A Pedagogical Framework for the Development of Software for EFL Learners

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This article describes a pedagogical framework and goals for developing software aimed at second language vocabulary acquisition for Japanese EFL learners, particularly those in secondary and tertiary educational settings. It considers recent developments in online vocabulary learning, and summarizes various tools that enable the collection of user data, which can inform researchers as to how the software is being used and what kinds of materials students are studying. Applying this information, the researchers are in the process of developing an original, web-based software application for vocabulary learning by combining aspects of currently existing software and modifying it to serve the needs of the students that they teach. This article will briefly contextualize some considerations that must be made for Japanese EFL learners when studying vocabulary. It will survey previous literature on guiding principles in second language acquisition that provide the rationale for the development of a new software system. The final segment provides a brief overview of the software being developed and some of key functions that make it unique compared to existing programs.

BACKGROUND

The acquisition of vocabulary is foundational in language learning. Wilkins (1972) famously wrote, "While without grammar very little can be conveyed, without vocabulary nothing can be conveyed (p. 111). In regions where incidental vocabulary acquisition is typically unlikely due to limited opportunity to interact in the target language, an intentional vocabulary learning method is very important. Advances in technology have greatly aided this process and in the present, language learners have access to more computer-based vocabulary study tools than one could ever possibly utilize in a lifetime.

The conception of the new software is the result of the first author's teaching experiences in Japan. He has had the unique experience of having taught at nursery school, up through university and nearly all levels in between. More often than not, students in Japan face the challenge of lacking adequate time to review materials as they matriculate up through the education system, leading to gaps in their proficiency. In Japan, English courses should be consistent with the national curriculum guidelines established by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT). These national standards, called the "Course of Study," were revised in 2018 with an emphasis on connecting contents across various levels and improving communicative skills (Nakashima, 2021). However, with pressures stemming from entrance exams and standardized tests, there can be a disconnect between the goals and reality. MacWhinnie and Mitchell (2021) contend that the extensive amount of grammar knowledge necessary to score well on

university entrance exams leaves limited opportunity to review and engage with materials previously studied. Furthermore, assuming that even when a curriculum is well-connected between various levels, there is a need for students to be able to manage materials previously studied, ideally into one well-maintained database that is customizable for their aims. The software being developed aims to integrate reading materials, vocabulary lists, and corpus software into one, easy-to-use platform that will help Japanese EFL learners improve their learning of vocabulary.

There are a vast number of computer-assisted language learning resources to achieve this aim. Currently, however, vocabulary acquisition software, extensive reading resources, and corpus software exist as separate entities, though the trend is towards integrated systems. In Japan, one of the favored methods of vocabulary study is through rote memorization of word lists (Yamamoto, 2014). Reading skills (and to an extent, vocabulary is included in this) are developed in various ways, such as through the use of graded readers, or textbooks, and in recent years, utilizing corpus software. Though students now have access to software made for all three of these areas of study, they could benefit to an even greater extent if these programs were combined into one, integrated platform. The goal of this project is to create new software that combines aspects of currently available software to provide a practical and efficient learning tool. We will explain how the proposed system has been conceived through research-based reasoning.

Vocabulary Learning Strategies for L2 Learners

Specific strategies for vocabulary acquisition require clarity regarding what it means to "know a word." Paul Nation (2013) has identified three aspects of word knowledge: form, meaning, and use (p. 59). These are described in the table below:

TABLE 1. Nation's Three Aspects of Knowing a Word (2013). Paraphrased by the Authors.

Key aspect	Description
Form:	Knowing the physical appearance or written form of a word. It includes the spelling and pronunciation of a word.
Meaning:	Understanding the definition or concept that a word represents. It involves recognizing the relationships between a word and other words and how they are used in various contexts.
Use:	The ability to use a word correctly and appropriately in one's own production of the target language.

According to Nation, it is important for language learners to develop a deep understanding of all three aspects of knowing a word in order to be able to use it effectively and appropriately in communication. This involves actively practicing and using new words in context, as well as regularly reviewing and reinforcing the words that have been learned. The software proposed in this article aims to facilitate these practices.

