the present studies. Chapter 4 presents results about the theoretical and methodological trends of technology-integrated L2 vocabulary learning respectively. Finally, Chapter 5 provides general discussions and conclusions based on the findings.

## Key concepts

**Multidimensionality of vocabulary knowledge.** It has been well-established that vocabulary learning involves a range of knowledge aspects (Schmitt, 2008; Nation, 1990, 2013). According to Nation (2013), three aspects of knowledge are needed to fully master a word: form, meaning, and use. Form denotes both sound and written forms of a word, as well as word parts; meaning refers to the form-meaning association of a word, the concept and its referents, and the associations among the words; use includes grammatical functions and collocations, as well as restraints on the use (e.g., frequency and register). Each of the three aspects is derived into receptive and productive knowledge of the word. Receptive vocabulary knowledge involves “perceiving the form of a word while listening or reading and retrieving its meaning,” and productive vocabulary is used to “express a meaning through speaking or writing and retrieving and producing the appropriate spoken or written word form” (Nation, 2013, p. 47). Table 1 illustrates the receptive and productive distinction of vocabulary knowledge proposed by Nation (2013).

Table 1

### *Types of Vocabulary Knowledge (Nation, 2013)*

Form	Receptive	The sound of the word
		How the word looks
		Recognizable parts in the word
	Productive	Pronunciation, spelling
Meaning	Receptive	Meaning signaled from the form
		Meaning included in the concept
		Other words associated with the word
	Productive	Forms to express the meaning
		Items to which the concept refers
		Other words that can be used instead of the target word
Use	Receptive	The patterns and collocations that occur

		Contexts in which we see the word
	Productive	The patterns and collocations we use with the word
		Contexts in which we use the word

In addition to acknowledging the receptive-productive distinction of vocabulary knowledge, Henriksen (1999) proposed a three-dimensional model to conceptualize lexical competence by adding two other dimensions: partial-precise knowledge and depth of knowledge. Partial-precise knowledge deals with vocabulary size or breadth, which has been typically operationalized as the ability to translate the word in L1, find its correct definition, or paraphrase it in the target language. In addition, word recognition tasks or a checklist is also typically used to assess vocabulary size. The depth of vocabulary knowledge stresses “the quality of the learner’s vocabulary knowledge.” In Henriksen’s (1999) three-dimensional model, depth of vocabulary knowledge exclusively refers to the knowledge aspects of lexical competence, and the receptive-productive distinction is considered a separate dimension that deals with a learner’s accessibility or control over the target lexical item. Henriksen (1999) suggested that a combination of different test formats should be incorporated so that learners’ depth of vocabulary knowledge could be assessed accurately.

In terms of how the words are taught or learned, vocabulary learning is categorized into two main approaches: direct and indirect learning (Nation, 1990). Direct vocabulary learning focuses learners’ attention on vocabulary through exercises or activities, such as word building, word guessing, word lists, or vocabulary games. Indirect vocabulary learning, also referred to as incidental vocabulary learning (Schmitt, 2010), occurs when learners focus on other features of a text, such as comprehending the message conveyed by the writer (Nation, 1990). Thus, incidental vocabulary learning is considered “a by-product of language usage” (Schmitt, 2010, p. 29).

When it comes to the teaching and learning processes of vocabulary, Nation (2007, 2013) maintained that four strands of vocabulary knowledge should be included in a well-designed language program: meaning-focused input, meaning-focused output, language-focused learning, and fluency development. Meaning-focused input directs learners' attention to the information they are reading, and learning occurs when learners are familiar with 98% of the words they encounter (Nation, 2013). Meaning-focused output allows learners to strengthen the vocabulary they learned through input by using it in speaking or writing. The third strand, language-focused learning, deals with direct vocabulary learning, which is supported by the belief that the gradual and incremental process of vocabulary learning can be boosted by an adequate amount of deliberate vocabulary instruction. Last, fluency development aims for fluent use of the words that are already learned. Nation (2013) maintained that fluency development in vocabulary learning should receive as equal amount of emphasis as the other three strands, as learners may not be ready to use the words without fluency practice.

In sum, researchers have recognized that various aspects of vocabulary knowledge are involved in vocabulary learning, and not all aspects are acquired simultaneously. Therefore, instructional and learning approaches should be designed to target each unique aspect of vocabulary knowledge, and the assessments should also adequately test the specific aspects of knowledge that were learned (Schmitt, 2008; 2010).

The present studies will adopt Henriksen (1999) and Nation's (2013) frameworks of vocabulary knowledge by examining both the breadth and depth of vocabulary knowledge, and the depth of vocabulary knowledge will be divided into the receptive and productive aspects, following Nation (2013). First, Nation (2013) did not include vocabulary size in the framework of vocabulary knowledge but discussed it as a separate aspect. Since researchers have commonly



agreed that vocabulary size plays a crucial role in reading comprehension, the breadth of vocabulary knowledge should be considered when examining learner's lexical competence. Second, Henriksen (1999) did not specify what knowledge or traits comprise of depth of vocabulary knowledge, whereas Nation (2013) outlined specific aspects of vocabulary knowledge with their receptive-productive distinctions, which provided clearer guidance for researchers and teachers in research and practice. Combining the two frameworks, the current studies will examine: 1) vocabulary size (breadth), and 2) depth of vocabulary knowledge, which consists of receptive and productive aspects.

**Definition of technology.** The concept of technology in language learning has been evolving with rapid advances of new technologies over the past decades. Computer-assisted language learning (CALL) may have originated in the 1960s, when computer programs were developed for language learning at several universities (Butler-Pascoe, 2011). In general, CALL could be defined as a learning process in which language learning is improved as a result of a learner's using a computer (Plonsky & Ziegler, 2016). During the past decade, mobile-assisted language learning (MALL) has also emerged with widespread use of mobile technologies, which mainly refers to mobile phones, media players, PDAs, and tablet computers (Duman, Orhon, & Gedik, 2015). MALL distinguishes itself from CALL in its use of personal and portable devices and emphasizes continuity and spontaneity of access and interaction across multiple contexts (Kukulska-Hulme & Shield, 2008). For the purpose of the present studies, any types of digital technology, including desktop computers and mobile devices, will be considered MALL.

**Technology affordances.** The concept of affordances was originated from Gibson's (1979) work on ecological psychology, which was defined as what the environment "offers the animal, what it provides or furnishes, either for good or ill" (as cited in Oliver, 2013, p.33). It

was described as real and permanent features of the environment (Aaggard, 2018). In adherence to this notion, affordances were later extended to the field of educational technology to describe technical features of educational technologies which allow and constrain certain actions (Aaggard, 2018).

However, such positivist notion of technology affordances was criticized for being “technologically deterministic” (Oliver, 2013, p.34). From a deterministic perspective, educational technology permits or constrains human actions as a controlling role. Oliver (2013) contented that such account for technology failed to present how technology was produced, made sense of, and rejected in relation to people who take the action. On the other hand, a social approach to accounting for technology centers on people who take actions with technology and recognizes individual agency, which is more consistent with the constructivist and learner-centered stance that are currently favored in educational technology. Similarly, Aaggard (2018) argued that decontextualized analysis of affordances as quasi-objectivist features of technology does not explain which of these affordances is utilized in practice and how. Therefore, technology affordances can only be understood in terms of the concrete relations with those who use the technology.

Additional researchers have also supported that research on technology affordances should focus on the fundamental interactions between technology and users. Kay, Meyer, Wagoner, and Ferguson (2006) considered affordances as the interaction supported by the technology for individuals, which are influenced by the individuals’ prior experiences. For instance, K-16 students use computers to mostly play games and communicate with peers, so computers primarily provide game affordances, rather than learning affordances, for these students based on their experiences. Li and Song (2018) noted that technology affordances can

be examined in both the functional and relational approach. From a relational stance, affordance addresses the broader spectrum of social surroundings.

Technology affordances have been conceptualized with multiple dimensions. Cope and Kalantzis (2017) categorized e-learning affordances into seven dimensions: spatial-temporal dimension (ubiquitous learning), epistemic dimension (active knowledge making), discursive dimension (multimodal meaning), evaluative dimension (recursive feedback), social dimension (collaborative intelligence), cognitive dimension (metacognition), and comparative dimension (differential learning). Li and Song (2018) has adopted a broader conceptual framework for analysis with three dimensions: material, affective, and social dimensions. The material affordance focuses on technology property and individual perceptions (i.e. the perceived affordance); affective dimension targets users' mental and emotional state about learning engagement and assurance; finally, social dimension addresses small-group social collaborations, which was further divided into two perspectives: knowledge transfer for an individual's future learning and larger community for knowledge sharing.

The conceptual framework of technology affordances in the present study is adapted from Cope and Kalantzis (2017) and Li and Song (2018). While Cope and Kalantzis (2017) provided a more detailed account for different dimensions of technology affordances, it did not include affective dimension as Li and Song (2018). Therefore, the current study examines eight dimensions of technology affordances: spatial-temporal, epistemic, discursive, evaluative, social, affective, cognitive, and comparative dimensions.

