

Twenty-Five Years of History and Prospects of Handheld Unabridged Electronic Dictionaries in Japan — Galapagosization's Gains and Losses¹⁾

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1. Introduction

One thing that surprises native English speakers when they come to Japan is the use of handheld unabridged electronic dictionaries (HUEDs) by not only English teachers and researchers, but also the junior-high and high school students. Sekiyama (2007) classifies electronic dictionaries into three types — HUEDs, dictionary software, and web-based dictionaries — but it is safe to say that HUEDs are the type most familiar to Japanese people. Outside of Japan, in contrast, web-based dictionaries and dictionary software are the most widespread, and HUEDs are uncommon except among a handful of crossword puzzle enthusiasts. In a country where personal computers and smartphones are widely used, why do Japanese people use HUEDs, which cost hundreds of dollars, instead of cheaper web-based dictionaries and dictionary software?

This paper reviews 25 years of changes in HUEDs, from their inception to the present, and considers the chronology followed by Japan's uniquely Galapagosized¹⁾ HUEDs. First, I will describe the predecessors of HUEDs in Section 2: the electronic speller developed in the U.S., and the handheld electronic wordbooks (HEWBs) released in Japan. In doing so, I will clarify the influences on how English dictionaries were used in Japan versus the U.S. Next, in Section 3, I will analyze the evolution of HUEDs in Japan into four stages, and discuss how their specifications changed at each stage. Finally, in Section 4, I will discuss the influence of the spread of smart devices like smart-

phones and tablets has had on HUEDs.

I will restrict the term HUED in this paper to refer to only “full-content” electronic dictionaries, which are equipped with the complete textual information of paper dictionaries. To distinguish them clearly from HUEDs, I will designate HEWBs as those devices that list only English/Japanese equivalents and which are *not* based on the contents of paper dictionaries. Furthermore, this paper considers dictionaries built into non-dictionary-specific devices, such as electronic book players and electronic organizers, as outside of the scope of analysis.

2. The Prehistory of HUEDs: Differences between Japan and the U.S.

The prototypes of modern HUEDs were the electronic spellers developed in the U.S. in the late 1980s and the HEWBs released in Japan in the late 1970s to 1980s. Strictly speaking, these were not dictionaries, but as we are considering how HUEDs are positioned differently in Japan versus the U.S., I believe it is valid to discuss them in the context of their origins.

In this section, I briefly describe the functions of each type of device, and discuss how it would become the foundation of electronic dictionaries, which were different in Japan and the U.S.

2.1. The U.S.: Electronic Spellers

Because English uses phonogram such that spelling and pronunciation lack a one-to-one correspondence, it is extremely difficult to look up the meaning of a word for which the exact spelling is unknown in a paper dictionary. Thus, learning to spell accurately is a necessary step that native English speakers must take before using a dictionary.

This background led to electronic spellers being developed earlier in the U.S., with the first-of-its-kind “Spelling Ace” (SA-88) released by Franklin Electronic Publishers in 1986. The function of the SA-88 was to compare the spelling of an input word against a built-in word list: if the spelling was incorrect, the device would infer and display correctly spelled word suggestions. Because its purpose was to confirm

and revise the spelling of words, information considered essential for dictionaries (definitions, synonyms, examples, etc.) was omitted, and it was instead equipped with a list of approximately 83,000 English words, a comparable scope to the paperback compact English dictionaries used daily by native English speakers.

The SA-88 was equipped with algorithms for inferring spelling not only based on similarity in spelling, but also based on phonological rules. Thus, correctly spelled word suggestions would be displayed to users if they input words according to their pronunciation. This includes even words they did not know the spelling of at all, or words of which they had only a vague recollection. At the time the SA-88 was released, most native English speakers were using traditional mechanical typewriters. As these lacked built-in spell-check functions of the kind seen in more-recent electronic typewriters and English word processing computer software, the SA-88, with its ability to look up the spelling of words simply, became a bestseller, selling millions of units.