However, the process towards learning new words varies from person to person and is a highly personalized endeavor. Gu (2003) defines four factors that influence how one learns vocabulary in a second language: person, task, context, and strategies. He defines vocabulary learning strategy as "the purposeful analysis of the vocabulary learning task, the planning, deployment, monitoring, and evaluation of learning behaviors in order to acquire the vocabulary of a second language" (p. 2). When learning new words, the instructors and learners must consider these variables and create a strategy that best suits the learner.

In both an L1 and L2 context, learners are introduced to words through two broad channels: incidental and intentional exposure to vocabulary. While it has been argued that incidental vocabulary learning achieves better results than intentional learning strategies (Gu, 2003), incidental learning requires a high degree of exposure to a target language to be effective. In Japan, these conditions are often not possible. Mizumoto (2010) writes, "First, incidental vocabulary learning by guessing from context presupposes that several requirements have been met, conditions that are practically impossible for beginner level learners in input-poor environments such as Japan" (p. 18). In contexts such as the one in Japan, an intentional approach is a pragmatic way to make up for a lack of exposure. The study of word lists is one way to facilitate this.

SELECTION OF VOCABULARY ITEMS IN WORD LISTS

The strategic selection of vocabulary items in a personalized word list should be made through informed decisions and careful consideration of the needs of the learner. For example, it is said that the most frequent 100 words of English cover up to 50% of words that occur in texts (Nation, 2016), which would suggest that these words be prioritized when first learning English. Though this information may well be known to academics, it is likely less familiar to Japanese EFL learners in tertiary education and below. Making this information easily accessible to students will help them to make better decisions when it comes to selecting vocabulary for self-study. Word lists, both general and specific, provide vital information to learners when choosing words for study. For example, the New General Service List includes a list of 2,800 vocabulary items that cover 92% of most English-based texts (Browne et al., 2013). Other lists are specific to regional contexts, such as the CEFR-J word list, which is an adaptation of the more famous Common European Framework of Reference for Languages: Learning, Teaching, Assessment (CEFR) and oriented to account for Japanese EFL textbooks (Tono, 2022). This list, as well as others such as the New JACET 8000 (Ishikawa, n.d.), also has the additional feature of categorizing lists by difficulty level, which can support students when deciding which words to focus on. The table below is a compilation of key word lists that have been chosen to be included in the software being developed by the authors.

TABLE 2. Key Features of the Word Lists Being Utilized in the Program

Word list	Type of coverage	Reason for selection	Number of words	Source
NGSL 1.1	Covers high frequency English words	Covers 92% of the most frequent words in English texts	2,800	Browne et. al, 2013
CEFR-J	Corpus of English textbooks used in Japan and neighboring countries	Applies CEFR standards to categorize words by difficulty	7,801	Tono, 2022
TOEIC Service	Provides 99% of TOEIC test coverage when combined with NGSL	TOEIC is the most taken test in Japan	1,200	Browne & Culligan, 2016
New JACET 8000		Specifically designed for Japanese EFL learners	8,000	Ishikawa, n.d.
Hirotan	Covers basic and advanced words for daily conversation, academics, and business	Word list used in general English classes at Hiroshima University and contains original example sentences	6,000	Enokida et al., 2018
MEWL	A word list for medical purposes, focusing on body systems	Word list used in a medical course at Hiroshima University	1,750	Davies et al., 2020

Basic knowledge about vocabulary items such as frequency, as well as difficulty and the provision of sample sentence can aid students when prioritizing vocabulary items throughout the process of learning. In the present, access to this information is readily available and freely attainable on the internet.