## CHAPTER II

### LITERATURE REVIEW

#### **Primary Theories**

A brief introduction will be provided for the theoretical frameworks underlying technology-integrated L2 vocabulary learning in this section. Drawn from Alvermann, Unrau, and Ruddell (2013), Samuels and Kamil (2002), and Tracey and Morrow (2006), all of which provided a comprehensive overview of the theories in reading research, six major strands of theories in reading research are included in the current studies: behaviorism, constructivism, information/cognitive processing theories, social constructivism, and sociocognitive theories.

**Behaviorism.** Behaviorism focuses on observable changes in human behavior. Behaviorism holds that change in behavior occurs in response to external stimuli, which can be manipulated to influence a person's behavior (Tracey & Morrow, 2006). Behaviorism theories, such as classical conditioning theory, connectionism, and operant conditioning theory, investigate the connection between such stimuli and behavior from different perspectives. Behaviorists describe reading as a behavior that consists of isolated skills, each of which can be reinforced through direct instruction to influence student achievement (Tracey & Morrow, 2006). Many educational software programs are designed in light of behaviorism, breaking complex tasks into smaller components and providing learners with immediate feedback to reinforce their positive behavior.

**Constructivism.** Constructivism views learners as agents who actively build new knowledge from prior knowledge or from interaction with their surroundings. Knowledge, in this sense, is developmental, internally constructed, and negotiated in social contexts (Unrau & Alvermann, 2013). From a constructivist perspective, learning occurs during inferencing process,

or “reading between the lines,” when a reader tries to figure out meanings not explicitly stated in the text (Tracey & Morrow, 2006, p. 48).

Theories derived from constructivism include schema theory, transactional theory, and psycholinguistic theory. Schema theory postulates that readers comprehend a text by activating relevant schema that give coherent explanations of the objects or events in the text. Schema not only provides ideational scaffolding for information in the text but also serves as the basis for inferential elaboration and reconstruction (Anderson, 2013). Extrapolating from schema theory, Rosenblatt (1988, 2013) proposed the transactional theory of reading in which every reading experience is unique to the reader, since readers have their own background schema and thus respond to texts differently. Transactional theory posits that both the reader and the text together constitute a dynamic situation together, while readers’ personal experiences enrich the meanings of the text. Psycholinguistic theory views reading as a language guessing and inferencing process. Goodman (1967) postulated that, instead of reading all elements in a text, efficient readers select the fewest and most productive language cues to produce right guesses. In addition, the miscues used by readers provide important insights about their reading process. For instance, good and less proficient readers may both make miscues on simple sight words, but good readers’ miscues tend to preserve grammar and sense (Weaver, 2002). From a psycholinguistic perspective, miscues indicate how the reader has conducted the language guessing game during reading.

**Information/cognitive processing theories.** Information/cognitive processing theories and models examine how information is taken in, transformed, stored, and retrieved (Samuels & Kamil, 2002). These models aim to explain internal mechanisms when readers engage in complex mental tasks of reading.

From information/cognitive processing perspectives, dual-coding theory (DCT), the cognitive theory of multimedia learning, and cognitive load theory are frequently referenced in research on technology-based teaching and learning. DCT posits that the linguistic and nonlinguistic representations are processed in two functionally independent but interconnected mental systems: verbal and nonverbal (Paivio, 2010). According to DCT, nonverbal codes play an indispensable role in understanding how readers process and remember sensory experience. The cognitive theory of multimedia learning (Mayer, 2009; 2014) is based on the notion that the design of multimedia instruction should be aligned with how people process information. The theory consists of three assumptions: dual-channels assumption, limited capacity assumption, and active processing assumption. Derived from DCT, dual-channels assumption believes that humans process visual and verbal representations through two separate channels; limited capacity assumption holds that each of the two channels is limited in the amount of information it can process at one time; finally, active processing assumption postulates that meaningful learning occurs when learners actively select, organize, and integrate information.

Aligned with the limited capacity assumption of cognitive theory of multimedia learning, cognitive load theory has identified three types of cognitive load in multimedia learning: intrinsic, extraneous, and germane (Pass & Sweller, 2014). Intrinsic cognitive load is caused by the natural complexity of the task or material and can be adjusted only by changing the nature of the task or the knowledge level of the learner. Extraneous cognitive load may be caused by inappropriate instructional designs when learners have to process unnecessary interactive elements. Finally, germane cognitive load, or generative cognitive processing (Mayer, 2009), refers to the working memory resource allocated for dealing with intrinsic cognitive load. Cognitive load theory suggests that multimedia instruction should aim to reduce extraneous load

caused by inappropriate design, so that increased resources can be devoted to intrinsic cognitive load.

**Social constructivism.** Social constructivism posits that individuals construct knowledge through social interaction. A central concept is the zone of proximal development (ZPD) proposed by Vygotsky, which refers to the difference between what one can achieve independently and what one can grasp with the help of a more knowledgeable or capable person (Unrau & Alverman, 2013). ZPD highlights the social and interactive nature of learning, particularly learning with more knowledgeable people. The scaffolding provided by these people is another key factor that facilitates learning when learners acquire new skills within the ZPD (Tracey & Morrow, 2006).

**Sociocognitive theory.** Driven by increased interest in sociocultural influence on literacy since 1980s, sociocognitive models of reading have embedded the cognitive reading processes in the social and cultural contexts in which reading occurs (Unrau & Alvermann, 2013). In addition to cognitive processing factors, sociocognitive models take into account readers' cultural backgrounds as well as a teacher's role in creating an instructional environment, which in turn reflects a complex meaning negotiation process.

One of the theories that examines reading from a sociocognitive stance is reading motivation theory, which focuses on the motivational factors that engage readers in the reading process to explain students' reading outcomes. Reading motivation researchers have identified that reading motivation is a multifaceted construct that includes intrinsic motivation, extrinsic motivation, reading goals, self-efficacy, and social reasons of reading (Guthrie & Wigfield, 2000). Motivation theories maintain that setting appropriate goals enables students to develop a sense of efficacy in achieving the goal and that such self-efficacy would lead to self-regulated

learning (Schunk & Swartz, 1993). Thus, self-efficacy and self-regulation are two key motivational and cognitive processes that affect learning achievement (Schunk & Zimmerman, 2007).

### **Theoretical and Methodological Trends of Research on Technology and SLA**

Theoretical trends in technology and SLA were examined in a systematic review of MALL-related literature published between 2000 and 2012 (Duman, Orhon, & Gedik, 2015). The commonly addressed theoretical frameworks were categorized into three groups in this systematic review: 1) learning approaches, 2) multimedia design and learning approaches, and 3) technology-oriented approaches. Learning theories and models such as constructionism, social constructionism, sociocultural theory, and situated learning theory were most commonly referenced among the selected MALL studies. Following learning theories, multimedia design and learning approaches (e.g., DCT, cognitive theory of multimedia learning, cognitive load media design principles, learning memory cycle) and technology-oriented approaches (e.g., technology acceptance model, unified theory of acceptance and use of technology) were also frequently addressed. Further, the study noted that a high percentage of the selected articles did not specify any theoretical framework to support their research (37%), considered a methodological weakness (Duman, Orhon, & Gedik, 2015).

In addition to the theoretical trends in technology and SLA, the methodologies employed in the field have been systematically investigated in recent research syntheses as well, which noted several areas of concern (Burston, 2015; Elgort, 2018). A lack of information in the reports about participants' target language proficiency level was revealed in both Burston (2015), a systematic review of MALL research published between 1994 and 2012, and Elgort (2018), a more recent systematic review on the use of technology in vocabulary learning in particular. The



reviewed studies were published from 2010 to 2017. Both review studies raised a concern about inadequate reports of participants' language proficiency level since language proficiency is closely associated with the effectiveness of instructional and learning approaches for the target population.

Additional methodological issues, such as the insufficient reporting of learning outcomes (Burston, 2015), the prevalence of research with university students in formal educational contexts, and a preference for comparing technology integration with traditional instruction (Elgort, 2018), were reported in the two review studies. Burston (2015) revealed that 74 of 109 studies on MALL project implementation did not include quantitative reports of learning outcomes. Either, these studies focused on topics such as mobile device usage, learning strategies, and teacher/student attitudes without showing the learning outcomes, or the outcome reports were largely based on teacher impressions or student self-evaluations, making it difficult to quantitatively evaluate the MALL outcomes.

For vocabulary learning in particular, Elgort (2018) reported that many studies which integrated technology in vocabulary learning have focused on university students in formal academic contexts, mostly due to convenience or constraints, but only 20% of the studies explored the use of technology outside language classrooms. The author posited that it would be problematic if learners' personal language learning goals and their academic study were not well connected. Further, for several reasons, the review suggested that research on technology-mediated vocabulary learning should shift its focus from comparing with traditional instruction without technology to examining different conditions that include technology: existing findings have dominantly favored instruction with technology compared to a traditional format, and technology has become part of learners' life regardless of whether it is incorporated in the

classroom. From an ecological validity perspective, it is rare to find exactly the same instructional conditions with/without technology in a language classroom, so it would be more meaningful to investigate how technology-integrated instructions can be optimized for a certain population, learning goals, or specific aspects of vocabulary knowledge (Elgort, 2018).

