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VOCABULARY THROUGH AFFIXES AND WORD FAMILIES – A COMPUTER-
ASSISTED LANGUAGE LEARNING PROGRAM FOR ADULT ELL STUDENTS

by

MAGDALENA KIELISZEK

A master's thesis submitted to the Graduate Faculty in Linguistics in partial fulfillment of the
requirements for the degree of Master of Arts, The City University of New York

2015

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This manuscript has been read and accepted for the Graduate Faculty in Linguistics in satisfaction of the requirement for the degree of Master of Arts.

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Abstract

VOCABULARY THROUGH AFFIXES AND WORD FAMILIES – A COMPUTER-ASSISTED LANGUAGE LEARNING PROGRAM FOR ADULT ELL STUDENTS

by

Magdalena Kieliszek

Advisor: Martin Chodorow

Vocabulary plays an important role in language learning of ELL (English Language Learner) students. This work discusses the importance of metalinguistic awareness in teaching vocabulary to adult English Language Learners at an intermediate- or advanced-level of English language proficiency with an emphasis on learning vocabulary through word families and increased morphological awareness. The main contribution is a computer-based program that guides users through a series of interactive reading and vocabulary practice exercises which allow them to explore and learn how certain words are connected through word families and how some of the most common affixes in English can affect the meaning and grammatical function of words. Unlike most existing Computer-Assisted Language Learning systems, the number of vocabulary practice exercises it can produce is unlimited, as is the range of reading materials it can analyze, including text supplied by the users.

Acknowledgements

I offer my sincere gratitude to my advisor, Dr. Martin Chodorow, for his expertise, guidance, patience, dedication, and support. I am especially grateful for his thoughtful questions and creative problem-solving ideas that provided me the latitude to explore new perspectives in the design and development of my project.

I extend my appreciation to Dr. Cheryl Comeau-Kirschner for her comments about my thesis and expert editing advice. I would like to thank Chandana Mahadeswaraswamy and Basia Park for their help, encouragement, and suggestions throughout the many steps that led to the completion of this thesis. I am also thankful to all my other friends and colleagues who have let me brainstorm ideas for my project with them.

I would like to express my gratitude to my family for their encouragement and support throughout my graduate studies and the thesis writing process.

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Introduction

Vocabulary plays an important role in language learning of ELL (English Language Learner) students, and vocabulary acquisition in this population has been studied extensively. The research that deals specifically with teaching word formation mechanisms to adult English Language Learners and increasing their awareness of English morphology has not received a great deal of attention, although studies that have been conducted to date suggest that this approach might be beneficial for adult language learners (Guo, Roehrig, & Williams, 2011; Zhang & Koda, 2012). Researchers have suggested that adult ELL students often benefit from explicit language instruction, and being able to recognize affixes in newly encountered words and make connections with words they already know might give them an advantage in understanding and even being able to remember new vocabulary better (Bauer & Nation, 1993; Birch, 2007; Nation, 2001; Schmitt, 2000; Schmitt & Boyd Zimmerman, 2002).

When teaching vocabulary in an ELL classroom, language instructors guide their students in planned word practice activities that promote vocabulary development. Since ELL students need as much target language exposure and practice as possible, it would be beneficial if they were able to learn in a similar fashion outside the classroom. Computer-Assisted Language Learning (CALL) may be able to serve as an extension of the classroom and provide learners with structured language practice through interactive activities and immediate feedback.

One focus of this thesis is on the importance of metalinguistic awareness in teaching vocabulary to adult ELL students at an intermediate- or advanced-level of English language proficiency. An emphasis will be placed on learning vocabulary through word families and increasing learners' morphological awareness as a means of expanding their lexical knowledge.

This work also addresses Computer-Assisted Language Learning as a tool for learning vocabulary and describes some vocabulary practice methods used in CALL applications.

The main contribution of this thesis is to present a computer-based program for adult ELL students to learn vocabulary by becoming more aware of word formation processes and increasing their knowledge of word parts. It is a program that guides users through a series of interactive reading and vocabulary practice exercises, which allow them to explore and learn how certain words are connected through word families and how some of the most common affixes in English can affect the meaning and grammatical function of words. The users can test their newly acquired knowledge with a quiz and receive feedback for the answers they provide.

Vocabulary Needs of English Language Learners

Vocabulary is an essential aspect of language learning, and lexical growth contributes to increased language comprehension and production. Vocabulary appears to be particularly important for beginning-level ELL students, but it also plays an essential role in language learning of more advanced students. Nation (1993) suggested that when English Language Learners become more proficient, their improved language use (reading skill in particular) promotes vocabulary development, which in turn helps advance language use. Furthermore, vocabulary, language use, and knowledge of the world are overlapping skills for proficient readers, and development of one of the areas influences an increase in knowledge or skill in the other two. According to this view, vocabulary at later stages of language learning is not necessarily “a prerequisite to the performance of language skills” (Nation & Waring, 1997, p. 6), but it is certainly a crucial factor that contributes to and is influenced by the development of other skills. Therefore, it is important that more proficient language learners are guided in their vocabulary development and that vocabulary practice activities they engage in are designed to fit

the needs and language goals of this student population.

Researchers who study lexical growth have explored some important questions concerning vocabulary and ELL students such as *What does it mean to know a word? How many words should ELL students know to be able to use the English language for various purposes?* and *What words should ELL students focus on learning?* This paper will first summarize some of the research findings in the areas of word knowledge, vocabulary size, and vocabulary selection for ELL students and later will focus on understanding of word parts as an important aspect of word knowledge for intermediate and advanced adult English Language Learners.

What Does It Mean to Know a Word?

Learning the vocabulary of a target language is usually a long and complex process, in which “knowing a word” requires taking many aspects into consideration. This word knowledge may be either receptive or productive; the former is generally said to precede and be easier to master than the latter. Receptive vocabulary includes words that learners are able to understand from spoken or written input, while productive vocabulary encompasses words that they are able to successfully express through speaking or writing (Nation, 2001). Nation suggested that the terms receptive and productive “cover all the aspects of what is involved in knowing a word” (2001, p. 26). He grouped these properties of word knowledge in terms of form (spoken, written, word parts), meaning (form and meaning, concept and referents, associations), and use (grammatical function, collocations, constraints on use) (2001). With form, learners need to be able to recognize and produce accurate pronunciation and spelling of a word, identify its parts and their meaning, and be able to use those parts to create appropriate word forms. In terms of meaning, students need to understand and generate the sense a word conveys in a given context and identify and produce its synonyms or antonyms. Having a good command of the use of a

word involves being able to recognize and produce grammatically correct sentences in which the word occurs, understanding its collocations as well as the frequency and register of the word.

Nation (2001) pointed out that receptive and productive word knowledge is sometimes called active and passive, and it might be seen as a continuum with different degrees of word familiarity or described in terms of availability of word retrieval or choice in word usage. Language learners are also said to acquire word knowledge incrementally as mastery in one aspect does not necessarily indicate competence in other areas (Schmitt & Meara, 1997). Schmitt (1998) agreed with this notion by saying, “for any individual word, each of the different types of word knowledge is known to different receptive and productive degrees” (p. 287). Researchers have found, for example, that even relatively advanced ELL students may still lack proficiency in word formation processes (Schmitt, 1998; Schmitt & Boyd Zimmerman, 2002; Schmitt & Meara, 1997). The subsequent sections of this paper will discuss knowledge of word parts and the importance of morphological awareness among adult ELL students as well as the challenges they might face in this area.

How Many Words Should English Language Learners Know?

It is estimated that educated native speakers of English know about 20,000 word families (Goulden, Nation, & Read, 1990; Zechmeister, Chronis, Cull, D’Anna, & Healy, 1995). The average vocabulary size of an adult ELL student is much more limited, and a vocabulary size that would be comparable to university-graduate native speakers might be difficult to achieve for many language learners (Nation & Waring, 1997). However, research has suggested that the actual extent of vocabulary that ELL students need to attain is much less extensive and depends on the language goals and needs of those individuals.

Researchers have estimated that language learners need to know about 2,000 of the most

frequent word families to successfully communicate in basic everyday life conversations and to prepare for “more advanced study” (Schmitt, 2000, p. 142). Schmitt and Schmitt (2014) proposed to raise this threshold to the 3,000 most frequent words in English in order to include additional words that provide a significant coverage of the English lexicon. ELL students are estimated to need a vocabulary base of about 3,000 word families to be able to read unsimplified text, which involves understanding at least 95% of the text and being able to use context to understand new words (Laufer, 1989). The highest-frequency 3,000 word families plus proper nouns would also provide 95% coverage of spoken English (Nation, 2006).

In addition, successful reading for pleasure might require knowledge of about 5,000 word families and 98% of all words in the text (Hirsh & Nation, 1992). Knowledge of an even greater number of word families would be necessary for more advanced language use and better understanding of spoken and written language. Assuming a 98% coverage, Nation (2006) proposed that a threshold of 8,000-9,000 word families is needed to read novels or newspapers in English, and vocabulary of about 6,000-7,000 word families is necessary for understanding “spontaneous unscripted spoken language” (p. 77). Schmitt and Schmitt (2014) supported Nation’s findings through their analysis of the Corpus of Contemporary American English (COCA) (Davies, 2008) and also suggested that the most frequent 9,000 word families would offer good coverage of both spoken and written English.

In summary, it appears that the most frequent 3,000 word families are the minimum that ELL students need to learn for basic language use, while knowledge of the 9,000 most-frequent families is sufficient for them to attempt more advanced language tasks based on authentic materials. It is also important to note that language learners do not need to master all or most words at a certain level to start learning words of lesser frequency (Schmitt & Meara, 1997).

What Words Should ELL Students Focus on Learning?