Corpus and Text-analysis Software for EFL Learners

The compilation of effective word lists is aided by the tools used to make them. Corpus software is designed to facilitate the creation, management, and analysis of corpora (collections of written and spoken language). It can be used to create and manage large collections of text and audio data and then analyze this data to identify patterns and trends in language use. Over the last thirty years, it has become an indispensable tool in the formulation of word lists. Szudarski (2017) draws on the definition of corpus linguistics by citing Cheng (2012), who writes "In simple terms, corpus linguistics can be defined as the study of 'the compilation and analysis of corpora'" (p. 6). He defines corpora by citing Sinclair's (1991) definition of them as "large collections of naturally occurring language texts chosen to characterize a state or variety of language" (p. 171). In other words, corpus linguistics is a field of linguistics that uses large collections of written and spoken language (corpora) to study language and linguistic phenomena.

Many corpus applications with advanced functionality can be freely accessed on the internet for use not only by researchers, but lay people also (Anthony, 2017; Anthony, 2022; Cobb, n.d.; Mizumoto, 2021; Uchida, 2021). The most comprehensive and feature-rich resource online that we were able to find is the

Compleat Lexical Tutor, created by Tom Cobb, and shown in Figure 1 (Cobb, n.d.). The site comprises various tools made for text analysis and contains nearly every feature that a language learner would conceivably need in order to analyze a text through corpora. For the purposes of Japanese EFL students, we have a particular interest in the text analysis tools, namely the vocabulary profiler. However, the breadth of text analysis tools that can be utilized through the website may prove difficult for most English learners in Japan. By his own admission, Cobb (2004) states, “The interface is not particularly user-friendly and the lack of instructions on how to use many of the activities poses a challenge” (p. 8).

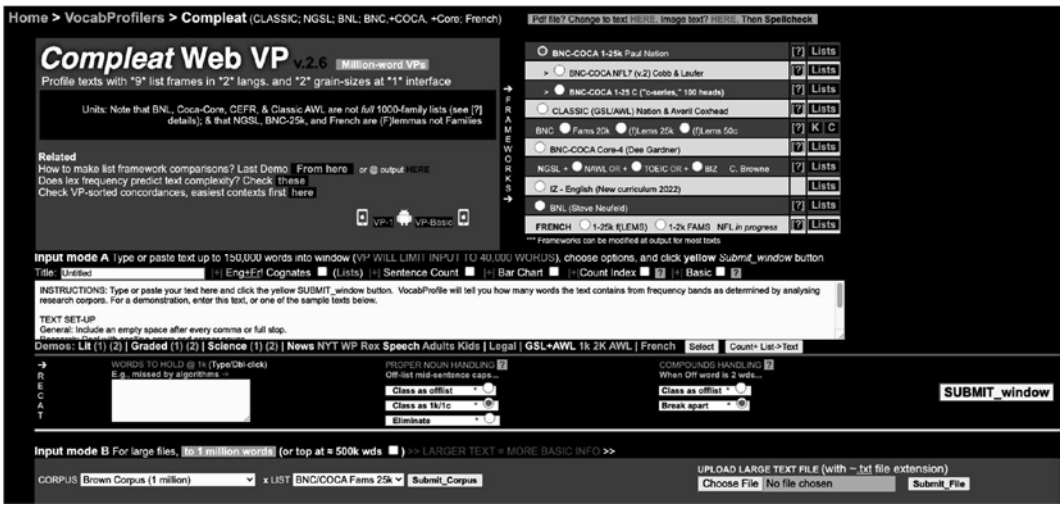

Figure 1. Screenshot of the Compleat Web VP by Tom Cobb (Cobb, n.d.)

We believe that these tools are underutilized by most Japanese EFL learners for various reasons, including those just described. In contrast, Japanese students can be seen ubiquitously on trains and in public spaces studying word lists out of books, which are often compiled for achievement in specific examinations. Thomson and Mehring (2016) summarized a large list of studies suggesting that rote memorization is the predominant vocabulary learning strategy among Japanese students. While potentially effective as a means towards a utilitarian goal such as passing a test, the lack of context and interaction with a word in a natural context make long-term retention of these vocabulary items unrealistic. Okamoto (2007) corroborates this, arguing that Japanese students reach their peak vocabulary knowledge in their third year of high school, when presumably, the stakes are highest due to the demands of university entrance exams, only to forget many words once enrolled in university. If students are able to access text analysis through corpus data, they may be more capable of understanding a word at a deeper level. Often, the problem with encouraging Japanese EFL learners to utilize corpus tools is that many are too complicated for the learner. Whatever learners’ goals may be, whether they intend to learn vocabulary for short-term purposes, such as improving their score on a TOEIC Test, or more long-term goals, such as to become fluent in a specific discipline, corpus-based tools can help in the process by providing the learner with important data about words that a learner may come across.