### **Effectiveness of Technology on L2 Vocabulary Learning**

During the past decade, several research syntheses have demonstrated positive effects of technology in L2 vocabulary learning in a variety of settings. Many of these studies adopted a meta-analytic approach and quantitatively examined the effects of multiple types of technology in L2 vocabulary learning, which yielded medium to large effect sizes. Medium effects were found in computer-mediated vocabulary instruction for EFL learners (Chiu, 2013) and the use of hypertext glosses in L2 vocabulary learning (Yun, 2011). Another meta-analysis that also examined computer-mediated glosses, however, produced larger effect sizes for both immediate and delayed posttests (Abraham, 2008). Additionally, a large effect was noted in the use of captioned video, where videos were simultaneously paired with on-screen texts in the target language (Perez, Van Den Noortgate, & Desmet, 2013). Although the scopes of these studies varied (e.g., computer-assisted vocabulary learning in general vs. specific types of technology, or L2 learners vs. EFL learners), the overall positive effects of the technology in vocabulary learning were mainly supported by DCT and multimedia learning (Mayer, 2009; Sadoski & Paivio, 2013), as the target words were presented with multiple modalities through various digital tools that provided additional scaffolding for L2 learners to acquire new words.

Despite the consensus on the overall positive influence of technology on L2 vocabulary learning, there have been ongoing debates over the possible moderating effects of certain factors on the effectiveness of technology, and, if there is any, to what extent such moderating effect is.

The following sections will review the primary moderating factors examined in the existing meta-analysis.

**Learner's target language proficiency level.** Learner factors, particularly learner's L2 proficiency level, has been one of the central concerns in CALL reading research (Abraham, 2008). Chiu (2013) found that computer-assisted vocabulary instruction was generally more effective for L2 learners with a higher educational level (high school and above) compared with elementary-level learners. The author contended that the advantage for older learners to use technology was possibly attributed to their maturity level in terms of age that allowed them to use technology more effectively, as well as the more difficult words these learners were assimilating. In contrast, younger learners may focus on basic vocabulary which may not be necessarily facilitated by technology. The group differences found in this study should be interpreted with caution, as the study did not provide the results of the statistical analysis for the significance of the group differences.

A similar trend was found in Abraham's (2008) meta-analysis of computer-mediated glosses as well, in which statistically significant differences were found among beginning, intermediate, and advanced L2 learners' vocabulary outcomes in the delayed post-tests. Computer-mediated glosses were found to be most beneficial for advanced learners, followed by intermediate and beginning learners, probably because more advanced learners could process deeper lexical knowledge and better connect new vocabulary with their existing semantic system. Beginning learners, on the other hand, are still developing their vocabulary foundation, thus implying a need to reach a threshold level of vocabulary knowledge for the glosses to be helpful in learning new words (Abraham, 2008).

Contrary to the above studies, two other meta-analyses revealed that technology has brought equal or more benefits to beginning L2 learners than to more advanced learners. Yun (2011) examined the effects of hypertext glosses on L2 vocabulary learning and revealed that the hypertext glosses had a significantly larger effect for beginners than to intermediate learners. The study acknowledged that such findings contrasted with previous research in which glosses demonstrated less benefit for beginners (Salem & Aust, 2007); yet, no further interpretation was provided for the inconsistent findings in this study. Perez, Van Den Noortgate, and Desmet (2013) found that captioned video positively influenced vocabulary outcomes across all proficiency levels, although only one study was included in the high intermediate to advanced group. The effects of captioned video were large across all proficiency levels without a statistically significant difference between groups, indicating that learner's L2 proficiency level might not be a moderator of captioning effectiveness. The authors explained that captioned video was effective for beginners who need extra help with decoding, because captions visualize word boundaries and reduce the decoding time for learners so that they can pay more attention to the language in the video.

**Types of vocabulary knowledge being assessed.** In addition to learner related factors, existing research syntheses have also yielded mixed findings about the moderating effect of the type of vocabulary knowledge being assessed. Two meta-analyses on computer-mediated glosses concluded that learners performed better in receptive vocabulary tests (e.g., word recognition) than in productive tests (e.g., recall or think-aloud) (Abraham, 2008; Yun, 2011). In addition, more studies assessed learners' receptive vocabulary knowledge using a multiple-choice test format than did those that assessed their productive knowledge. Such preference in assessment type may be attributed to the generally higher reliability and validity of the multiple-choice test

format (Yun, 2011). Abraham (2008) stated that learners' better performance in receptive tests indicates that L2 learners have a larger receptive vocabulary size than they do a productive one.

On the contrary, captioned video was found to be helpful for L2 learners' performance regardless of the types of vocabulary assessments, indicating that the type of vocabulary knowledge being assessed was not a moderator for the effectiveness of captions (Perez, Van Den Noortgate, & Desmet, 2013). Nevertheless, the authors noted that only two studies on vocabulary learning assessed recognition, so the findings should be further validated with larger numbers of primary studies.

**Types of technology.** Previous meta-analyses also explored what types of technology may be beneficial for L2 vocabulary learning, and the discussions have centered on the integration of games in the intervention (Chiu, 2013; Chen, Tseng, & Hsiao, 2016). For instance, Chiu (2013) found that vocabulary learning without games was more effective than with games, which was contrary to many previous reports. The author argued that this might be associated with the drill-based and exam-oriented nature of vocabulary learning, and digital games might not be helpful for such purposes. Nevertheless, Chiu (2013) acknowledged that learners' interest and excitement in playing digital games could be an important attribute for learning, so the design of games should consider learning objectives to make the games more meaningful for vocabulary learning. On the other hand, a later meta-analysis on digital games and EFL vocabulary learning witnessed a large overall effect of game-based vocabulary learning (Chen, Tseng, & Hsiao, 2016). This study discovered that adventure games, characterized by critical thinking, problem-solving, and engaging tasks, were more effective for EFL vocabulary learning than non-adventure games, such as drill and practice, and that such positive influence was persistent regardless of a learner's age or linguistic background. The authors postulated that

adventure games are more stimulating and motivating than non-adventure games because the former usually require high cognitive functioning, such as problem solving, critical thinking, and task engagement, and fun is critical to a game's success. On the contrary, serious learning contexts may bring anxiety and thus inhibit learners' linguistic awareness in vocabulary learning.

**Other factors being examined.** The length of intervention and the teacher's role during intervention were also examined in Chiu's (2013) meta-analysis on computer-assisted L2 vocabulary learning. Computer-mediated interventions of less than one month was found to be more effective than longer interventions for L2 vocabulary learning (Chiu, 2013). The study postulated that learners were more interested in the new technology and that their vocabulary size may increase quickly at the beginning of the intervention. However, long-term studies have different testing intervals than short-term studies; therefore, students in longer-term studies may lose interest and satisfaction gradually, and they may also forget the words they have learned over time. In other words, technology may be helpful for vocabulary learning given a short period of intervention, but its effect over a longer period of intervention might be limited. Such findings were contrary to Burston's (2015) claim that treatment longer than one month is recommended in experimental studies to ensure meaningful outcomes.

As for the teacher's role in computer-assisted vocabulary instruction, the use of technology without teacher involvement was more effective than with teacher's help, which indicated that computer-mediated vocabulary learning could be beneficial for learners' autonomous learning, considering that technology affords great flexibility for individual learning styles and pace (Chiu, 2013). However, as noted earlier, the between-group differences in this study should be interpreted with caution as statistical analysis of group differences was not reported.

## **Gaps in the Literature**

The existing research syntheses have revealed several critical gaps in the field while laying an essential foundation for examining the current trends of technology-integrated L2 vocabulary learning. First, relatively limited research has concentrated on PreK-12 learners in technology-integrated vocabulary learning, compared with college students and other adult learners. Many research syntheses on technology-integrated L2 teaching and learning have demonstrated that existing empirical studies have predominantly focused on the university level (Abraham, 2008; Elgort, 2018; Grguovic, Chapelle, & Shelley, 2013; Yun, 2011); yet, findings from adult learners should not be applied directly to younger learners without considering their different needs (Macaro, Handley, & Walter, 2012). With fast growing English language learner (ELL) populations both in and outside English native speaking countries, more systematic reviews are needed, particularly for younger learners, to examine the implementation of technology for vocabulary learning in PreK-12 settings.

Second, the theoretical foundation and methodologies used in technology-mediated L2 vocabulary learning are relatively less reviewed in previous research syntheses, despite the importance of theory and methodology to study outcomes. As theories are the foundation of designing a study and interpreting its findings, it is vital to investigate the theoretical trends in the field and understand what theories have been guiding the research and practice of technology-mediated L2 vocabulary learning. Moreover, as previous meta-analyses have revealed much divergence about the effectiveness of technology, it is particularly vital to review the theoretical basis and methodologies of existing empirical research, so that researchers might further explore the source of such divergence. Existing systematic review has identified a series

of major guiding theories in this field (Peterson, 2010; White & Gillard, 2011); yet, additional research is needed to synthesize the theories under a more comprehensive framework.