In addition to its spell-check function, the SA-88 also came equipped with a wild-card search. If a user was unsure of some letters comprising a word, they could replace the unknown letters with "?", and the correctly spelled word suggestions would be displayed¹). In the U.S., with its many crossword puzzle enthusiasts, many used the SA-88 when solving or creating difficult crosswords. Instead of including definitions and usage examples to provide functions that are characteristic of dictionaries, which would consume much memory, makers had prioritized in improving the precision of the spell-check and wild-card search functions by increasing the size of the compiled word list as much as possible.

The Word Master (WM-1000), the successor model to the SA-88, was released in 1987, equipped with a synonym search in addition to the spell-check and wild-card search. After several subsequent HEWBs, the SCD-770 — the first HUED in the U.S. — was finally released in 1996²).

The need is great in the U.S. for spell-check and wild-card search

functions. What became mainstream then were electronic spellers released with essentially the same specifications as the SA-88, a trend extending even to the present day. We can consider the SCD-770 and its successor models to be high-end HUED models, in which the dictionary search functions intended for specific professionals have been added to the functions of the electronic spellers that have continued since the SA-88. The resulting long intervals between model changes and long-term continuations of individual models on the market are a point that greatly differs from Japanese trends.

2.2. Japan: Handheld Electronic Wordbooks (HEWBs)

Japanese uses *kana* alphabets, in which characters and sounds have an almost one-to-one correspondence. Therefore, a person can search the meaning of even an unknown word in a Japanese dictionary, in which words are listed in Japanese syllabary (*gojūon*) order, if they hear its pronunciation. In contrast to the relationship between native English speakers and English words, Japanese people do not feel that spelling Japanese words correctly is difficult, and so spellers of the kind seen in the U.S. are not considered necessary. In addition, thanks to the existence of *kanji* ideographs, simply being an adult native Japanese speaker is sufficient to be able to infer the meaning of unknown words simply and easily. As a result, dictionaries of the English language, which all Japanese learn as part of compulsory education (i.e., English-Japanese and Japanese-English dictionaries) have historically drawn greater interest than pure Japanese-language dictionaries.

The *Den'yaku-ki* (IQ-3000), released by Sharp in 1979, was the world's first HEWB: the product can be considered a prototype HUED in Japan. Approximately 2,800 English entry words, predominantly basic vocabulary, and about 5,000 Japanese equivalents were compiled in the device. Japanese translations were displayed in *katakana* because LCD screens that could display *kanji* had not yet been in development at the time.

In 1987, the *Denjirin* (PD-1) was released by Sanyo Electric, containing approximately 35,000 words, and displaying Japanese equiva-

lents in *kanji*. Almost the same number of words was compiled in the device as in English-Japanese print dictionaries intended for high school students: a user could use the device instead of a paper dictionary if they wanted to know merely the Japanese translation of a common word. However, neither the IQ-3000 nor the PD-1 contained usage examples, grammar notes, or other information besides translation equivalents: as opposed to HUEDs, these devices amounted to no more than large-scale HEWBs.

In 1991, the TR-700 was released by Seiko Instruments. This model was the first proper HUED, containing all of the textual information from the print editions of the English-Japanese & Japanese-English dictionary, "*Kenkyusha's New Collegiate English-Japanese Dictionary 5th Edition*," "*Kenkyusha's New Collegiate Japanese-English Dictionary 3rd Edition*," and "*Roget's II The New Thesaurus*," as well as examples and other information. HUEDs in this initial period were extremely expensive³, and so HEWBs containing approximately the same number of words as paper dictionaries were released in tandem, with accompanying lower price lines.