Corpus software is an especially powerful tool in individualizing the learning process as it can help learners make calculated judgements on which vocabulary items may be of interest based on their individual needs. Nation (2016) contends that a good corpus should reflect the individuality of the learner, citing the influence of age on reading materials. He writes, "Young native-speakers of the language talk and read about different things than adults do. A good corpus should reflect this" (p. 9). The ability to study contents that a learner is interested in can help to engage their studies in a more meaningful way.

Despite the many corpus tools available, there are two gaps in the body of software that the proposed platform hopes to bridge. First, many text analysis tools we found lack a built-in function to store texts and words for later study. This is likely due to the difficulty and cost of maintaining a service capable of handling large amounts of data from various users. Second, for EFL learners at a rudimentary level, some online corpus tools provide more information than the learner would need in order to determine whether they want to study a particular word in the future. This is likely due partly to the authors' observation that most corpus software is aimed at academics, not learners. By providing software to learners that satisfy these goals, students will be better equipped to pursue their studies, based on their own specific needs.

AUTONOMOUS LEARNING

By having the knowledge to make informed decisions about compiling word lists and performing basic text analysis with corpus tools, learners will be well positioned to engage in self-study outside of an institutional setting. Autonomous learning refers to the ability of a learner to self-monitor their own learning process and make decisions about what they need to learn, how they will learn it, and how they will apply it. Schwienhorst (2007) defines learner autonomy as "a learner-centered approach to learning, where learners are encouraged to critically reflect on their learning process and develop a personally meaningful relation to it" (p. 11). This can be especially beneficial in the context of learning a second language, as it allows learners to tailor their learning to their own needs and interests and to focus on the areas that are most relevant to them. It also addresses another issue of continuity through different stages of study.

One of the challenges in language learning is in being able to retain knowledge and materials from an institution into post-institution, self-study. The ability to do this through the accumulation of data from previous levels of education would be especially useful where English is required for purposes outside of an educational institution. Through the first author's research and development of medical English materials, it is evident that many professionals lack an organized methodology for carrying over the information received during their tertiary education into their profession. This software aims to bridge that gap by allowing users to save study materials and data for review and study in the future.

Tailoring Word Lists to a Learner's Specific Circumstances: Data-driven Learning (DDL)

Data-driven learning (DDL) is a teaching and learning approach that uses data and analytics to inform and guide the learning process. In DDL, data are collected about learners' progress, performance, and learning preferences, and these data are used to tailor the learning experience to the individual needs and goals of each learner. There are a number of ways in which DDL can be implemented in vocabulary learning strategies, including:

1. Adaptive learning: In adaptive learning, data are used to adjust learning contents based on the needs and progress of each individual learner. Examples include modifying content or activities to different learners based on their performance or preferences.
2. Personalized feedback: Data can be used to provide personalized feedback to learners on their performance and progress. This can help learners to identify areas where they need to improve and to focus their learning efforts.
3. Student-centered learning: Learners can personalize their method of study and take an active role in developing their own materials. This can involve using data to identify learners' interests and goals and to create learning experiences that are more tailored to their needs.

The DDL approach uses data and analytics to inform and guide the learning process, by enabling individuals to gather data and make informed decisions for their own course of study, based on that information. Szudarski (2017) notes, "Thus, not only does DDL raise learners' awareness of the way language is used in real-life communicative situations, but it also develops their autonomy by encouraging them to take responsibility for their own learning" (p. 104). Additionally, the DDL approach in our software helps learners to transition from reading in a passive style of learning, to an active approach, as it helps learners to engage with the text and think critically about what they are reading.