Third, previous empirical studies on technology and L2 vocabulary learning explored the application of particular types of technology, and many of the existing research syntheses have targeted specific types of technology as well. Some potential uses of technology may not have been fully explored, which calls for further systematic reviews to include greater varieties of technology (Golonka, Bowles, Frank, Richardson, & Freynik, 2014). Comprehensive reviews that examine variations across technology types and study designs would allow researchers to understand current trends in the types of technology used, the populations targeted, and the assessment of vocabulary knowledge. A thorough understanding of such trends would help researchers identify future directions of improvement. For practitioners, a comprehensive review would inform teachers of the currently suggested instructional approaches using technology, thus helping them design activities based on their needs.

### **The Current Study**

The purpose of the present studies is to systematically examine the theoretical and methodological trends in research on the use of technology in L2 vocabulary learning among PreK-12 learners over the past ten years. A systematic review, compared with traditional narrative review, is transparent in its article collection and analysis procedures, and studies are selected as a result of exhaustive and reliable search (Macaro, Handley, & Walter, 2012). Compared with meta-analysis that requires strict selection criteria for calculating effect sizes, a systematic review allows for more varieties of relevant studies to be included, such as observational, correlational, or other qualitative research. Therefore, a systematic review is



conducted to gain a comprehensive understanding of the research trends in technology and L2 vocabulary learning.

## CHAPTER III

### METHODOLOGY

#### **Purpose of the Study**

The purpose of the present study is to systematically examine the theories and methodologies in research on technology and L2 vocabulary learning for PreK-12 ELLs between 2008 and 2018. To examine the theoretical trends, specific research questions include:

1. What types of vocabulary knowledge have been emphasized with the use of technology?
2. What types of technology have been implemented in L2 vocabulary learning, and what are the affordances of technology in L2 vocabulary learning?
3. What theories have been guiding research and practice in technology-integrated L2 vocabulary learning?

To examine the methodological trends, specific research questions include:

1. What are the contexts of the selected studies?
2. What are the participants demographic profiles?
3. What types of research design have been adopted?
4. What types of measures have been used to assess the outcome?

#### **Search Criteria and Study Eligibility**

The article search targeted empirical studies published between 2008 and 2018 on the use of technology in L2 vocabulary learning for PreK-12 ELLs. The search was conducted in multiple databases including ERIC, Education Full Text, JSTOR, PsycINFO, and Google Scholar, using key words such as *vocabulary learning*, *vocabulary development*, *vocabulary skills*, *second language instruction*, *second language learning*, *foreign language teaching*, *foreign language*

*learning, English as a second language (ESL), English as a foreign language (EFL), technology, multimedia, hypermedia, mobile-assisted language learning, and computer-assisted language learning.* The initial search yielded 330 unique results with duplicates removed. After the initial screening of titles and abstracts, 154 articles were removed because: 1) they did not target vocabulary learning (64); 2) the studies did not focus on the use of technology (43); 3) the studies examined languages other than English (10); or, 4) the studies were not empirical, such as literature reviews, conference proceedings, commentaries, or book reviews (54). The reasons for exclusion were not mutually exclusive, and an article might be excluded for more than one of the reasons above.

The remaining 176 articles were further analyzed for full reviews with the following inclusion and exclusion criteria. Studies were included if: 1) L2 vocabulary development was the main or one of the outcomes; 2) the study incorporated at least one type of technology to assist L2 vocabulary learning; and 3) the study focused on PreK-12 learners of English. In accordance with the above inclusion criteria, studies were excluded from the final sample if: 1) it targeted college students or other adult learners; 2) it targeted native speakers of English; or, 3) it focused on software description with insufficient report about the learning outcome of users. As a result, 60 studies were included in the final sample.

### **Coding Procedures**

The following variables were coded to address the three research questions: vocabulary knowledge, types of technology, affordances of technology, and theoretical framework of the study. Coding of the vocabulary knowledge was based on Henriksen (1999) and Nation's (2013) frameworks, which included breadth and depth of vocabulary knowledge. The depth of vocabulary knowledge further consisted of form, meaning, use, as well as whether it was

receptive or productive aspect. Affordances of technology were coded based on Cope and Kalantzis (2017) and Li and Song (2018)'s frameworks and were examined in terms of eight dimensions: spatial-temporal (ubiquitous learning), epistemic (active knowledge making), discursive (multimodal meaning), evaluative (recursive feedback), social (collaborative intelligence), affective (learning motivation and engagement), cognitive (metacognition), and comparative dimensions (differentiated learning). Major theories, following Alvermann, Unrau, and Ruddell (2013), Samuels and Kamil (2002), and Tracy and Morrow (2006) as presented in the previous section, included behaviorism, constructivism, information/cognitive processing theories, social constructivism, and sociocognitive theories. Additionally, following Yang et al. (2018), each theory was coded based on whether they were referenced explicitly or implicitly in the selected articles. An 'explicit' theory indicates that the authors explicitly stated the theoretical background of their study, and an 'implicit' theory indicates that the theory was not directly stated in the study but could be inferred by the researcher. The coding of all three variables was not mutually exclusive, and each article might be coded for multiple aspects of vocabulary knowledge, functions of technology, and relevant theories. A detailed coding scheme is summarized in Appendix A.

The following methodological variables were coded as well: study context, participants' demographic information, research design, text genre, and outcome measures. Study context included the country where the study was conducted, whether the study was in English as second language (ESL) or English as foreign language (EFL), whether it was classroom based or outside classroom, and whether it was incidental or intentional/direct vocabulary learning. Participants' demographic information included their grade level, first language (L1), English proficiency level, and sample size. Research design included whether it has qualitative and/or quantitative data and

length of treatment. Text genre included narrative, expository, and argumentative. A detailed coding scheme is provided in Appendix B.

## CHAPTER IV

### RESULTS

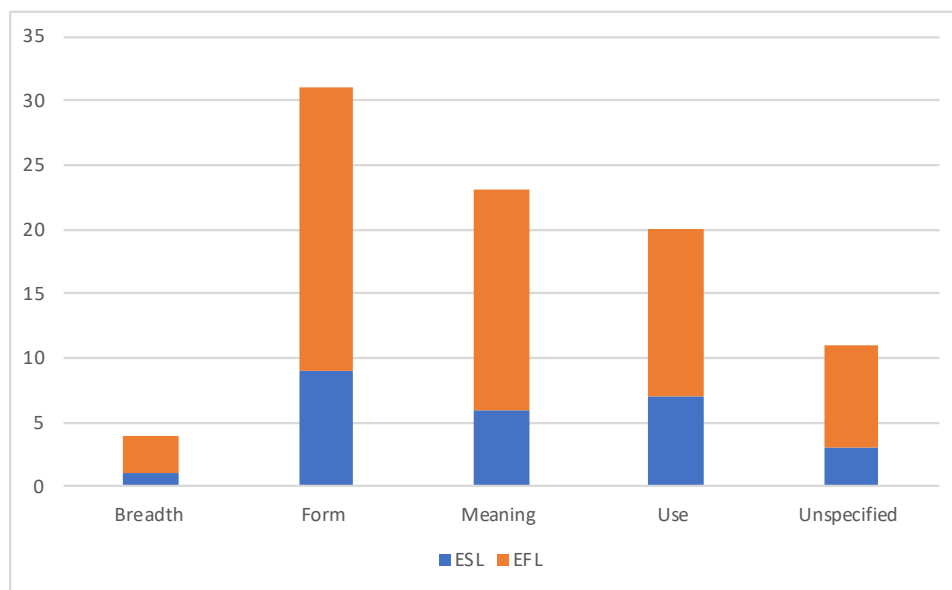
#### **Conceptual and Theoretical Trends in Technology-Integrated L2 Vocabulary Learning**

This chapter presents findings about the theoretical and methodological trends in technology-integrated L2 vocabulary learning for PreK-12 ELLs over the past ten years (2008-2018). To review the conceptual and theoretical trends, three questions were addressed: 1) what types of vocabulary knowledge have been emphasized with the use of technology? 2) What types of technology have been implemented in L2 vocabulary learning, and what are the affordances of technology in L2 vocabulary learning? 3) What theories have been guiding the research and practice in technology-integrated L2 vocabulary learning?

**Research question 1: What types of vocabulary knowledge have been emphasized with the use of technology?** Among the 60 selected articles, emphasis was placed mostly on the depth of vocabulary knowledge rather than vocabulary breadth when technology was implemented in vocabulary learning. Among the three types of knowledge of vocabulary depth, specifically, vocabulary form was practiced and assessed most (n=31), followed by meaning (n=23) and use (n=20) (Figure 1). With the narration function in the programs, students were able to listen to the pronunciation while looking at the target word on the screen to strengthen their understanding of the letter-sound correspondence. To become familiar with the form of the word productively, they could record their own pronunciation and get feedback from the instructor or write down the word to practice spelling (Fehr, et al., 2012; Young & Wang, 2014).

In addition to vocabulary form, many studies also examined meaning and use. For example, to teach prepositions to second grade ESL learners, Wong and Looi (2010) incorporated mobile devices which allowed students to take photos in their surroundings to

illustrate the sentences they made with the target prepositions. Students learned the use of prepositions through sentence- making practice, and more importantly, these sentences came from the photos they had taken in real life. For EFL learners, the use of captions and glosses in multimedia settings has facilitated the understanding of the meaning of the words (Lwo & Lin, 2012; Hu, Vongpumivitch, Chang, & Liou, 2014). The captions and digital glosses helped learners understand the meaning of the target words while they watched a video or read a text online, and such aids have led to greater vocabulary gains when students were assessed the meanings of the target words at the end of the program.