ELL students who are at the beginning stages of language learning with a vocabulary base below the 2,000-3,000 word family range would benefit from studying the most general and high frequency vocabulary (Nation & Waring, 1997). This vocabulary may be retrieved, for example, from the recently published New General Service List (NGSL) (Browne, 2013). NGSL includes about 2,400 high-frequency word families and is based on a 273 million-word subsection of the 1.6 billion-word Cambridge English Corpus (CEC) and, as suggested by its authors, provides better coverage than its predecessor, A General Service List of English Words (GSL) (West, 1953). A general-service vocabulary is important for ELL students, as it includes a wide range of items used in both spoken and written language and serves as a basis for learning general English as well as English for Specific Purposes (ESP) (Nation & Kyongho, 1995).

Students who have a good command of a general-service vocabulary and those at more advanced stages of language learning should decide whether their lexical needs are universal or whether they should focus on more specialized vocabulary (Nation & Kyongho, 1995). If they plan on attending college, and they have passed the threshold of 2,000-3,000 high-frequency words, an appropriate selection of words for them to study would be academic vocabulary (Nation, 2001). Academic vocabulary spans a variety of academic disciplines and, as suggested by Nation (2001), it is important to learners of English for Academic Purposes (EAP) for a number of reasons. First, it is specific to and prevalent in academic text. Second, it provides good coverage of vocabulary in college-level materials. ELL students are also said to be less familiar with academic than technical vocabulary, and finally it is a type of vocabulary that is possible for English teachers to introduce to their students as compared to technical vocabulary, which might be difficult to teach for language instructors without a background in the content material.

There are many vocabulary lists available to date that have attempted to compile the most frequent academic words in English. The benefit of using one of the lists is that they are usually based on a large corpus of data and often provide a good representation of academic vocabulary. It might be true that an accurate representation of the academic lexicon is not possible, as different disciplines require students to be familiar with field-specific vocabulary. However, a general list of academic vocabulary might be a good start for students beginning to develop the vocabulary they need in academic work, such as those who are the focus of this paper.

One of the most recent compilations of academic vocabulary is the Academic Vocabulary List (AVL) by Gardner and Davies (2014). AVL is based on a “120-million-word academic subcorpus of the 425-million-word Corpus of Contemporary American English” and, as stated by its authors, offers “the most current, accurate, and comprehensive list of core academic vocabulary in existence today” (Gardner & Davis, 2014, p. 21). The core academic vocabulary of AVL consists of 3,000 lemmas or 2,000 word families, and it is most suitable for students who plan to study EAP and who are already familiar with general-service English vocabulary (Gardner & Davis, 2014).

AVL might serve as a replacement for the most commonly used list of academic vocabulary to date, the Academic Word List (AWL) (Coxhead, 2000). The main differences between AVL and AWL are that the former is based on a much larger and more recent corpus (Gardner & Davis, 2014). AVL also groups words by lemma rather than word families, which allowed its authors to arrive at a more “accurate assessment of word forms, functions, and meanings” (Gardner & Davis, 2014, p. 9). AVL was subsequently converted into a word-family version after incorporating Paul Nation’s 20,000+ word families into the database. Each lemma in the word-family version of AVL is listed with its frequency as well as its derived forms and

their parts of speech, thus providing some additional valuable information for language learners and researchers.

AVL was used as the basis for vocabulary selection in the computer-assisted language program described in this paper. The word-family version of AVL was particularly important for this project. It provided a list of derived forms for each lemma in the Academic Vocabulary List and facilitated creation of a program with a focus on teaching word formation processes to ELL students whose goal is to study at an English-speaking college or university.

Knowledge of Word Parts among ELL Students

Various researchers have stressed the importance of understanding word formation processes among college-bound ELL students. Birch (2007) noted that increased understanding of morphological processes may lead to better comprehension of complex words, and this might be particularly important for English Language Learners in an academic setting. More advanced readers are likely to come across morphologically complex words such as those found in academic texts; therefore, it may be very useful for them to be able to understand word stems in novel lexical items as well as the function and meaning of affixes (Li-jen & Anderson, 2006). Nation (2001) also pointed out that “academic vocabulary is largely of Latin or Greek origin and so learners can use word part analysis to help learn the vocabulary” (pp. 196-197).

Research in the area of teaching English morphology to adult ELL students is rather scarce; however, studies conducted to date provide arguments suggesting that knowledge of word parts and word formation processes is beneficial for this population of language learners. The knowledge of word formation mechanisms might make it easier for learners to understand and learn new words (Guo, Roehrig, & Williams, 2011) since they might be able to recognize word parts they are already familiar with (Nation, 2001). It will also help them become more

proficient and independent learners (Tahaineh, 2012) and allow them to develop “grammatically suitable language” (Schmitt & Boyd Zimmerman, 2002, p. 145).

The following sections will explain selected terminology that relates to knowledge of word parts and will further discuss benefits as well as challenges that ELL students might face when acquiring this aspect of word knowledge. The sections will also summarize some suggestions for teaching and learning word formation mechanisms.

Morphology, Morphemes and Word Families

Morphology is the part of linguistics that deals with word formation and analysis of the smallest units of meaning called morphemes. Morphemes can be classified as either bound, which means that they cannot occur in isolation (for example, ‘er’ in learner), or free (for example, ‘learn’). Bound morphemes can be further divided into derivational morphemes, that is prefixes or suffixes added to base forms of words to create new words, inflectional morphemes, which add grammatical information but do not form new words, and bound roots (for example, ‘vise’ in supervise or ‘port’ in import) that must occur with a prefix or a suffix in order to form a word (Birch, 2007, p. 124). All English inflectional morphemes come in the form of suffixes, and the word classes that can be inflected in English are nouns, verbs, adjectives, and adverbs. Derivational morphemes, on the other hand, are either prefixes or suffixes, and they often change the part of speech or meaning of the word they are attached to.

The inflected and derived words that share a base form with a common meaning are part of one word family. According to Bauer and Nation (1993), “a word family consists of a base word and all its derived and inflected forms that can be understood by a learner without having to learn each form separately” (p. 253). A group of words that a learner considers to be a part of one word family will grow as the learner becomes more proficient and incorporates other words

into the group (Nation, 2001). Therefore, the size of a word family for a given lexical item will vary based on the learner's language proficiency.

Morphological Awareness

Li-jen and Anderson (2006) define morphological awareness as the “ability to reflect on and manipulate morphemes and word formation rules in a language” (p. 161). Researchers have proposed that there are three aspects of morphological awareness that contribute to derivational competence: relational knowledge, syntactic knowledge, and distributional knowledge (Tyler & Nagy, 1989). Relational knowledge is characterized by being able to recognize individual morphemes in a morphologically complex word and identify the semantic relationship between words that share a common morpheme. Syntactic knowledge indicates an understanding of how the syntactic category of a word and its function in a sentence are affected by the addition of a derivational suffix. Distributional knowledge describes an awareness that certain syntactic categories of words can be combined with certain types of affixes and that some combinations of stems and affixes are prohibited.

The ability to apply word formation rules in receptive language use involves identifying word parts in lexical items, knowing what those parts mean and understanding how the meaning of a whole word is affected by its parts (Nation, 2001). In addition, language learners might also need to be able to identify strings that appear to be bases of words but are not a part of a given word family “even though the orthographic string for the base occurs, for example *me* in *mean*” (Bauer & Nation, 1993, p. 257). When speaking and writing, ELL students need to be aware of how pronunciation (e.g. stress change in *flirt/flirtation*) or spelling (e.g. *describe/description*) of words is affected when affixes are added to the base, as well as which affixes can be combined with which word forms (e.g. *-ly* can be added to adjectives but not nouns) (Nation,

2001, p. 274). They also need to know the syntactic information that suffixes convey, “for example that *-less* makes the derived form an adjective” (Bauer & Nation, 1993, p. 257) and be able to choose an appropriate word form to fit the grammatical context of a sentence (e.g. *precise* when the context calls for an adjective, and *precision* when a noun is needed) (Schmitt & Boyd Zimmerman, 2002). These processes might be challenging for ELL students, but they can play an important role in language learning.

Benefits of Understanding Morphological Processes

Although the majority of research focuses on children acquiring their first language, there is some empirical evidence to support the hypothesis that morphological awareness has a positive effect on reading comprehension and vocabulary development of adult ELL students. The studies of skilled adult language learners show that morphological awareness has a direct effect on vocabulary knowledge and that vocabulary affects reading comprehension (Guo, Roehrig, & Williams, 2011; Zhang & Koda, 2012). However, as far as the direct contribution of morphological awareness to reading comprehension is concerned, the research is inconclusive as to whether this direct effect exists (Guo, Roehrig, & Williams, 2011) or not (Zhang & Koda, 2012) in adult proficient readers. Even though the specifics of the impact that morphological awareness has on the language use of adult ELL students are still being debated, researchers seem to agree that knowledge of word formation processes is beneficial for this population of language learners.

Knowledge of affixes and roots may help ELL students learn new words, since they might be able to guess the meaning of a word through the meaning of its parts or by relating the unknown word to other words they are familiar with (Nation, 2001). Being able to recognize and understand word parts may also “be used as a way of checking whether an unfamiliar word has

been successfully guessed from context” (Nation, 2001, p. 264). Furthermore, learning to recognize morphemes and patterns within words can help ELL students have a better understanding of how words relate to one another, which might facilitate efficiency in learning new vocabulary. Bauer and Nation (1993) stated that “once the base word or even a derived word is known, the recognition of other members of the family requires little or no extra effort” (p. 253), provided that their meanings are closely related. Schmitt and Boyd Zimmerman (2002) also recognized the facilitative effect of knowing a member of a word family in identifying other members as far as receptive word knowledge is concerned, but they said that this “facilitative effect may well be less robust in terms of production” (p. 148).