Furthermore, while general word lists serve as an important base of learning, some students may wish to learn English for specialized purposes such as their future profession, or in a specific academic context. One of the advantages of being able to access text analysis tools is that the learner can make an informed decision on what he/she should choose to study based on their individual needs. Anthony (2018) suggests that while general word lists can provide valuable information to a learner, individuals may attain more specific information by conducting a text analysis themselves. Browne et al. (2013) corroborate this assertion, advising learners that when studying vocabulary items beyond their NGSL 1.1 list, they are better served by learning words within their specialization. They write on their website, "The number of words they need to learn to make an additional 1% coverage gain increases sharply after 92%, and ... depending on the student's specialization, it is very likely that they will make significantly faster gains by learning special purpose vocabulary" (n.d.). This viewpoint suggests that learners can make more meaningful advances in their vocabulary acquisition if they are able to focus their studies on their specific needs and interests. We aim to support this process by enabling one to compile a personalized word list.

Spaced Repetition Software

Once students have made an informed decision on a set of vocabulary items that may suit their needs, the time to mastery can be expedited through an intentional and systematic process for vocabulary retention. Spaced repetition software is thought to provide an advantage over more random methods of vocabulary memorization. Spaced repetition is a learning technique that involves reviewing and practicing material at increasing intervals of time. The idea originated from the theory that by reviewing material at progressively longer intervals, one can more effectively commit that material to long-term memory and retain it over a longer period of time. This idea has existed since the 1800s when Ebbinghaus observed that he learned better by spacing his studies out. Figure 2 illustrates how the amount of information we retain decreases rapidly

after the first exposure, but that the rate of forgetting gradually slows over time if reviewed periodically. The curve suggests that reviewing or practicing the information at set intervals can improve long-term retention.

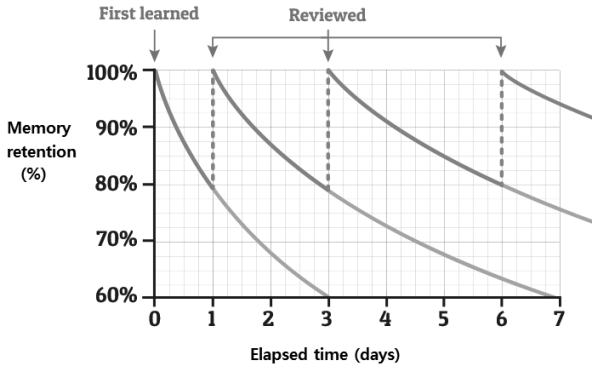

FIGURE 2. Ebbinghaus' Forgetting Curve (Chun & Heo, 2018)

The forgetting curve became an influential principle for vocabulary retention. In the 1970s, Sebastian Leitner created a method of studying and reviewing, which is now known as the Leitner system. It works by dividing material to be learned into a series of boxes, with each box containing a set of flashcards or other study materials. The student begins by reviewing the cards in the first box and then takes a test to assess their understanding of the material. If the student is able to correctly recall the information, they move the cards to the next box. If they are not able to recall the information, they return the cards to the first box for further review as demonstrated in Figure 3:

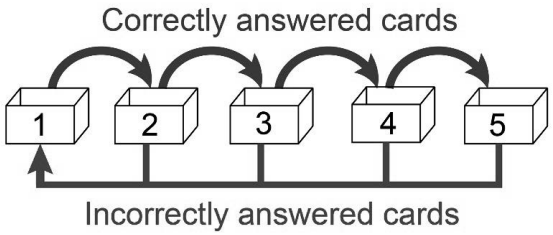

FIGURE 3. The Leitner System ***(Image public domain, CC by 1.0)***

As the student progresses through the boxes, the intervals between review sessions for each set of cards increases. This is based on the principle that information that has been learned and retained is less likely to be forgotten, so it requires less frequent review. The Leitner system was made more efficient with the advent of digital flashcards. Instead of a learner having to manually organize physical flashcards into categories based on memory retention, the computer can now take care of the spacing and management of study items. This digitization was first realized by Polish computer scientist Piotr Wozniak in the 1980s, with his program, SuperMemo, a software program that uses the principles of the Leitner system but employs an algorithm to determine the optimal intervals for reviewing new information based on the user's performance on previous

review sessions. The algorithm is designed to review information at intervals that allow for optimal retention (Wikipedia, 2022). The algorithm is designed to review information at intervals that allow for optimal retention.