*Figure 1.* Types of vocabulary knowledge.

In terms of the receptive and productive vocabulary knowledge, as Figure 2 displayed, nearly half of the selected studies investigated both aspects with the integration of technology. In addition to the receptive vocabulary knowledge, such as word recognition or understanding of meaning, technology has also facilitated learners’ productive knowledge by encouraging them to use the target words for authentic purposes. For instance, Lai (2016) used instant chat messengers to encourage students to use target verbs during their group chats. Students worked in groups and were expected to discuss any topics with each other via text messages, so long as

they used the prompted verbs as much as possible. The instructor also provided timely feedback during the group chat if any incorrect use of the word was noted.

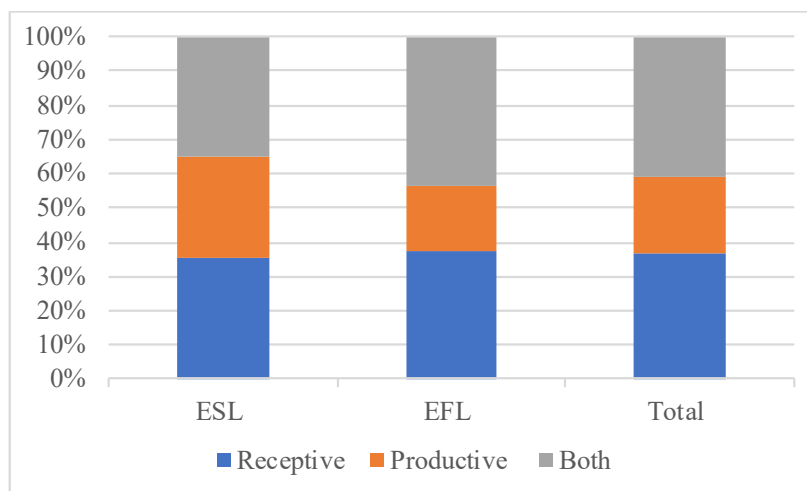


Figure 2. Receptive and productive vocabulary knowledge.

**Research question 2: What types of technology have been implemented in L2 vocabulary learning, and what functions has the technology served?** The technology used in the selected studies were categorized based on whether the learning activities were carried out on computer-based devices (e.g. computer program, video, PPT etc.) or mobile devices (e.g. mobile apps, text message, mobile annotation etc.). While CALL was prevalent in most of the studies (65%, n=39), mobile learning was more discussed in EFL studies (32%) compared with in ESL studies (26%). In other words, more EFL studies adopted mobile technology in vocabulary learning, such as mobile applications, language learning programs designed on mobile devices, instant messenger, and mobile-based gloss.

Figure 3 and 4 presented the technology affordances in L2 vocabulary learning based on the learning context and learners' grade levels. In both EFL and ESL contexts, the affordances of technology focused on the discursive (multimodal learning, 72%), epistemic (active knowledge making, 67%), comparative (differentiated learning, 53%), and evaluative (recursive feedback, 40%) dimensions. A major difference was observed between the EFL and ESL studies in terms



of the social dimension (collaborative intelligence), in that 10 studies conducted in the EFL context emphasized the collaborative environment which technology offered, whereas only one study in the ESL context addressed it.

In terms of the learners' grade level, multimodal learning affordance was frequently discussed across all grade levels (71%, n=43); yet, the epistemic dimension of technology (active meaning making) was mainly addressed for K-5 learners. For middle school students, the differentiated learning realized by technology tools was equally frequently addressed in addition to the multimodal learning affordance. For high school students, the epistemic (active knowledge making) and comparative (differentiated learning) dimensions were equally addressed.

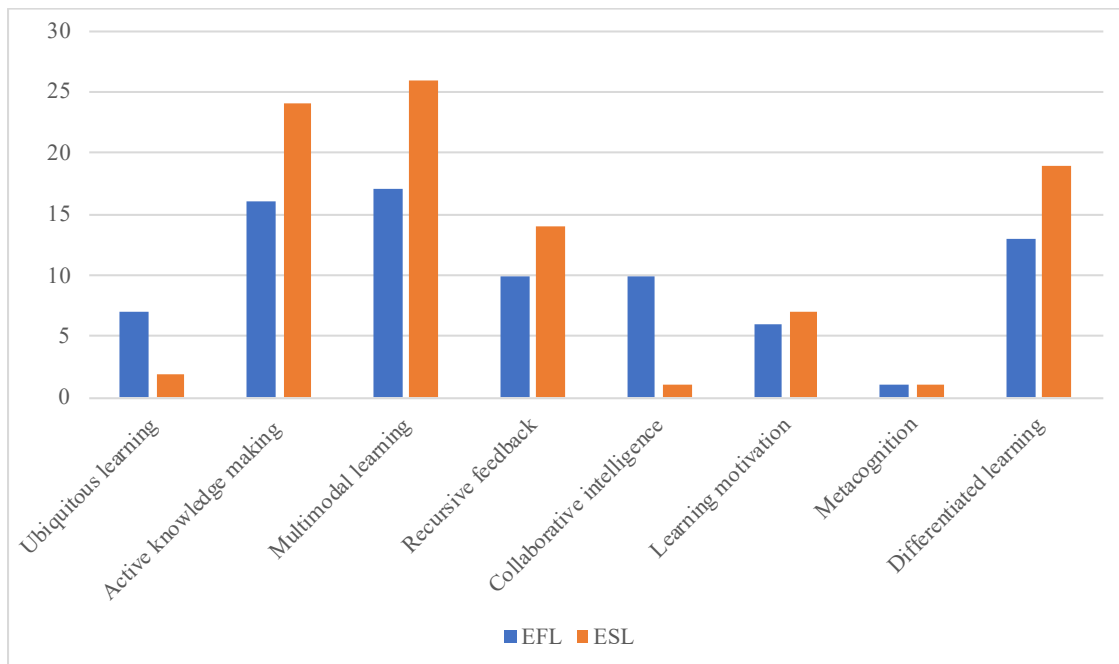


Figure 3. Technology affordances by study context.

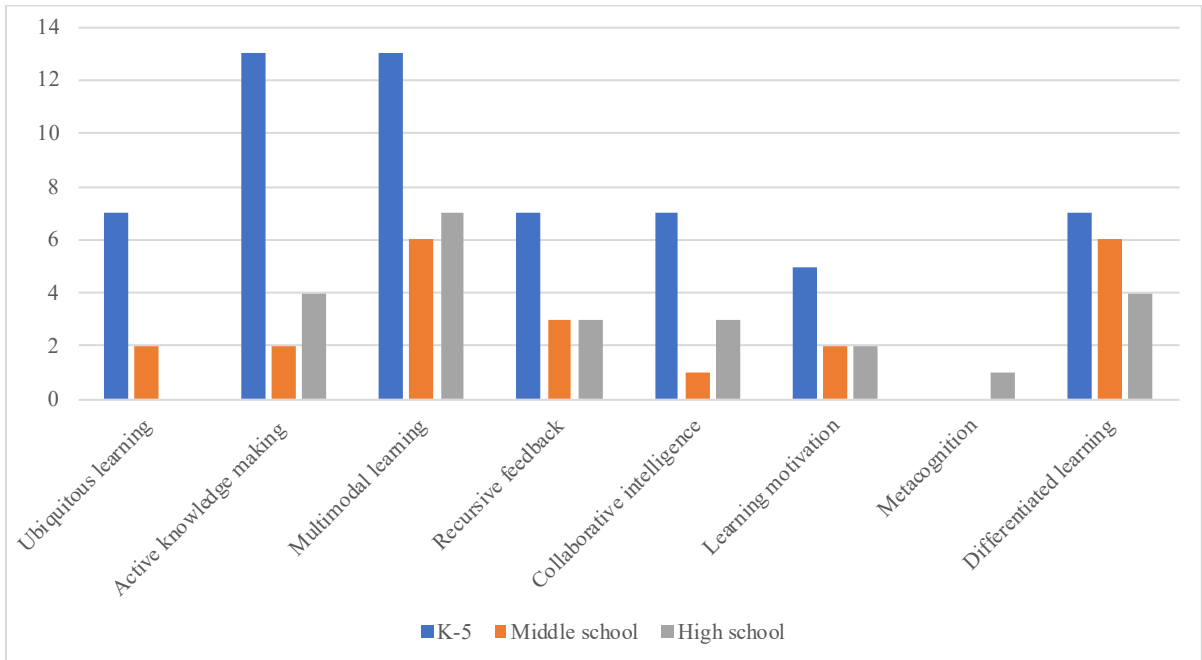


Figure 4. Technology affordances by participants' grade level.