Additionally, ELL students who are familiar with word formation may become more effective dictionary users. When they want to look up the meaning of a new word, they often need to locate the root of the word first and then use their understanding of English affixes to arrive at the meaning of an unknown word, as many of the derived forms are not listed in dictionaries designed for ELL students (Birch, 2007). Without an awareness of word formation rules and a working knowledge of English prefixes and suffixes, language learners might not be able to find the meaning of some unknown words when using abridged versions of dictionaries.

Challenges of Learning Word Formation Processes

Although understanding of morphological processes is beneficial to vocabulary and language learning, it is undeniable that these processes are difficult for ELL students to master. Language learners at the beginning and intermediate stages of English language proficiency might understandably find recognition and production of inflected and derived forms of words to be a challenge, but research has suggested that complete proficiency in English morphological rules might be out of reach even for the advanced learners.

In a study of intermediate ELL students, Schmitt and Meara (1997) found that the participants had significantly lower rates of recognition and production of derivational suffixes than inflectional ones, and their general knowledge of inflectional suffixes was also lacking. The majority of advanced English Language Learners in Schmitt's (1998) study did not have a complete mastery of word family members either even though their level of English language competence allowed them to attend postgraduate university classes in English. Schmitt and Boyd Zimmerman (2002) also suggested that even relatively advanced ELL students "have considerable trouble acquiring the full complement of word family members even when they already know one member or more" (p. 150).

Derivation is considered to be more challenging than inflection, and it also appears to be acquired at later stages of language learning. Among the derived forms, adjectives and adverbs seem to be more difficult to master than nouns and verbs (Schmitt & Boyd Zimmerman, 2002; Schmitt, 1998). One of the difficulties for language learners is that the rules to create derived forms of words in English are not always straightforward, and language learners might have trouble with identifying them (Schmitt & Boyd Zimmerman, 2002). There are also some words in English which, as Laufer (1997) suggested, are "deceptively transparent," meaning that they appear to consist of meaningful morphological units when in fact they do not (for example *out* in *outline* does not mean *out of*) (p.146).

Implications for Teaching and Learning

A number of researchers have stressed the importance of explicit teaching of word formation processes to ELL students. Birch (2007) suggested that English Language Learners should learn morphemes and rules that govern word formation through direct instruction and extensive reading as well as controlled and guided practice with clear examples and sample

sentences. Nation (2001) also emphasized explicit teaching of word formation processes in English to ELL students, although he cautioned that it might be a long-term process. Schmitt and Boyd Zimmerman (2002) advised teachers to provide overt instruction in word formation and not to “assume that learners will absorb the derivative forms of a word family automatically from exposure” (p. 163). Educational researchers have also provided suggestions for approaches and best practices in teaching word formation.

Some researchers have proposed grouping English prefixes and suffixes to facilitate learning and define possible constraints on affix acquisition. They have also advocated teaching one word formation process before introducing another. In order to make teaching and learning of English prefixes and suffixes more systematic, Bauer and Nation (1993) organized them into a series of levels based on their productivity, frequency, regularity, and predictability and stated that this classification might provide “a consistent description of what should be considered to be part of a word family for readers at different levels of morphological awareness” (p. 255). Schmitt and Boyd Zimmerman (2002) noted that since English inflectional suffixes are regular and predictable, they are likely to be more easily acquired, and so the emphasis in language instruction for ELL students should be placed on derivational suffixes as the rules they are governed by are often less obvious and need to be taught more explicitly. Language teachers should also keep in mind that “many complex words are not based on regular, frequent patterns and are best learned as unanalyzed wholes” (Nation, 2001, p. 274).

Another way to reinforce derivational morphology among ELL students is to provide them with appropriate language input through reading. Schmitt and Boyd Zimmerman (2002) suggested using academic texts to help ELL students learn derivational affixes. As noted above, these texts are usually rich in morphologically complex words, and so they might give language

learners exposure to a variety of derivational suffixes.

There has also been a movement in the area of teaching morphological processes to introduce new vocabulary items in conjunction with other members of their word families rather than teaching words in isolation. Bauer and Nation (1993) proposed introducing new vocabulary items along with their derived forms, and suggested that “teaching *govern* and then briefly pointing out the possibilities of *governor*, *government*, and *ungovernable* is much less work than teaching each of these as a separate item” (p. 264). Schmitt (2000) agreed with using this technique and stated that with this strategy, teachers can “maximize vocabulary learning” and get students accustomed to discussing word derivations on a regular basis (p. 148).

Finally, and as a general rule in language learning, novel vocabulary items or grammar points should be introduced in small samples and reinforced through repeated exposure so as not to overwhelm the learner. Nation (2001) suggested that frequency of the items chosen to study should also be kept in mind to maximize the benefits of the learning process, and so more frequent vocabulary items should take priority in language teaching before less frequent ones are introduced.

The above-mentioned strategies have been taken into account, and effort has been made to integrate the research findings into the design of the computer-based program described later on in this paper. The program incorporates elements of explicit learning and implicit instruction. It focuses on academic vocabulary and introduces words along with their family members. Target words as well as their derived forms are presented in descending order of frequency, and affixes are introduced incrementally. Emphasis is placed on derivational morphology.

The following sections will discuss the use of Computer-Assisted Language Learning for vocabulary development of adult ELL students, and describe some of the strategies used in

computer-based environments for vocabulary practice. A discussion of some of the existing vocabulary and morphology-based computer applications will follow.

Computer-Assisted Language Learning (CALL) for Adult ELL Students

Computers have been used for educational purposes for over half a century now. The first documented computer applications used for language learning in the U.S. date back to the 1960s; however, at that time these applications were not technologically advanced and there was limited access to them as they were costly to use and required specialized equipment (Chapelle, 2001). Emerging technologies and increased access to computers as well as advances in applied linguistics research have allowed for more sophisticated Computer-Assisted Language Learning to be developed in the late 1980s (Chapelle, 2001).

Nowadays, Computer-Assisted Language Learning for adult ELL students is widely available on the internet, and a number of CALL systems can be accessed free of charge. Students can use these applications to study on their own or supplement what they have learned in a language classroom. These applications are not intended to replace the classroom experience or interaction with other language users, but they offer other benefits to language learners. Students might use CALL programs to work on language skills at their own pace and decide how much time they want to dedicate to language learning. They can also practice a target language through interactive activities and receive immediate feedback on the progress they are making.

Impact of CALL Applications on Vocabulary Acquisition

The research to date has not reached a consensus on the benefits of CALL in terms of quantifiable learning outcomes (Chapelle, 2001). Studies that compare more traditional strategies of teaching and learning vocabulary with computer-based methods suggest there is no significant difference between the two methods as far as vocabulary learning (Oberge, 2011) and

comprehension (Aust, Kelley, & Roby, 1993) are concerned. However, when the general attitude of learners towards CALL and qualitative outcomes were taken into account, researchers have found that students enjoy learning with computers and that they consider CALL applications to be useful and interesting to study with (Chapelle, 2001; Knight, 1994). Some students might even show a preference for them, as shown in studies by Ercetin (2003) and Oberg (2011). The research suggests that students' attitudes towards learning tend to improve when using technology-based learning tools.

CALL programs appear to have a wide range of benefits beyond the enjoyment factor. They can provide a more individualized approach to learning as many of them adjust the level of difficulty to students' needs or allow them to choose what they want to study. Many CALL applications also give students individualized feedback and provide this feedback immediately and as often as needed. This might not always be feasible in an ELL classroom especially when teachers are assigned large numbers of students. Another possible benefit of using CALL is that students may decide what and when they want to study. They can dictate their own pace of learning and decide when they want to stop practicing. The motivated students can expand on what they have learned in the classroom, and the ones who are struggling can access lower level materials to build up their language skills. Computer-based language practice exercises may be used in the classroom under a teacher's supervision if a computer lab is available for class use. They can also be used as a self-study tool for the students or be assigned as homework, provided that all students have access to a computer with an internet connection.

Yet, there are certain risks involved if learners are browsing the internet on their own in search of materials to study the target language. They can find sources that are not very reliable or ones that are too easy or too difficult for their language needs. Students might be

overwhelmed with the number of programs available online and might not be able to find the ones that would benefit them the most. It appears that even though CALL applications can be utilized as self-study tools, it would be beneficial for students if they had guidance from their language instructors in finding appropriate resources.

Selected CALL Methods for Vocabulary Development

Computer-based applications can be valuable language-learning tools provided that their design is carefully planned. There are a number of considerations that need to be taken into account when building a CALL application for ELL students and a variety of strategies that may be incorporated into the design of a computer-based vocabulary practice tool. Some of the initial factors to consider are the audience and the methodologies involved. Ma and Kelly (2006) suggested that the background information about users should direct the choices made in creating CALL programs and that these programs “should be targeted to a particular group of learners who have in common a series of characteristics” (p. 23). It is important that users’ language proficiency and technology skills are taken into account as well as their needs and interests (Loucky, 2010). Researchers have also emphasized that language learning theories should be used as a framework for a CALL program design (Loucky, 2010; Ma & Kelly, 2006).

Another consideration to keep in mind when creating a computer-based language tool is whether to focus on introducing vocabulary to the users in isolation or in context and how much freedom the users should have while studying with the CALL program. Ma and Kelly (2006) recommended “situating vocabulary learning in context instead of treating it as an isolated activity, as was the case before” (p. 16). They also suggested that the actions users can take at a given stage of learning with the program be somewhat controlled to ensure that the students take full advantage of the methodologies implemented in the CALL application and the strategies

used in the design of the program. Controlled language practice would also ensure that students stay on task and that the time and effort dedicated to learning with is well spent.