DATA ANALYTICS AND CLOUD COMPUTING

The final component to our proposed system is the creation of a solution to enable language learners to store study materials for study in the future. While many commercially available vocabulary learning platforms such as Duolingo (Duolingo, 2022) and Memrise (Memrise, 2022) allow for word lists to be saved and practiced at a later time, most corpus and text-analysis platforms lack this feature. Therefore, responsibility is left to the learner to determine the best method of storing data, which often requires the combined use of more than one web-based or computer application. For computer-savvy and determined learners, this may not be a deterrent, but for an average learner, it would be advantageous to have all of these functions exist under one umbrella. This is where utilizing cloud computing can greatly aid in the management of word lists and study materials. Microsoft defines cloud computing as "the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale" (Microsoft, n.d.). In recent years, commercial cloud systems have enabled individuals with limited resources to develop their own software and put it on the web with far more ease than ever. By being able to save study materials to an online database, learners can go back to review those contents at a later date and see if their reading comprehension has improved based on their vocabulary study. Cloud computing can also give researchers insights into how learners utilize the system.

Analytics for Researchers

Finally, cloud-based platforms also offer opportunities for researchers looking to collect data as a means of gaining information about vocabulary learning processes. Currently, Hiroshima University has implemented Hirotan, a vocabulary study system, which can be accessed online via PC or portable device. Enokida et al. (2018) have noted the merits of data driven analytics to gain insights about students' usage of Hirotan. Their system enables them to monitor login statistics and study time. As part of this project, we seek to collect additional information such as the personalized lists that students compile, the types of texts students are studying, the length of texts, and the time a word takes to master.

BASIC OPERATION OF THE PROPOSED SYSTEM

The program consists of two main components: a front end, which is what the user will see on the website, and a back end, which can manage user accounts, save word lists and compile data that the researchers and site managers will have access to. The following is a summary of the features that the software aims to include:

TABLE 3. Features of the Proposed Software

Users of this software will be able to:
1. choose texts (autonomous learning)
2. perform vocabulary profiling analysis based on selected word lists (data-driven learning)
3. compile and save personalized word lists (autonomous learning)
4. review words efficiently (spaced repetition)
5. store reading materials for future review
6. use data analytics to better understand study behaviors

In practice, a learner's process can visualized in the following steps:

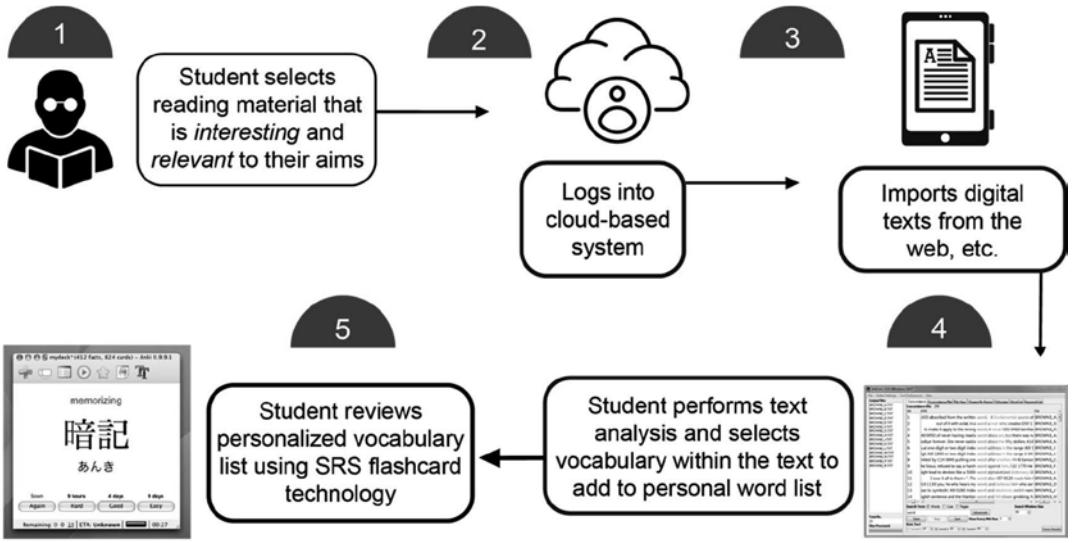

FIGURE 4. Visualization of the Proposed System

We believe that a system such as this will be beneficial in the context that the first author currently experiences as a university English teacher in Japan. It is possible that these experiences also carry over to a broader constituency outside a Japanese university context. The flexibility in choosing texts and vocabulary items will ensure that students, including those with aspirations going no further than acquiring just enough English to complete their coursework, can utilize the software in an easily accessible way. In practical terms, this means that many of the features included in similar software will not be utilized, in favor of making it usable even for novice learners.

CONCLUSION

This paper has surveyed some of the innovations in language learning tools related to second language vocabulary acquisition and selected various elements of this software that can serve the constituents the authors are most familiar with, in this case, Japanese students at the tertiary level. We have reviewed some

of the current online corpus and vocabulary acquisition tools available for self-study and hope to add to this current body of software based on the specific needs of the students we are familiar with. As practitioners, we hope that the software being developed in this project will enable students to take more agency in the selection and compilation of their word lists, engage with texts more actively, and make their studying more efficient. As researchers, our aim is to incorporate data collection tools that would give us insights about the learning behaviors of students to better inform our practices as English teachers.

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ABSTRACT

A Pedagogical Framework for the Development of Software for EFL Learners

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This article reports on the initial conceptualization of a web-based platform aimed at supporting Japanese tertiary-level students in English vocabulary acquisition. It outlines some of the pedagogical and practical considerations that have influenced the development of this web-based software. By reviewing previous literature and highlighting some of the challenges that Japanese EFL learners may face in learning vocabulary, it sets a framework for the development of a program that can contribute to filling some of the gaps between existing software and the needs of Japanese EFL students in tertiary education, as well as being applicable to a wider population of EFL learners. The software is intended to support autonomous, data-driven learning by allowing learners to develop personalized word lists through the use of corpus tools and standardized word lists. As cloud computing has become cheaper and more easily accessible in recent years, users will be able to save word list data for future study. Furthermore, researchers and instructors will be able to collect data-usage information to better inform their practices.

要　約

EFL 学習者を対象としたソフトウエア開発のための教育学的枠組み

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本論文は，日本の高等教育に属する学生の英語語彙習得を支援することを目的とした Web ベース・プラットフォーム形成の初期段階について報告し，本 Web ベース・ソフトウェアの開発に影響した教育学的および実践的な議論について概説するものである。先行研究レビューを通して日本人 EFL 学習者が語彙学習において直面しうる課題を明らかにすることにより，本研究は，既存ソフトウェアと高等教育における日本人 EFL 学習者のニーズとの間に存在するギャップを埋めるだけでなく，EFL 学習者というより幅広い学習者集団にとっても適用可能なプログラムを開発することを目指し，枠組みを設定している。本ソフトウェアは，学習者の自律的なデータ駆動型学習を支援するように作られており，学習者はソフトウェア上でコーパスや標準化された単語リストの利用を通して自身のニーズに合った単語リストを作成することができる。近年，クラウドコンピューティングが，より安く簡単に利用できるようになってきており，利用者は今後の学習のために単語リストのデータを保存も可能だろう。さらに，クラウドコンピューティングの分析によって，研究者や指導者は学生のソフトウェアの利用状況についてデータを収集することが可能となり，自分たちの実践についてより多くの情報を得ることができるようになる。