**Research question 3: What theories have been guiding the research and practice in technology-integrated L2 vocabulary learning?** Overall, information/cognitive processing theories were most frequently referenced in the selected studies (43%, n=26), followed by social constructivism (37%, n=22), sociocognitive theories (25%, n=15), constructivism (22%, n=13), and behaviorism (22%, n=13). Many studies explicitly cited information/cognitive processing theories, such as the cognitive theory of multimedia learning and cognitive load theory to guide the design of the technology-integrated vocabulary activities. DCT was also frequently cited as the theoretical basis for incorporating multiple presentation modes to facilitate the understanding of the words. For example, Jingjit (2015) developed a multimedia reading program in Thai for third grade EFL learners. The visuals and texts in the program were arranged to avoid splitting learners' attention during reading. To reduce both internal cognitive load, the materials were delivered through multiple learning modules to reduce the task complexity, and adequate instructions were provided to further minimize learners' cognitive load.

Following information/cognitive processing theories, social constructivism also frequently guided research on technology-integrated vocabulary learning. In a scaffolded digital reading program (Dalton, Proctor, Uccelli, Mo, & Snow, 2011), the multimedia texts included pedagogical agents as coaches, who provided models and hints for the learners. Hence, when students were participating in the essay response activities in the program, they could choose to click on a coach, who provided model responses, as well as an explanation of the thinking behind such responses. Students were also allowed to write or audio record their responses in either their L1 (Spanish) or English of their choice. With the various scaffolding options available in the program, the learning processes were differentiated based on individual differences, and students were able to seek immediate support from the digital coach as needed.

Although information/cognitive processing theories were explicitly referenced most, a majority of the other theories identified in the selected studies were only implicitly implied (76%). For the most part, sociocognitive theories were implicitly referenced for the emphasis on learner motivation and engagement in learning English vocabulary as a result of participating in technology-integrated vocabulary learning activities. In addition to learning interest, students' confidence and self-regulation in learning English was also addressed in the selected studies. To enhance the self-regulated vocabulary learning of fourth grade EFL students, Chen & Lee (2018) incorporated data visualization and color-coded warnings in the language learning program. A reporting table of the learner's mastery of each learning scenario was presented based on their answers. Further, each word within the scenario was color coded for the mastery level, such as "mastered", "could be better", or "not mastered". These functions helped students constantly regulate their learning based on the current learning status. To encourage students to practice productive vocabulary, Young and Wang (2014) incorporated a game-based activity in their

vocabulary learning program. Students were expected to pass each leveled barrier by selecting and recording the correct word, and they received a color medal for passing each level. Passing the levels and getting medals served a goal-setting and reward system that motivated students to practice and achieve the final level. Additionally, students who originally demurred to speak English in public felt more comfortable speaking to a machine, and the researchers observed more peer interactions as well. The game context created a less stressful environment for these students, which helped them to increase their confidence as they practiced the target language gradually. Therefore, most of the studies reported positive attitudes and learning experiences reflected by the participants after completing the program, which served as a critical indicator of the success in implementing the target technology from learners' perspectives (e.g. Nova, Chavarro, & Zubieta; Young & Wang, 2014).

Constructivism and behaviorism were mostly implicitly referenced as well. Researchers encouraged students to connect the target words with their everyday lives and topics that the students were familiar with so that the target words could be learned in familiar contexts. Specifically, using everyday language to teach academic vocabulary in a multimedia platform demonstrated a significant positive influence on students' science concept learning (Ryoo, 2015). With the help of everyday language and additional visual and audio aids provided in the program, students, after participating the program, were able to connect the abstract science concepts with their everyday life and explain the target vocabulary in their own words.

Some technology-enhanced activities also reflected behaviorism by targeting direct vocabulary learning through drill practice and repeated exposure to the target words. Mizaei, Domakani, and Rahimi (2016) introduced a computer platform that combined concordance and dictionary, by which Iranian junior high school students participated in direct learning about the

pronunciation, meaning, and example usage by going through the vocabulary one-by-one in the program. In addition to repeated practice, the program also provided immediate feedback after the self-assessments, so that they could correct any errors in time. . In another study on computerized word lists, Nakata (2008) integrated a computer-controlled sequencing algorithm in the program, so that the target words were presented and practiced in customized orders based on the learner’s performance on the previous word. Learning the word list with programmed sequences yielded higher vocabulary retention score in the delayed-posttest, compared with the control group who used the regular print word list.

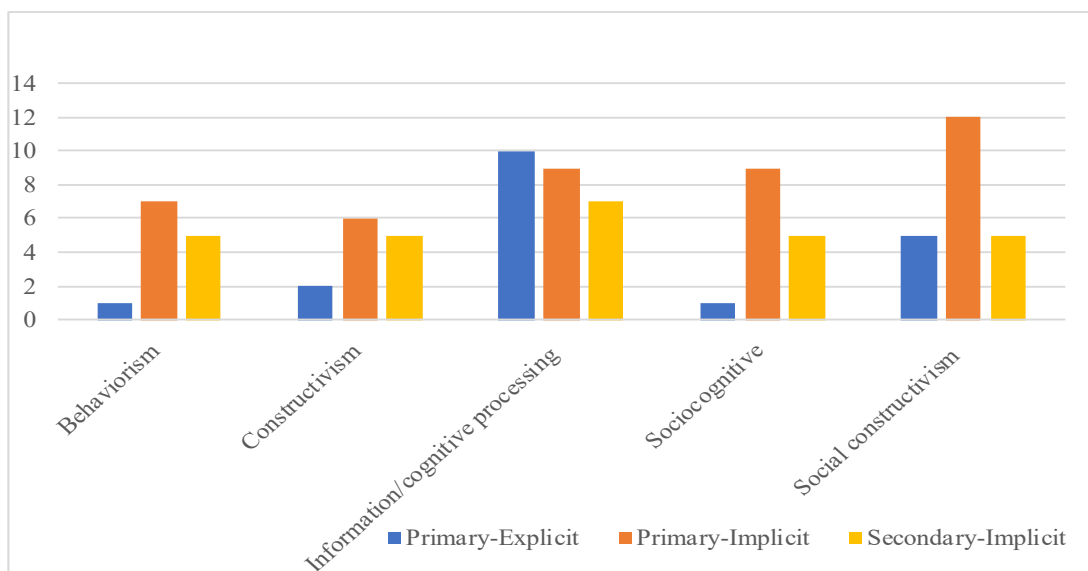


Figure 5. Major theories guiding technology-integrated L2 vocabulary learning.

### Methodological Trends in Technology-Integrated L2 Vocabulary Learning

**Study context.** Overall, the number of studies on technology-integrated L2 vocabulary learning for PreK-12 ELLs were found more in English as a foreign language (EFL) contexts than English as a second language (ESL) ones during the past ten years (41 vs.19 studies). As Figure 6 displays, while the numbers of ESL studies were more than EFL studies between 2008 and 2012, EFL studies have exceeded the ESL ones in past five years, which indicates faster

growth of research in this field in EFL countries. Most of the EFL studies were conducted in Asian countries, in particular, east Asian countries, such as Taiwan, South Korea, and Japan, while the other studies were conducted in Middle East countries, Europe, and South America. ESL studies were mostly held in the United States, with a few studies in Canada and Asian countries (e.g. India, Singapore; see Figure 7).

Additionally, the majority of the studies were conducted in classroom settings (90%), and only a small proportion (10%) examined the use of technology outside school. The incidental and direct/intentional vocabulary received equal attention in the current sample studies; yet, most of the studies on direct vocabulary learning were conducted in EFL contexts (87%, n=26).

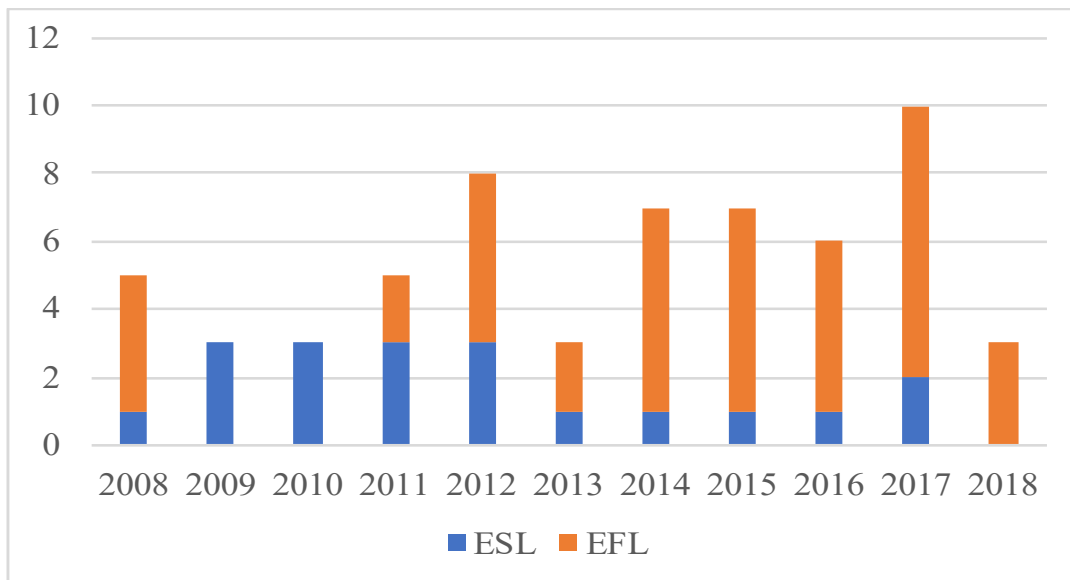


Figure 6. ESL/EFL context by publication year.