Schmitt suggested that learners need to notice vocabulary and grammar in order to learn it (as cited in Chapelle & Jamieson, 2008). Learners might become aware of a new word when they realize that they do not understand it, when it is highlighted in the text, or when they are provided with multiple opportunities to interact with a vocabulary item through pre- and post-reading activities (N. Ellis, 2003; Sharwood Smith, 1993; White, 1998 as cited in Chapelle & Jamieson, 2008). Highlighting a vocabulary item might increase the chances of users noticing a word and deciding to check it in a dictionary as readers might disregard words they do not fully understand when they grasp the general meaning of the text from context. They might also assume that they know a word when in fact they do not, and mistake an unknown word for a similar one that has higher frequency (Schmitt & Meara, 1997). Nation (2001) also mentioned the importance of becoming aware of new words in a text and pointed out that, “noticing also occurs when learners look up a word in a dictionary, deliberately study a word, guess from context, or have a word explained to them” (p. 63), all of which can be incorporated into a CALL program to create an interactive and effective learning environment for ELL students.

Embedded dictionaries are one of the tools used in CALL that seem to have a variety of benefits for language learners. They have been shown to facilitate access to word definitions and other lexical information, and minimize “interruption of the reading process” (Ma & Kelly, 2006, p. 19). They also seem to improve comprehension of a written text (Knight, 1994). Access to an electronic dictionary appears to help accidental vocabulary learning as well (Li, 2009), and a hyperlinked text may give students the advantage of seeing the word in context (Chapelle & Jamieson, 2008). In addition, when words in a text are made visible through highlighted

hyperlinks, readers are more inclined to access an embedded dictionary (Hill & Laufer, 2003). Aust et al. (1993) found that subjects in their study who used electronic texts with glosses were more likely to access word definitions than those with paper-based dictionaries, thus taking a more active role in the process of learning. These subjects also spent less time on task, which made their study sessions more time-effective than those who used traditional dictionaries.

Interaction with vocabulary items is also an important factor in vocabulary retention, and it is often an integral part of CALL. Research has found that learners need to encounter a vocabulary item about seven times, on average, in order to be able to remember it (Loucky, 2010). CALL programs can be very useful in that regard as activities can be designed so that multiple revisits of a word are possible. Hill and Laufer (2003) noted that learners are more likely to remember a word if they focus on different aspects of word form and meaning such as the “word’s pronunciation, orthography, grammatical category, meaning and semantic relations to other words” (pp. 89-90) rather than a single word property, and that the most effective vocabulary learning tasks are those that require the user to show word comprehension.

CALL programs are often designed to give immediate feedback to the learners. Chapelle and Jamieson (2008) stated that the best kind of feedback a language learner might receive is one that is informative. They cited a research study by Nagata who argued that when students learn grammar, it is best for them to receive explicit feedback that gives an explanation about why the students’ answers were correct or incorrect rather than only indicating the error itself (as cited in Chapelle & Jamieson, 2008). The feedback provided in a computer-based program will most likely be less intimidating than a formal quiz or exam in a language class, and it may give learners insight into the progress they are making. Chapelle and Jamieson (2008) stated that the low-stakes tests in CALL may have a positive effect on students’ learning and the “evaluation

can be used to motivate students to study the material and guide them to review what they did not learn the first time” (p. 83).

An attempt has been made to include the best CALL practices in the design of the computer-based program created for this project. The student audience and language proficiency of the target English Language Learners have been taken into account to create a computer-based learning environment. Users of this program are guided through a series of structured activities that allow for independent exploration and decision making about what exactly they want to study. Furthermore, users can access an embedded dictionary and are given multiple opportunities to see and interact with selected vocabulary. Finally, they are given feedback about the answers they submit in a quiz, and, if needed, clues on how to reach a correct answer.

Existing Applications for Teaching Academic Vocabulary and English Morphology

Activities for vocabulary and reading practice for adult ELL students are widely available on the internet, and exercises for learning about English morphology are also relatively easy to find. However, most of these resources focus either on vocabulary and reading or English morphology. Those that incorporate the study of affixes and word formation with another aspect of language learning and that are also appropriate for adult language learners are scarce. In addition, the online-based resources for adult ELL students that deal with English morphology usually provide tutorials or practice with affixes in isolation rather than in a sequence of activities with transitions and language support that would mimic classroom experience.

Internet-based exercises that offer practice with English derivational morphology usually list prefixes and suffixes with definitions and sample words or sentences, or mark the affixes in the words provided by underlining or highlighting them. To check their knowledge of derivational affixes, users are often asked to supply a derived form of a word by completing a

fill-in-the-blank, multiple-choice, or matching exercise or identify a part of speech of a given word. Exercises that allow users to study and practice inflectional suffixes are commonly incorporated into grammatical exercises that focus on subject-verb agreement, comparative and superlative forms of adjectives and adverbs, present and past tense, or possessives.

Even though some of the resources for studying derivational affixes might provide good explanations of meanings and grammatical functions of English affixes or examples of affixes used in words or sentences, those words or sentences are typically introduced out of context and the number of practice exercises is often limited. Another issue is that some websites contain word formation exercises without any guidelines on how affixes might affect meaning or parts of speech of words, while other sites contain detailed information about word formation processes but no practice exercises. The ones that offer sufficient explanation of morphological processes in English and an adequate number of good quality practice exercises are difficult to find. Two resources that might come close to fulfilling the need for a computer-based program that combines vocabulary and morphology practice for adult ELL students are described below.

Grammar-quizzes.com: Practice on points of English grammar.

One of the websites that provides both tutorials and practice exercises for English morphology is “Grammar-quizzes.com: Practice on points of English grammar” (Sevastopoulos, 2000). This website, <http://www.grammar-quizzes.com>, has sections for inflectional (regular and irregular plural nouns) and derivational (adjective and noun formation) suffixes that include lists with common affixes and exercises for the users to check their knowledge of word formation in context. The section with noun inflections lists both singular and plural nouns and pronunciation for most of the plural forms. All of the derivational noun suffixes are listed with their meanings, sample words before and after the affix was added, and parts of speech of these words. The

adjectives that use the same roots but different affixes are explained with sample sentences and additional comments that further clarify word meanings. The derivational noun section includes some zero suffix noun-verb pairs as well as an explanation of the stress shift for some of the pairs.

There are several practice exercises provided on this website. One is a fill-in-the-blank activity with drop down menus and options to choose from for the answer. Another type is an error identification exercise based on a short text. Users are provided sentences from the text that contain errors and are asked to edit those sentences and correct the errors. They can check their answer by clicking the check button and comparing their edited sentence to the one in the feedback box. In another version of this exercise, users are asked to identify a sentence from the text as correct or incorrect. The last type of the practice exercise is one in which users need to reword a sentence and use a derived form of a target word.

The obvious benefits of this website are that it gives very clear explanations and examples of the suffixes it introduces, and it provides a variety of practice exercises using words with those suffixes in context. However, only some inflectional and derivational affixes are discussed here. For example, the website does not discuss verb formation with derivational suffixes, and it does not address any prefixes at all. The information provided in the tutorial part is very informative and appropriate for adult ELL students, but the lists of suffixes and examples are rather long and might discourage some of the less motivated learners or those with a limited amount of time to study. The exercise sections are also relatively brief when compared to the explanation sections, forcing the users to search for other resources to supplement their studies.

Using English for academic purposes: A guide for students in higher education.

Another resource available online that deals with vocabulary and English morphology is “Using English for academic purposes: A guide for students in higher education” (Gillet, 1999). This website, <http://www.uefap.com/index.htm>, is highly informative and offers a wide range of language learning activities. It provides advice and strategies as well as web-based exercises for EAP that include listening, reading, speaking, vocabulary, and writing. The word formation section focuses on the most common affixes in academic English and provides users with a listing and practice exercises for these affixes.

The “Building” part of the vocabulary section, which is the one that deals with word formation, contains a list of some of the most common prefixes and suffixes for noun, verb, and adjective formation along with the meaning of the affixes and explanations of how they affect parts of speech of the original words. The practice activities for this section include fill-in-the-blank exercises to practice the use of the derived words in context.

There is also a section of this website that focuses on selecting vocabulary items to learn. This part contains several word lists: A General Service List of English Words (GSL) (West, 1953), Academic Word List (AWL) (Coxhead, 2000), Academic Keyword List (AKL) (Paquot, 2010), and a subject-specific list of words that do not appear in the previously mentioned lists but include words that cover a wide range of academic disciplines (Gillet, 1999). The words in the first three word sets are listed together with links to their definitions from the Cambridge Advanced Learner’s Dictionary, and the words from GSL and AWL are additionally listed with other related words. The exercises for this section include reading materials with highlighted target vocabulary and other practice activities such as fill-in-the-blank exercises, sentence

scramble with a target word, definition match, word search, hangman, jumble, discover the word, and flashcards.

While this website is a valuable resource for studying English for Academic Purposes, and it offers a variety of exercises for learning vocabulary and word formation, it has some drawbacks. The part of the website that introduces the most common affixes is clear and well constructed, and it provides practice exercises for users to check their knowledge of the affixes they just studied; however, the practice exercises are limited to about 20 sentences for each of the following categories: verbs, nouns, adjectives, and “mixed”. This amount of practice might not be enough for a language learner to get a good grasp of even the most common affixes in English.