Essentially, the successor models to HEWBs, the Japanese HUEDs have an over-20-year history since the IQ-3000, which has been marked by successive improvements that continue to the present day. This sets them apart from their American counterparts. Cheaper than HUEDs, HEWBs remained popular for a time even after the TR-700 were in the consumer market. However, HUED prices began to fall, and as the difference in cost between them and HEWBs narrowed, gradually an increasing number of consumers began to carry around HUEDs instead of paper dictionaries or HEWBs. As described in Section 3.2, the unit shipments of HUEDs have exceeded those of HEWBs ever since 2002. Accompanying this trend, new products have been released every year to date with improved functions, such as having more dictionaries installed or allowing cross-searching between all compiled dictionaries on the device. These developments have created an evolutionary history of HUEDs that is unique to Japan.

3. History and Classification of HUEDs in Japan

In this section, I describe how Japanese HUEDs have evolved to date, broadly classifying their progress into four stages. I will limit my discussion to those important functions added or modified at each stage, with accompanying examples of representative HUED model names and makers.

3.1. Stage I: 1990s

I classify the HUEDs released in the 1990s, starting with the introduction of the TR-700 in 1991, as Stage I models. These HUEDs include the TR-9700 (Seiko Instruments, 1997), XD-1500 (Casio, 1999), PW-5000 (Sharp, 1997), and SR-8000 (Seiko Instruments, 1999) among others¹. Newly implemented features of HUEDs at this stage included jump search and phrase search, which were not present in the TR-700.

The jump search function, as described in detail by Yamada (2014), allowed a user to highlight an English word in a given dictionary in order to search for it in a different dictionary. For example, by selecting an English equivalent appearing in a Japanese-English dictionary and jumping to an English-Japanese dictionary, the user could view detailed usage notes and examples for that word. The TR-700 lacked a jump function, and so its users needed to re-enter the word and search once more. However, with HUEDs equipped with the jump function described above, users could move freely between installed dictionaries, giving the impression of “dictionary surfing” from the originally searched dictionary without needing to re-input the word. This is arguably an indispensable function for Japan, where HUEDs compete on the basis of the number of installed dictionaries.

Phrase search is a function for searching phrases compiled in a dictionary using a word or words. For example, if one wanted to look up the phrase “take advantage of”, deciding which word a phrase would be listed under would be a challenge: “take”, “advantage”, or “of”? This would be especially true for a beginning student with a paper dictionary. By using phrase search, the user could search for the

phrase in question simply by inputting some (or all) of the words constituting the phrase: e.g., “take” and/or “advantage” and/or “of”. In Japanese university entrance examinations, applicants are often asked about the meaning of phrases in addition to knowledge about words. Accordingly, phrase search is a heavily used function among not only the English teachers, but the high school and university students as well.

3.2. Stage II: Early 2000s

Stage II HUEDs are primarily those models released in the early 2000s. The HUEDs at this stage include the SR-9500 (Seiko Instruments, 2001), XD-R8100 (Casio, 2002), and PW-6800 (Sharp, 2002) among others. HUEDs experienced increased sales in this period, and in early 2002, had exceeded HEWB sales in terms of unit shipments. With improved hardware performance and high-resolution screens, users were able to access dictionaries at high speeds. Accordingly, in Stage II HUEDs, along with the increase in the number of dictionaries loaded into the devices, makers implemented many other functions not present in the previous HUEDs. Features of these novel functions included quick search and example search.

With the quick search function, the screen displaying translation equivalents is predictively updated each time a user inputs a letter of the word they want to search; thus, allowing them to search for a word without entering all the letters. Similarly to paper dictionaries, the user could see a word’s meaning if they know its first few characters, and the effort spent on keystrokes was economized considerably.

The example search function allowed a user to search for and list usage examples containing an input word from all dictionaries in the device. The user could use the examples from all dictionaries as a kind of corpus, which became a fundamentally priceless feature when searching for English sentences to serve as reference for their own English compositions.