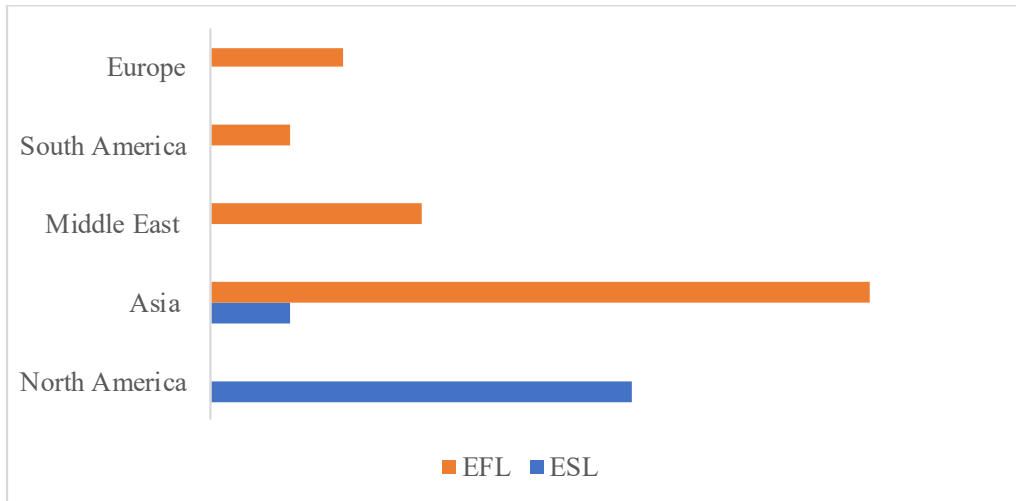


Figure 7. ESL/EFL context by countries.

**Participant demographics.** Elementary school students were investigated most (55%), followed by middle school (23%) and high school (2%) students (Figure 8). Research on PreK-5 populations was particularly prevalent in the ESL context (79%, n=15), while more even distribution across grade levels was observed among EFL studies.

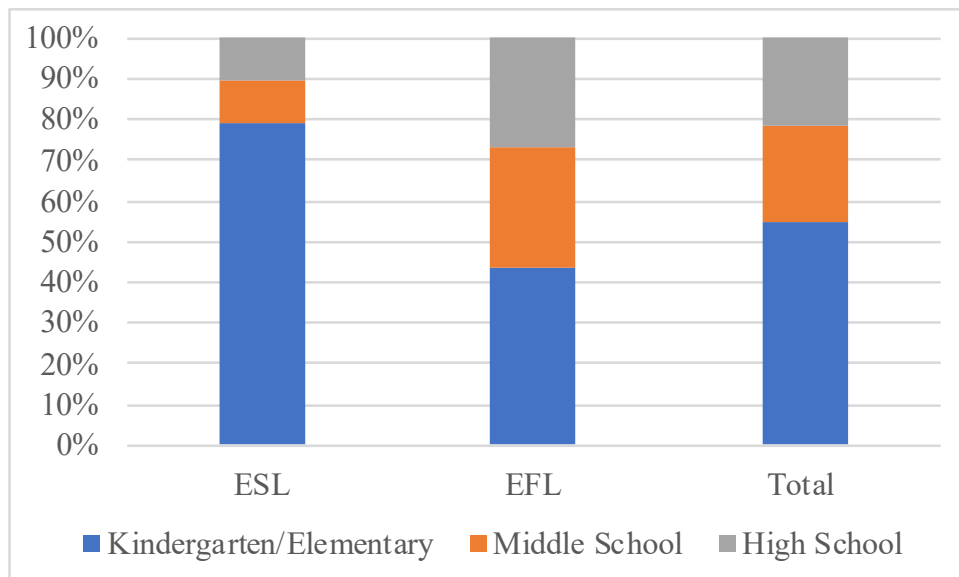


Figure 8. Participant's grade level.

Table 2

*Participant's English Proficiency Level*

	Beginner	Intermediate	Mixed	Special needs	Unspecified
ESL	3	0	3	2	11
EFL	11	2	6	3	19
Total	14	2	9	5	30

As Table 2 presents, half the studies did not report participants' English proficiency levels, and the remaining studies focused on beginning or lower level learners, including learners with special needs (32%, n=19). The participants' first languages (L1) in EFL contexts were typically aligned with the countries in which the studies were conducted, including Mandarin, Japanese, Korean, Persian, Arabic, Turkish, Spanish, and Swedish. On the other hand, in ESL studies, especially those conducted in the United States, many either featured learners of mixed linguistic background or did not report participants' L1 backgrounds. A large sample-size variation was observed among the quantitative studies (n=55), ranging from 11 to 1,490 students. The average sample size across these studies was 91, with a standard deviation of 198.

**Research design.** More than half of the studies included both qualitative and quantitative analysis (55%, n=33). In addition to assessing participants' vocabulary gains through a pre-post test comparison, these studies also collected information about learners' and teachers' perceptions, attitudes, or evaluations about using the target technology. Among the quantitative studies, 33% included a delayed posttest to examine vocabulary retention in addition to the immediate vocabulary outcomes, but the duration between the immediate posttest and the delayed posttest varied across studies.



Large variations were found in the length of treatment and study duration as well. First, 43% (n=26) of the studies did not specify the length of their treatment or reported only the duration within which the study was conducted. Moreover, seven studies (12%) used different units, such as session, lesson, or day instead of minutes or hour, making it difficult to calculate the total length of treatment. The intervention among the remaining 27 studies (45%) lasted between 30 minutes to 60 hours, with an average of 12 hours and a standard deviation of 17. As for the study duration, a small body of the research incorporated one-time activities (7%), in which learners participated in technology-integrated vocabulary activities one time only and completed the assessments. Most of the other studies included recurrent activities, ranging from three days to eight months.

**Outcome measures.** Researcher-developed measures were predominantly used to assess learners' vocabulary outcomes (82%, n=49). Multiple choice tests were most commonly used in the selected studies, and other types of measures included matching, true/false, fill-in-the-blank, and translation. 32% of studies (n=19) assessed basic vocabulary for daily use, and 22% (n=13) targeted academic or content specific vocabulary. In terms of the text genres used in the vocabulary activities, narrative texts were used more than expository texts, and no argumentative text was incorporated in these studies. 52% of the studies did not specify the text genres, and 34% reported neither the vocabulary type being assessed nor the text genre.

## **CHAPTER V**

### **DISCUSSION**

#### **Conceptual and Theoretical Trends**

The current study examined theoretical and methodological trends of technology-integrated L2 vocabulary learning for preK-12 ELLs over the past ten years. Among the multiple aspects of vocabulary knowledge, the current review found that vocabulary form was most frequently addressed in the selected studies. Since the participants in the current sample studies were mostly at the beginning level of English proficiency, the first crucial step for learning vocabulary is to establish the initial form-meaning link. Additionally, while vocabulary form is mainly acquired through exposure, such a condition may not be readily available for foreign language learners (Schmitt, 2008). Hence, teachers placed great emphasis on mastering the word form, both in written and oral vocabulary.

In terms of receptive and productive vocabulary knowledge, both receptive and productive vocabulary learning was investigated in the selected studies. As Nation (2013) noted, for multiple reasons, productive vocabulary knowledge is generally considered more difficult to acquire than receptive knowledge. For instance, the mastery of productive vocabulary requires additional knowledge about spoken and written patterns compared with learning receptive vocabulary. For beginning L2 learners, learning a new word usually starts with simple receptive connection to their L1 translation; additional connections between their L1 and the target word need to be developed over time. Moreover, due to insufficient practical needs, language policy, or their socio-cultural background, L2 learners may lack the motivation to use certain target words productively. Therefore, additional effort has been invested in vocabulary instruction to develop L2 learner's productive skills in addition to their receptive skills.

The primary affordances of technology in the current sample studies were aligned with the major theoretical frameworks identified in the present review. Information/cognitive processing theories were most frequently referenced, followed by sociocognitive theories, constructivism and behaviorism. Social constructionism and sociocultural perspective was commonly cited as well. Accordingly, the various types of technology used in the selected studies have mainly served to provide multimodal presentation of information, to enhance language learning motivation, and to promote collaboration and interaction among students. As DCT and the cognitive theory of multimedia learning maintained, information is better comprehended when it is presented through verbal and visual channels at the same time (Mayer, 2004). Guided by this line of theories, many studies incorporated multiple modalities, such as text, visuals, animations, videos, and audio narrations in their vocabulary activities, so that learners had the opportunities to process the target words through multiple channels at the same time. Sociocognitive theories were also frequently referenced as researchers acknowledged and emphasized the influence of learners' affective factors in language learning process and aimed to develop engaging multimedia programs. Motivation theories have argued that learner's motivation, including their interest in learning, confidence, autonomy, and goal orientation significantly contributes to the learning outcomes. When students are motivated to learn, they are more likely to engage in the task and invest more effort, which leads to better learning outcomes. The emphasis on motivation increase was particularly evident in the EFL studies in the current sample. As noted above, foreign language learners may feel reluctant and challenged to learn a language to which they are not exposed in daily life; therefore, teachers need to make additional effort to improve their learning motivation so that students' engagement and self-confidence in L2 vocabulary learning could be improved as well.