As far as the vocabulary selection is concerned, the website gives users access to four different word lists and definitions for all of the words plus a listing of word family members for three of the four lists. The lists are located in the “Selection” section of the website and range from 930 to 3,500 words per list. While vocabulary lists are generally a useful resource for English Language Learners, the length of these word lists would most likely be overwhelming for an ELL student if viewed in their entirety. It might also be helpful for an English Language Learner to see a clear connection between learning about word formation and its usefulness when studying vocabulary especially from long word lists. The task of mastering all these words and their derived forms might seem easier to accomplish once the student is able to recognize patterns in the vocabulary items. This connection seems to exist between the words included in the “Building” and “Selection” sections; however, it is not clearly stated.

Similarly, some of the texts with the highlighted words in the practice section might be too lengthy for language learners as quite a few of them are over 2,000 words long. Some of

those texts use over 50 items for the fill-in-the-blank word selection, which might also be an overwhelming task for ELL students to complete. In addition, the fill-in-the-blank exercises use the original text with the previously highlighted words removed and placed in a vocabulary box. This might promote recognition and recall rather than learning as students are asked to select words from a text they have just read and put those words in the blanks in the same piece of reading material.

Project Overview

After reviewing the resources available on the internet to date, it appears that there is a great need for a learning tool for adult ELL students that would help them expand their vocabulary while they learn about affixes and word formation in English. Ideally, this tool would provide students with enough background about selected prefixes and suffixes and not overwhelm them with superfluous information. It would also allow learners to practice the target language using activities that are extensive enough to let students achieve desired levels of proficiency in the subject matter without having to search for other resources. The program that was created for this project is an attempt to fill this gap.

The goal of the program is to provide ELL students at an intermediate- or advanced-level of English language proficiency with vocabulary practice and help them broaden their knowledge and understanding of English morphology. It was designed with an adult or young adult ELL student audience in mind and intended for independent language practice outside the classroom. The program is based on academic vocabulary, and so it might be most beneficial for college-bound ELL students, but it might also be a valuable resource for any intermediate-level adult English Language Learners who want to work on expanding their vocabulary. The intention was to provide ELL students with a study tool that would assist them with vocabulary

practice, increase their awareness of English morphology, and broaden their understanding of certain prefixes and suffixes.

Program Design

The program uses the NLTK (Natural Language Toolkit) library (Bird, Klein, & Loper, 2009) and Tkinter (for more information see <http://en.wikipedia.org/wiki/Tkinter>), a Python interface to the Tk GUI (Graphical User Interface) toolkit that was used to create an interface for vocabulary related exercises for ELL students. The interface consists of two separate windows as seen in Figures 1 and 2, which can be accessed one after the other. In the first window (Figures 1, 3, and 4), users read a short article and can use a dictionary embedded in the interface.

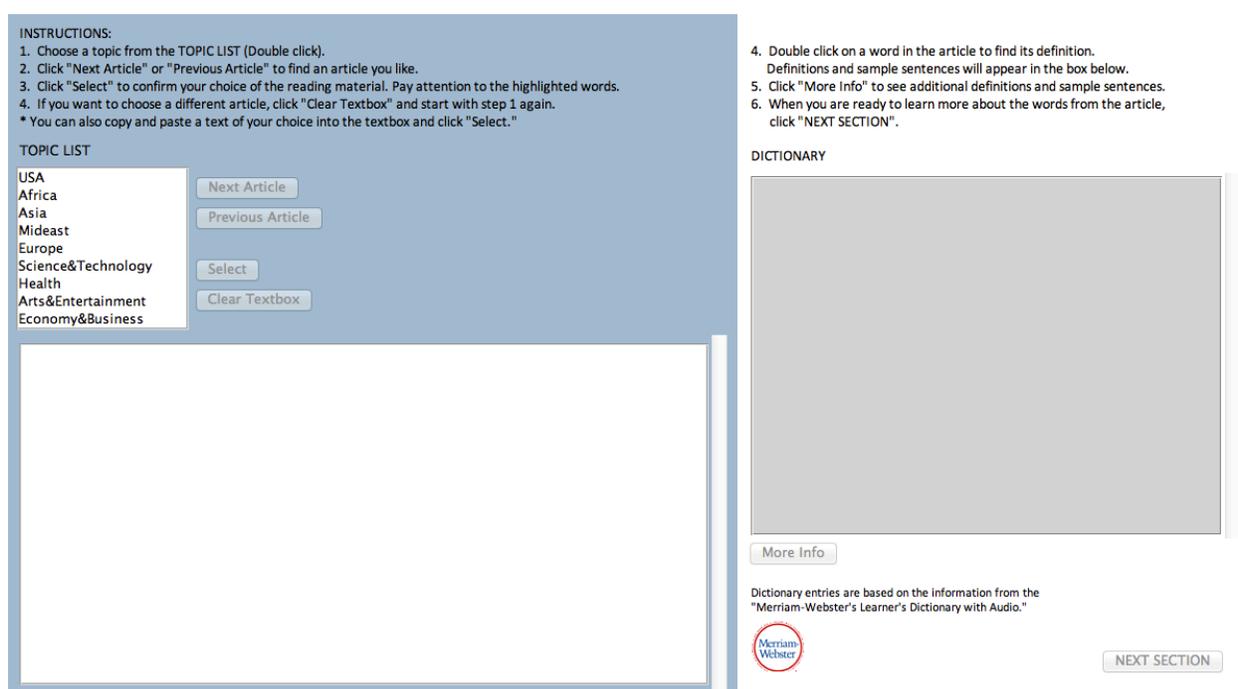


Figure 1. Reading and vocabulary section. This figure shows the first part of the interface where users select an article to read and can access an embedded dictionary.

In the second window (Figures 2, 5, and 6), users can explore selected words from the articles they have chosen to read. The program displays those words in a list, and if users click on individual entries in the list, the inflected forms of those words, some derived words, and the

meaning and usage of prefixes and suffixes that the derived words contain are displayed on the screen. There is also a quiz in the second window of the interface where users can check their understanding of the above-mentioned inflected forms and derived words in context. The second window also contains an embedded dictionary that displays definitions of derived word forms if selected by the users.

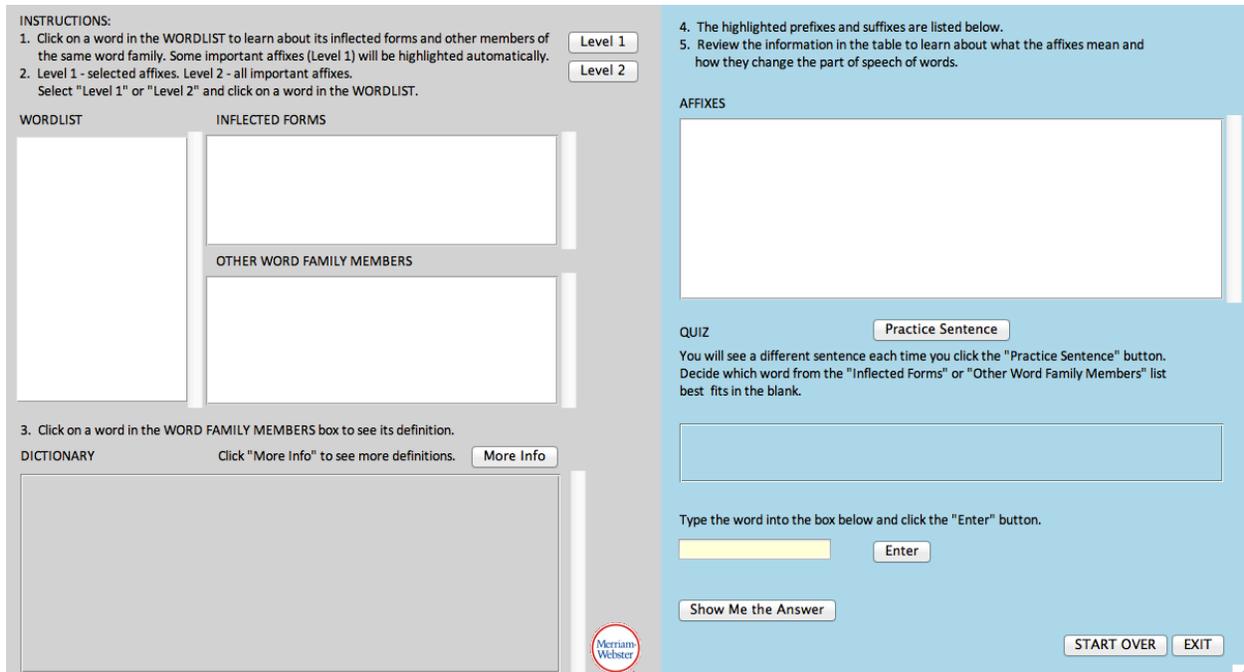


Figure 2. Word family section. This figure shows the second part of the interface with areas where selected words from the article, their inflected forms and derived words, and selected affixes that appear in the derived forms will be listed. Users can also access an embedded dictionary in this section to check the meanings of derived words and take an open-book quiz.

Reading and Vocabulary Section

The activities in the first window of the interface focus on reading. Users have nine article topics to choose from: USA, Africa, Asia, Mideast, Europe, Science and Technology, Health, Arts and Entertainment, and Economy and Business. In addition, users can copy and paste reading material of their choice into a textbox. The division of topics as well as the articles used in this program are retrieved from the Voice of America English News website

<http://www.voanews.com> (Government Broadcasting Board of Governors, n.d.), and the articles that are available to users are restricted to only those that are owned by VOA and are in the public domain. The articles are added by the Voice of America English News to its website daily, and they are retrieved by the program in real time.

Article selection.

The motive behind the selection of the source of reading was to provide users with authentic material that is relatively easy to understand and discusses topics that are interesting to an adult ELL student audience. Users select an article by double clicking on one of the entries in the *Topic List*. This prompts the program to remove the HTML content from the article using the BeautifulSoup Python library (Richardson, 2012) and display the article in a textbox on the screen along with the name of the topic, the title of the article, and the date when the article was published (Figure 3). Users can select a different article on the same topic by clicking *Next Article* or *Previous Article* buttons or by selecting a different topic from the list. Each time one of the buttons is clicked or a new topic is selected, a new article is displayed in the textbox. Articles typically range in length between an average of 120 to 500 words.

Users can browse through the articles and different topics and spend as much time as desired on the reading assignment. However, the number of articles available for each topic is limited, and when users have seen all of the articles in a given section, a message is displayed in the textbox, prompting them to select a different topic or click the *Previous Article* button. There is no time restriction for browsing through the articles or reading the text as this program mimics a free reading task or reading for pleasure rather than a testing environment. Users also have an option to copy and paste a piece of text of their choice into the textbox, and to work with a self-selected text rather than one of the articles provided by the program.

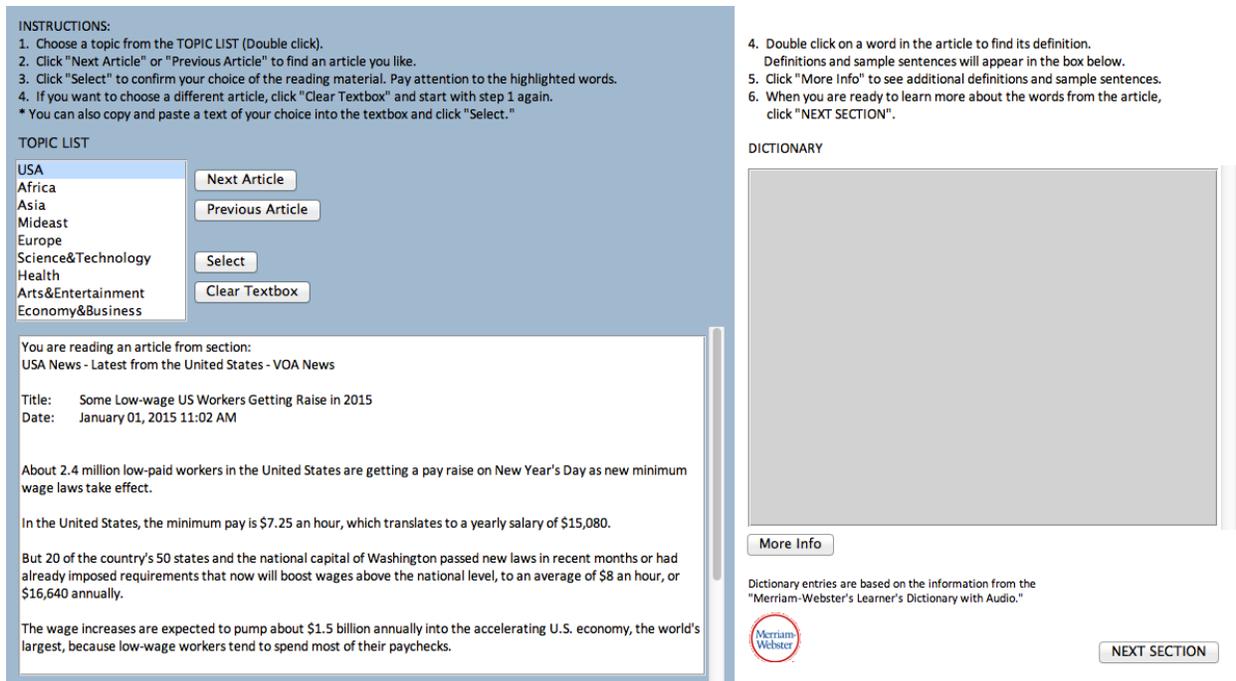


Figure 3. Article selection. This figure shows an article from the USA section of Voice of America English News website (Government Broadcasting Board of Governors, n.d.), that was printed out to the screen.

Once users find an article to read or paste their own reading into the textbox, the next step is to click the *Select* button, which disables *Next Article* and *Previous Article* buttons and prompts the program to process the reading material in the background. If, after clicking the *Select* button, users decide to read and work on vocabulary from a different piece of text, they can click the *Clear Textbox* button, which will clear the textbox and enable the *Next Article* and *Previous Article* buttons, making it possible to search for another article or to paste a different text into the textbox. The final selection needs to be confirmed by clicking the *Select* button again before users can proceed to the second screen.

If users mistakenly click the *Select* button before an article is displayed on the screen, a message will appear in the textbox requesting that a topic be selected from the list of topics and

that an article be found or that text be pasted into the textbox before once again pressing the *Select* button.

Academic vocabulary.

The *Select* button prompts the program to split the article into sentences and part-of-speech tag the text using the Stanford Tagger supplied by NLTK (Bird et al., 2009). The words are then lemmatized with the use of the NLTK's WordNet lemmatizer and crosschecked against the Academic Vocabulary List (Davies & Gardner, 2014). Words from the article that are listed among the 3,000 most frequent core academic lemmas in the AVL are highlighted in the body of the article or the user-selected text when users click the *Select* button. This is done to draw users' attention to those words (Figure 4). The highlighted words are also displayed in a list in the second window of the interface along with their inflected forms and other words in the same lexical family (Figures 5 and 6).

Embedded dictionary.

As users read the selected article, they can use an embedded dictionary to help them understand the text (Figure 4). The definitions as well as sample sentences and some grammatical information about the word are displayed in a textbox on the screen when users double click on a word in the article. This information is retrieved from Merriam-Webster's Learner's Dictionary with Audio (Merriam-Webster Developer Center, n.d.) in real time through the dictionary's API. The entries for each selected word include: definitions, grammar points (count vs. non-count noun, transitive vs. intransitive verb, comparative and superlative forms of adjectives, etc.), usage information (US, Brit, informal, formal, old-fashioned, etc.), phrases the word is used in, and sample sentences.

INSTRUCTIONS:

1. Choose a topic from the TOPIC LIST (Double click).
2. Click "Next Article" or "Previous Article" to find an article you like.
3. Click "Select" to confirm your choice of the reading material. Pay attention to the highlighted words.
4. If you want to choose a different article, click "Clear Textbox" and start with step 1 again.

* You can also copy and paste a text of your choice into the textbox and click "Select."

TOPIC LIST

USA
Africa
Asia
Mideast
Europe
Science&Technology
Health
Arts&Entertainment
Economy&Business

Next Article
Previous Article
Select
Clear Textbox

You are reading an article from section:
USA News - Latest from the United States - VOA News

Title: Some Low-wage US Workers Getting Raise in 2015
Date: January 01, 2015 11:02 AM

About 2.4 million low-paid workers in the United States are getting a pay raise on New Year's Day as new **minimum** wage laws take effect.

In the United States, the minimum pay is \$7.25 an hour, which translates to a yearly salary of \$15,080.

But 20 of the country's 50 states and the national capital of Washington passed new laws in recent months or had already imposed **requirements** that now will boost wages **above** the national **level**, to an average of \$8 an hour, or \$16,640 annually.

The wage **increases** are expected to pump about \$1.5 billion annually into the **accelerating** U.S. economy, the world's largest, because low-wage workers **tend** to spend most of their paychecks.

4. Double click on a word in the article to find its definition.
Definitions and sample sentences will appear in the box below.

5. Click "More Info" to see additional definitions and sample sentences.

6. When you are ready to learn more about the words from the article, click "NEXT SECTION".

DICTIONARY

WORD: requirements
PART OF SPEECH: noun
BASE FORM: requirement

DICTIONARY ENTRY: re*quire*ment
GRAMMAR POINT: count
DEFINITION :something that is needed or that must be done
FOR EXAMPLE:
-nutritional requirements
-a legal/statutory requirement
-(Brit) Her services were surplus to requirements. [=more than what was needed]

DEFINITION :something that is necessary for something else to happen or be done
FOR EXAMPLE:

More Info

Dictionary entries are based on the information from the "Merriam-Webster's Learner's Dictionary with Audio."

Merriam-Webster

NEXT SECTION

Figure 4. Vocabulary and embedded dictionary. This figure shows selected vocabulary from the Academic Vocabulary List (Davies & Gardner, 2014) that was highlighted in the article after the user pressed the *Select* button. Double clicking on a highlighted word in the text caused the dictionary information to appear. Definitions and sample sentences that are shown in the dictionary textbox were retrieved through an API for the Merriam-Webster's Learner's Dictionary with Audio (Merriam-Webster Developer Center, n.d.).

The dictionary entries take into account the part of speech of the selected word to provide appropriate information about its meaning, form, and usage. As users select a word to retrieve its definition, the program identifies the sentence the word appears in and part-of-speech tags the sentence using the Stanford Tagger that is accessed through NLTK (Bird et al., 2009). The program then displays the selected word, its part of speech, and the base form in the textbox, along with the definitions and sample sentences from the dictionary. The definitions and sample sentences that are initially displayed are part of the first listed sense of the selected word. To retrieve other senses of the selected word and their accompanying information, users can click the *More Info* button, and additional information about the word is printed out to the dictionary

textbox. If the dictionary does not list any additional word senses, a message is displayed in the dictionary textbox saying that there are no more definitions for this word in the dictionary.

When users are ready to proceed to the next screen and learn more about the words from the article, they can click the *Next Section* button and are then asked to confirm this action by clicking the *Yes* button. However, this step can only be completed if an article is displayed on the screen and the *Select* button has been clicked to confirm an article selection. Otherwise, a message appears prompting users to choose an article and click the *Select* button before proceeding. Users must click *OK* on the message box to continue with article selection.