The theoretical trends revealed in the current study were consistent with Duman, Orhon, and Gedik (2015) in that most of the selected articles did not explicitly articulate the theoretical foundation of their research. In Duman, Orhon, and Gedik's (2015) review on MALL between 2000 and 2012, 37% of studies did not specify any theoretical framework. In the current review, while some studies explicitly outlined their theoretical framework (mainly information/cognitive processing theories, social constructionism, and sociocultural perspective), the majority of the studies only implicitly acknowledged their theoretical rationale. Some theories, such as sociocognitive orientation, behaviorism, and constructivism, were mostly implicitly indicated. Since theories serve as the guiding principles for designing and implementing innovative technologies in vocabulary learning, it is particularly important for researchers to specify their theoretical rationales.

### **Methodological Trends**

Preliminary analysis of the methodological factors revealed that research on EFL vocabulary learning with technology has grown over the past ten years as opposed to its ESL counterparts, and the majority of the EFL studies were conducted in Asian countries. In ESL contexts where English is the official language, researchers showed preference for incidental vocabulary learning and a focus on PreK-5 learners. The intentional/direct vocabulary learning approaches were mostly incorporated in EFL countries, and more studies on middle and high school L2 learners were identified in this context as well. In terms of the research design, the selected studies revealed large variations in treatment duration and sample size, yet studies predominantly used researcher-developed measures to assess target vocabulary instead of standardized assessments.

The current review presented several methodological issues that could be further improved for research on technology-integrated vocabulary learning, which issues are largely associated with insufficient reporting of the relevant study information. First, consistent with Elgort (2018), which reviewed technology-mediated vocabulary learning among both adult and young learners, a large proportion of the studies did not report participants' English language proficiency (50%). Elgort (2018) stressed that learners' target language proficiency level is closely related to the instructional and learning approaches they need, while vocabulary development progresses differently based on a learner's proficiency level. Without explicit information about the participants' language proficiency, it is difficult to interpret and evaluate the effectiveness of technology being used for the target population. Further, it creates additional barriers for future researchers to replicate and validate the treatment without adequately understanding the language background of the target population in the previous study.

Second, there was insufficient and inconsistent reporting of the treatment duration as well as intensity in many of the selected studies. While the length and intensity of the treatment is another key factor influencing the effectiveness of the target learning approach, many studies included incomplete information about the duration of the intervention and how frequent it was implemented, again consistent with the previous review (Burston, 2015). Even though many studies provided relevant information, the study duration was reported in various units (i.e. by minutes, hours, lessons, and sessions). Some studies included only the total duration of the study without specifying the frequency of treatment. With incomplete or vague information about how long and how often the target technology was implemented, it is difficult to determine the effect of treatment length on the learning outcomes.

Third, the current review examined the type of texts incorporated in vocabulary learning and whether the vocabulary learning involved basic or academic vocabulary; nearly half the studies did not specify either of these. The studies targeting content vocabulary learning, conducted mostly in ESL countries, selected primarily expository texts. Some of the studies that focused on basic vocabulary for daily use outlined the target vocabulary being assessed; yet, not all studies provided sufficient information about the type and context of the words being used. Since the design of the vocabulary learning activities is tailored to different types vocabulary and text genres, it is recommended that future studies include sufficient information about what words were targeted in the use of technology.

## **CHAPTER VI**

### **CONCLUSION**

This dissertation aimed to systematically review the theoretical and methodological trends in research on technology-integrated L2 vocabulary learning among PreK-12 ELLs that were published between 2008 and 2018. As previous research syntheses have reported that research on technology-mediated vocabulary learning has been dominated by university students or adults, the current studies fill the gap by examining the implementation of technology in younger L2 learners for their vocabulary learning. Specifically, two systematic reviews were conducted to investigate the theoretical and methodological trends in this field.

Overall, alignment between the research design and implementation, and its theoretical basis was observed from the current reviews. As most of the target population in the current reviews were young ELLs with relatively low English proficiency, vocabulary form was most frequently targeted in the selected studies when using technology for vocabulary learning. Because it has been well established that both intentional/direct and incidental vocabulary learning are essential for acquiring multiple aspects of vocabulary knowledge, a balanced number of studies adopted one or the other of the learning approaches. Primarily guided by behaviorism theories, the designs of the direct vocabulary learning activities in the selected studies allowed intensive and repeated practice of the target words, and learners were often provided with immediate feedback by the computer or mobile program to further improve their performance.

In addition, more studies were conducted in EFL context in the current review, and the importance of language learning motivation was acknowledged and emphasized by foreign language teachers when designing technology-enhanced vocabulary learning activities, which

design was largely supported by sociocognitive theories. Through qualitative data collected by interviews, questionnaires, and observations, researchers have confirmed the positive influence of incorporating digital materials and learning activities on L2 learners' interest and confidence in learning a foreign language despite limited exposure to the target language outside the classroom. The studies also demonstrated that technology-integrated activities facilitated the autonomous learning, so that learners would not rely solely on teachers in the language learning process.

The two systematic reviews also uncovered theoretical and methodological issues in the current research on technology-integrated vocabulary learning for young learners, which point to directions for future research. First, confirming previous systematic reviews, relatively weak connections between theory, research, and practice were identified in the current review (Duman, Orhon, & Gedik, 2015). Although many studies explicitly referenced information/cognitive processing theories and social theories of learning to guide the research design, a large body of the selected studies did not explicitly articulate their theoretical framework, which helps readers understand the rationale of the study design, and better modify and implement the target approach in other learning contexts. Thus, future research in this field is expected to clearly outline the theoretical frameworks to explain the rationale for designing the target approach, and how the findings could be interpreted within that framework.

Second, the current study revealed that more research is needed for ESL learners in terms of the use of technology in vocabulary learning. Currently, the ESL studies identified in the present view were characterized by heavy emphasis on the PreK-5 population with low proficiency level and incidental vocabulary learning. Considering the growing ELL population in English-speaking countries across all grade levels, more research should be conducted to



investigate the potential of technology-enhanced learning approaches for adolescents and more advanced L2 learners as their language proficiency develops. Meanwhile, a more balanced incorporation of both incidental and direct vocabulary learning approaches should be recommended for ESL learners, as the acquisition of multiple aspects of vocabulary knowledge requires both learning approaches.

Third, findings from the current reviews call for further improvement in research methodologies in technology-integrated vocabulary learning, particularly regarding the reporting of more complete and explicit information about participant's demographics and study duration, as well as research materials being used. Many of the selected studies lacked sufficient information from one or more of the above areas, making it difficult to evaluate the study quality and effectiveness of the treatment. As discussed in a previous chapter, explicit information about the participant's language proficiency, L1 background, sample size, length of treatment, and the types of materials would all help readers better understand how the activities were designed and implemented, thus determining the replicability of the learning activities in a different context.

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## APPEDIX A

### CODING SCHEME OF CONCENTUAL AND THEORETICAL TRENDS

1. Study ID
2. Study reference
3. Publication year
4. Type of technology: coded based on the themes generated from the sample articles
5. Affordances of technology (Cope & Kalantzis, 2017; Li & Song, 2018)
  - a. Spatial-temporal dimension (ubiquitous learning)
  - b. Epistemic dimension (active knowledge making)
  - c. Discursive dimension (multimodal learning)
  - d. Evaluative dimension (recursive feedback)
  - e. Social dimension (collaborative intelligence)
  - f. Cognitive dimension (metacognition)
  - g. Comparative dimension (differentiated learning)
6. Vocabulary knowledge (Henriksen, 1999; Nation, 2013)
  - a. Receptive/productive
  - b. Breadth/depth
7. Theories: each referenced theory was further coded for ‘primary/secondary’ and ‘explicit/implicit’.
  - a. Behaviorism
  - b. Constructivism
  - c. Social constructivism
  - d. Cognitive/information processing theories

e. Sociocognitive theory



## APPENDIX B

### CODING SCHEME OF METHODOLOGICAL TRENDS

1. Study ID
2. Study reference
3. Publication year
4. Study context
  - a. Country
  - b. ESL/EFL
  - c. In class/outside classroom
  - d. Intentional/incidental learning
5. Participant demographics
  - a. Age
  - b. L2 proficiency level
  - c. L1
  - d. L2
  - e. Sample size
6. Research design
  - a. Qualitative
  - b. Quantitative
    - i. Correlational
    - ii. Intervention
    - iii. Longitudinal
  - c. Length of intervention

7. Study material
  - a. Narrative/expository/argumentative text
  - b. Basic/academic vocabulary
8. Outcome measure
  - a. Source of the measure
    - i. Standardized
    - ii. Researcher-developed
  - b. Type of measure
    - i. Survey
    - ii. Interview
    - iii. Multiple-choice test
    - iv. Matching
    - v. Open ended
    - vi. Think-aloud