Word Family Section

The second part of the program focuses on inflections and derivations of words as well as prefixes and suffixes used in word formation of selected words from the article that users just read. The second window of the interface (Figures 2, 5, and 6) consists of a textbox where selected words from the article are printed out, a textbox for inflected forms and one for derived words as well as a textbox where prefixes and suffixes are printed out with some additional information about their meaning. There is also a dictionary section where users can access definitions of the listed derived words and another section with a fill-in-the-blanks quiz that tests users' knowledge of inflected forms and derived words. The second part of the interface allows users to go back to the first screen and read another article or exit the study session. The former can be accomplished by clicking the *Start Over* button and the latter by clicking *Exit* in the bottom right corner of the screen. Either action needs to be confirmed by clicking the *Yes* button in a message box.

Academic vocabulary wordlist.

The list of words from the article the users selected is displayed on the second screen (Figure 5). The words are listed in descending order of frequency based on counts from AVL (Davies & Gardner, 2014). When users click on a word in the list, its inflected forms and other words in the same lexical family are displayed in the *Inflected Forms* and *Other Word Family Members* textboxes (Figure 5). Every time users click on a word in the wordlist, the contents of the two above-mentioned textboxes are cleared and replaced with new data that relates to the selected word. All words in the *Inflected Forms* textbox and some of the affixes in the *Other Word Family Members* textboxes are highlighted in order to draw users' attention to them, especially when working on the *Quiz*.

The screenshot displays a web interface for an academic vocabulary wordlist. It is divided into several sections:

- INSTRUCTIONS:** A list of five steps for using the interface, including selecting a word, viewing inflected forms, and reviewing affixes.
- WORDLIST:** A vertical list of words. The word "state" is highlighted in blue.
- INFLECTED FORMS:** A box containing grammatical information for the selected word "state", such as "The word - state - is a NOUN", "PLURAL: states", and "The word - state - is a VERB", "PAST: stated", "PAST PARTICIPLE: stated".
- OTHER WORD FAMILY MEMBERS:** A box listing related words: "state, noun", "state, verb", "statement, noun", "stated, adjective", and "unstated, adjective".
- AFFIXES:** A box showing two affixes: "un-" (with a definition: "Part of speech change: adjective -> adjective", "Meaning: negation; reversal of a state", "Example: unconnected, unfashionable, unhappy, unsuitable, unkind") and "ment" (with a definition: "Part of speech change: verb -> noun", "Meaning: the result of an action or the process involved").
- QUIZ:** A section with a "Practice Sentence" button and a text box for the user to type a word. Below it is an "Enter" button and a "Show Me the Answer" button.
- DICTIONARY:** A section with a "More Info" button.
- Level 1 / Level 2:** Two buttons at the top right to filter the wordlist.
- START OVER / EXIT:** Two buttons at the bottom right.

Figure 5. Inflections, derivations, and affixes. This figure shows the *Wordlist* with selected words from an article the user read in the first window of the interface. The *Inflected Forms* and *Other Word Family Members* textboxes are populated with inflected forms and derived words for the word that is highlighted in the *Wordlist*. The *Affixes* textbox shows the suffixes and prefixes that are highlighted in the *Other Word Family Members* textbox as well as information about the change in part of speech that the affix might have triggered, the meaning of the affix and sample words.

Word family members: inflected forms.

The entries in the *Inflected Forms* textbox include the word itself, its part of speech, a listing of plural forms for nouns, past, past participle, V-ing and 3rd person singular forms for verbs, and comparative and superlative forms for adjectives and adverbs (Figure 5). If an adjective or an adverb is not inflected in English, a note to this effect is displayed in the textbox. In addition, if a given word can function, for example, both as a noun and as a verb, the inflected forms for both of these parts of speech are displayed.

The inflected forms are extracted from the Automatically Generated Inflection Database (AGID) (Atkinson, 2003), which was modified to suit the needs of this program. One of the modifications to the database was to remove all inflected forms about which the author of AGID voiced any type of concern. These included words with possibly inaccurate part of speech tags as well as those forms that were identified as “a less preferred form of the word” (Atkinson, 2003). Base forms of words in the AGID file were crosschecked against the core academic vocabulary of AVL (Davis & Gardner, 2014), and entries that did not appear in AVL were removed. All of the words displayed in the *Wordlist* are part of the core academic vocabulary of AVL, and they are the only ones for which inflections are displayed. Finally, the inflected forms in AGID were crosschecked against the words in the COCA lexicon list for the n-gram corpus (Davies, 2014) to maximize the accuracy of entries and remove those word forms that appeared in AGID but were not part of the COCA list. This was done to minimize the possibility of an erroneous inflected form being presented to the users.

Word family members: derived forms.

The derived forms of the word selected by users from the wordlist are listed in the *Other Word Family Members* textbox (Figure 5). These words are extracted from the word-family

version of AVL (Davies & Gardner, 2013) and are listed in the textbox in descending order of AVL frequency. The prefixes and suffixes that appear in the derived forms are the derivational affixes compiled by Bauer and Nation (1993); they are highlighted on the screen.

Bauer and Nation (1993) divide the derivational affixes into five levels based on the criteria they established. This program uses four out of those five levels and organizes them into two groups. The program lets users decide whether they only want to see some selected affixes (Level 1) or all important affixes (Level 2) highlighted in the derived words list. Level 1 in this program contains “the most frequent and regular derivational affixes” and “frequent, orthographically regular affixes” based on the classification by Bauer and Nation (1993, pp. 258-259). Level 2 includes the previously mentioned two groups as well as two other levels of derivational affixes as classified by Bauer and Nation “regular but infrequent affixes” and “frequent but irregular affixes” (1993, pp. 260-262). Grouping the affixes into two levels allows users to focus on the more frequent and regular affixes first and then proceed to studying a wider range of affixes when they feel that they have a good grasp of the affixes from Level 1.

The goal of this project is to help students learn word family members for selected words and allow them to check their knowledge and understanding through a fill-in-the-blank quiz; therefore, this program only displays items with morphologically varied derived forms and ones that have more than two members in its family. If all of the derived forms shown for a word were homographs, the fill-in-the-blank task would be reduced to entering the same word for each quiz item. Also, if there are few words listed in the word family, and one of them has a very low frequency of usage, there is a high probability that the low frequency word will not be represented in the corpus of sample sentences used for the fill-in-the-blank task, resulting once again in only one choice for each quiz item. To avoid this, words were not used if the lemma and

all of the listed derived forms were homographs (e.g., the words in the word family *subject* were *subject* as noun, verb, adjective, and preposition), or if there was only one word listed as the derived form (e.g., lemma *short* and word *shortish*), or if there were two words listed among the derived forms, and one of them had a very low frequency of occurrence in AVL (e.g., under word family *scope*, the derived forms listed in AVL are *scope* as a noun and *scoped* as an adjective with a frequency count of 3). Two other types of words were also excluded from the word families: some hyphenated words (e.g., the word family *century* has two derived words in the list *nineteenth-century* and *twentieth-century*) and words that follow British English spelling (e.g., *practice*, *favour*, *analyse*, *focused*).

Selected derivational affixes.

The affixes that are highlighted in the *Other Word Family Members* textbox are displayed in the *Affixes* textbox along with some additional information (Figure 5). Each prefix or suffix is listed with an explanation of how it affects the part of speech of the original word it is attached to, its meaning, and sample words that contain the affix. The affixes are also highlighted in this section to draw users' attention to them. Information about the part of speech change, meaning of the affix and sample words was compiled from the data provided by Bauer and Nation (1993) as well as from a website *Affixes: the building blocks of English* <http://www.affixes.org> (Quinion, 2008), which in turn is based on a book by Michael Quinion, *Ologies and Isms: Word Beginnings and Endings*.

Embedded dictionary for derived words.

The second part (Figure 6) of the interface also provides users with access to a dictionary. Any time the *Other Word Family Members* textbox lists word derivations, users can click on an item in this list to see definitions and sample sentences with the selected word in the *Dictionary*

textbox. The dictionary works as described in the *Embedded Dictionary* section above, and, as previously described, the data is also retrieved from Merriam-Webster's Learner's Dictionary with Audio (Merriam-Webster Developer Center, n.d.).

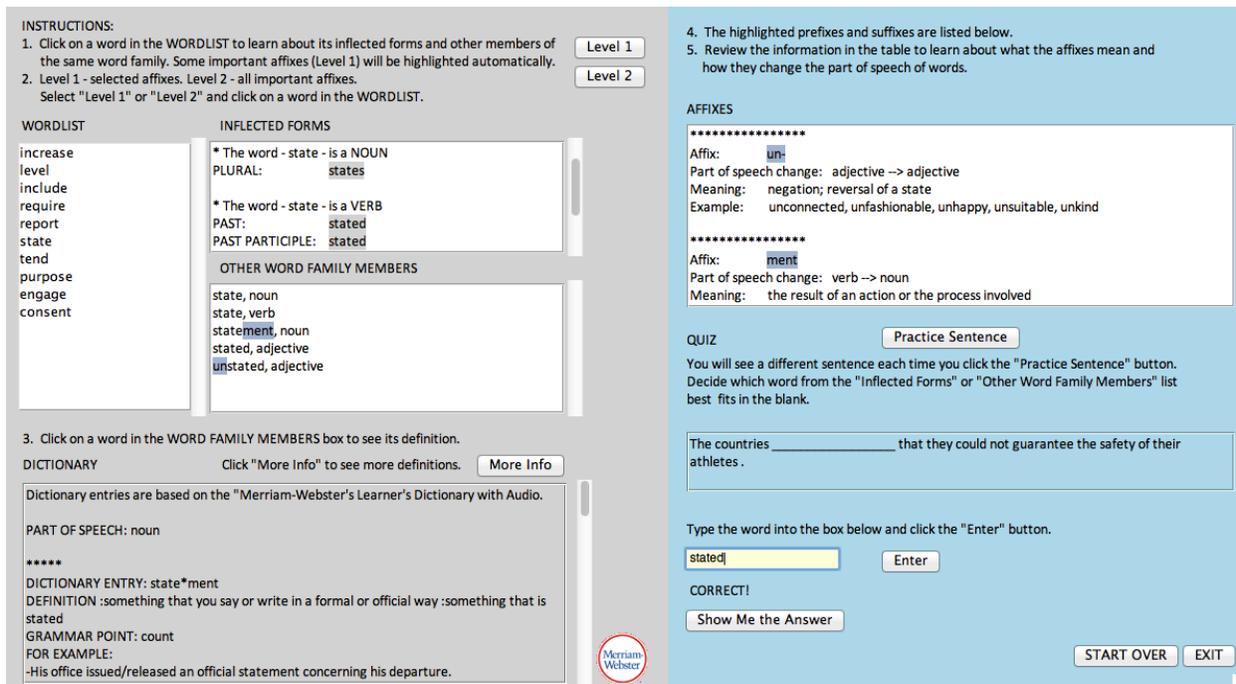


Figure 6. Dictionary and open-book quiz. This figure shows information displayed in the *Wordlist*, *Inflected Forms*, *Other Word Family Members*, and *Affixes* textboxes as in Figure 5. In addition, the *Dictionary* textbox is populated with definitions and other information about one of the derived words. Double clicking on a selected word in the *Other Word Family Members* textbox causes this information to be displayed. Finally, the *Quiz* section shows a sentence with a blank and a word the user chose for the blank entered in the answer box.

Open-book quiz.

The last part of the *Word Family* section is a quiz where users can check their understanding of prefixes and suffixes and try to use the inflected and derived forms of words in context. The quiz is a series of fill-in-the-blank exercises that use sentences retrieved from Simple Wikipedia (Wikimedia Downloads, n.d.) as a source of sentence samples. For this, a Simple Wikipedia dump from Wikimedia Downloads was cleaned with the Wiki Extractor tool (Attardi & Fuschetto, 2013) and processed to remove all remaining tags. Sentences were selected

that were considered to be the most suitable for the purpose of this project. Among the pieces of text that were excluded were those that consisted of long lists of places, people or objects, sentences with references to various locations and their detailed geographical descriptions as well as sentences with references to when and where historical or sport-related events took place, sentences with census information, biographical entries, quotes from religious works or references to religious figures, explicit, vulgar or offensive language, and/or sentences that describe people's political affiliations or family relationships. A database of the remaining sentences was constructed and indexed on words found in the COCA lexicon list taken from the COCA n-gram corpus (Davies, 2014). The sentences were used as the basis for the quiz. For any word that had a large number or sample of sentences, the first ten sample sentences were selected for the quiz.

The quiz is a type of open-book exam where users can scroll through the list of inflected forms and derived words when completing a fill-in-the-blank exercise. To start the quiz, one of the words in the *Wordlist* needs to be selected. If users mistakenly click the *Practice Sentence* button before selecting a word from the *Wordlist*, a message will appear in place of a practice sentence prompting them to double click on a word in the *Wordlist* and then attempt the quiz again.

When users click the *Practice Sentence* button, a sample sentence containing a blank in the position of a removed word is displayed on the screen (Figure 6). The removed word is one of the inflected or derived forms listed in either the *Inflected Forms* or *Other Word Family Members* section. Each time users click the *Practice Sentence* button, a new sentence is displayed on the screen and the one that has already been viewed is removed from the pool of sample sentences for the given word.

Users read the sentence and decide which word best fits in the blank. They then type the word in the provided entry space and click the *Enter* button. If the answer supplied by the users matches the word removed from the sentence, the message *Correct!* is displayed; otherwise, users are given a hint and prompted to try one more time, for example *TRY AGAIN. Hint: You need to use this instead →Verb, past tense*. The displayed practice sentence is part-of-speech tagged using the Stanford Tagger that is accessed through NLTK (Bird et al., 2009), and descriptions of part-of-speech tags are stored in a file and retrieved in real time to generate the hint. In the event that users cannot come up with a word that would fit in the blank, they can click the *Show Me the Answer* button to display the word that was removed from the sentence. Each time users click on the *Practice Sentence* button a new sentence is displayed. If the pool of sentences for a given word is exhausted, a message is displayed on the screen and users are asked to select a different word from the *Wordlist*. They can practice with the quiz as long as they feel it is necessary to acquire a better understanding of the vocabulary in the wordlist and the words' inflected and derived forms.

Discussion

This paper discussed vocabulary needs of adult English Language Learners in terms of vocabulary size and type of words they should focus on learning. It emphasized vocabulary instruction through increasing students' knowledge of word parts and word families and teaching academic vocabulary to intermediate and advanced ELL students who are interested in pursuing academic degrees at an English-speaking college or university. The educational research reviewed for this work has suggested that learning vocabulary through understanding of word formation processes might be beneficial to ELL students. Morphological awareness is said to facilitate learning and retention of new vocabulary, and help language learners make connections

between novel items and words or word parts that they are already know.

The focus of this paper was also on Computer-Assisted Language Learning applications and their use in learning vocabulary of the target language. Although computer-based applications do not appear to be more effective than more traditional methods of instruction as far as vocabulary acquisition is concerned, the research to date has suggested that CALL has a positive influence on student's attitudes towards learning. This work described some considerations and suggestions for creating computer-based applications for learning vocabulary and outlined a design of a Computer-Assisted Language Learning program for learning vocabulary and word formation processes.

The computer-based program was created as an attempt to address the need for a language learning tool that would assist adult ELL students in studying academic vocabulary through affixes and word families. This program incorporates elements of reading and vocabulary practice and provides users with some background information about morphological processes and word families of selected academic vocabulary. It also gives users an opportunity to test their knowledge of affixes and word families with an open-book quiz. The program selects words that would be most beneficial for learners of English for Academic Purposes and guides users in interactive vocabulary practice and word family exploration. It allows users to dictate the length of a study session and decide which words they want to study in more detail. The program is able to produce an unlimited number of vocabulary practice exercises and process a variety of reading materials including texts supplied by the users. The program can be expanded to include additional vocabulary practice exercises and other components that would assist ELL students in developing their language skills.

Recommendations

This section will list some possible improvements and additional features that may be incorporated into the design of the program described in this paper. It will also outline some potential steps that would need to be taken to make this program accessible to ELL students.

Certain features might be added to the existing sections of the program to improve its design. The dictionaries in both the *Reading* and *Word Family* sections could have an audio component to allow users to hear the pronunciation of words they are inquiring about. The program could also give users an option to mark other words in the article and transfer them to the *Wordlist*. Currently, the words that are highlighted in the article and later transferred to the *Wordlist* are restricted to those that appear in the AVL (Davies & Gardner, 2014). If users were allowed to add other words from the article to the list, they would be able to learn about the inflected and derived forms of words beyond the ones listed in the AVL.

The existing quiz could also be improved by incorporating additional sample sentences and providing a set number of sentences for each derived or inflected word available through the program. The sentences for the current quiz were retrieved from Simple Wikipedia (Wikimedia Downloads, n.d.), which contains over 100,000 articles. The Simple Wikipedia data was modified to suit the purpose of this program, and some articles or sections of articles were removed. After these changes, some of the remaining words appeared in fewer than ten sentences in all of the remaining Simple Wikipedia data.

There are also some possible new additions that could enhance the study experience within the program. One of them would be a quiz that checks students' understanding of word forms but does not let them see the lists of derived or inflected words. This quiz could incorporate a variety of question formats, for example fill-in-the-blank, multiple choice, or

true/false questions and either check users' knowledge of complete word forms or ask them to supply affixes only. For this quiz, it might be useful to allow users to provide any grammatically or semantically appropriate words in their answers and not just the ones they saw in the inflected and derived word lists in the *Word Family* section of the program.

Finally, users could be allowed to generate a PDF version of selected sections of the program. They would be prompted to choose parts of the output they would like to see on the handout, for example, an article, a list of words with definitions, a list of inflected and derived forms for selected words, a quiz with question formats that users choose to work, with an answer key for those questions. The handout format would be useful for students who want to save or print their work and study off line or for teachers who would like to incorporate the reading and word family exercises into their lesson plans. The program could also be available online and users would be able to save their work in a personal account.

Before releasing the program to the general public, a study involving ELL students should be conducted. The participants for this study would be adult English Language Learners whose level of vocabulary proficiency is beyond the 3,000 most frequent word family threshold. They would need to be tested with a vocabulary pre-test to determine their level of lexical proficiency. These participants would also need to be interested in studying academic vocabulary. Therefore, the most suitable candidates would be those ELL students who are planning to study in an academic setting with English as the language of instruction.

One idea for the study would be to determine whether students' knowledge of inflectional and derivational word forms would increase through explicit instruction, as suggested by some of the educational research to date (Bauer & Nation, 1993; Birch, 2007; Nation, 2001; Schmitt, 2000; Schmitt & Boyd Zimmerman, 2002). The control group for this design would involve

students acquiring knowledge of English morphology indirectly, for example through a reading activity. The research project could also evaluate students' subjective opinions about studying with a computer program versus completing a paper-based task and examine whether students' attitudes towards CALL confirm the results of previous qualitative studies that show a favorable opinion of it among English Language Learners (Chapelle, 2001; Ercetin, 2003; Knight, 1994; Oberg, 2011).

The above-mentioned recommendations would not only add to the design of the program but also assess its functionality and determine the impact of this computer-assisted application on learning vocabulary through word families and affixes among adult ELL students.

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