Functions that reproduced features of paper dictionaries (typified by quick search) were well-balanced with functions absent from them (such

as example search) in Stage II HUEDs, and their operability has greatly improved. The Stage II models with the built-in features of paper dictionaries, and other functions unique to these models have accelerated the transition from paper dictionaries to HUEDs.

3.3. Stage III: Mid 2000s

Stage III includes models released from 2003 to 2006. Examples include the SR-E10000 (Seiko Instruments, 2005), XD-H9200 (Casio, 2004), and PW-9800 (Sharp, 2003).

HUED unit shipments skyrocketed, and makers competed with each other to see who could load the most dictionaries onto their device. Only three dictionaries were loaded into the first-ever HUED model, the TR-700, but models with over 100 dictionaries were introduced in 2006. The multiple-dictionary search, the multiple-dictionary example search, and the Japanese jump search were functions newly built into Stage III HUEDs so that users could swiftly search through the large volumes of loaded dictionaries.

Using the multiple-dictionary search function, a user searches through all the dictionaries loaded into the device at once to return a list of search results by entering their target word. The sequence for multiple-dictionary search is to first enter the word, then select the dictionary with the desired contents: this contrasts with searches in prior HUEDs, where the user needed to select the dictionary they wanted to use before entering the word to search. This function permits users to get results more quickly by searching cross-sectionally through the dictionaries in the device irrespective how high their number is. Because of this, nearly all HUEDs since have come with this function built in.

The multiple-dictionary example search function is an expanded version of the example search mentioned in Section 3.2: one can search for usage examples in which the input words are searched through all the English dictionaries loaded into the device. Pertinent example sentences can be found across the corpora of the dictionaries in the device, a function that is distinct from the previous singular

dictionary example search. As a result, some models could arrange examples by dictionary, or align sentences with the target word in the center of the display.

The Japanese jump function was an expanded version of the jump function mentioned in Section 3.1: one could now jump to other dictionaries by selecting not only English words, but Japanese words as well. Different from English with its words separated by spaces, Japanese lacks a clear separation of words. As a result, the target words to jump both to and from must be segmented before jumping, a CPU-intensive task. The dramatic improvements in processing speed in Stage III HUEDs that allowed users to now search dozens of dictionaries at once also made it possible for them to jump to and from Japanese words, a challenge for prior models.

The implementation of the Japanese jump function allowed users to jump bidirectionally, from English to Japanese and vice versa, meaning they could now freely go back and forth between almost all the dictionaries loaded into the device. People could now access and compare dozens of paper dictionaries, a feat virtually impossible in reality. The Japanese HUED had become a unique search tool, sharply distinguishing itself from not only paper dictionaries and the CD-ROM dictionary software & web-based dictionaries that contained them verbatim, but from the HUEDs and HEWBs of other countries as well.

3.4. Stage IV: Late 2000s-Present

Stage IV includes HUEDs from 2007 to today. Models of this stage are equipped with color LCD displays and touch panels, and include the XD-A10000 (Casio) and PW-TC920 (Sharp)²⁾.

Having experienced long and continued growth, HUED unit shipments peaked in 2007, with approximately 2.8 million units shipped (JBMIA, 2015). At the same time, with the release of the iPhone in 2007 and the iPad in 2010, HUEDs became exposed to competition from smart devices like smartphones and tablets. It should be obvious that traditional HUEDs, where users searched using a keyboard and monochrome display, could not possibly compete with smartphones,

with their high-resolution color LCD displays and screens that users could intuitively manipulate by touch.

Until this point, the stimulus for functional improvements and enhanced operability had been through friendly competition amongst makers, within the scope of HUEDs, leading to the creation of HUEDs unique to the Japanese market. From Stage IV onwards though, the same makers were forced to be conscious of smartphone progress. A touch-panel-equipped HUED was first introduced in 2007, and from 2010 onwards, almost all models had adopted color LCD displays. HUEDs were also introduced where the user could add non-dictionary software, models that would be more aptly called “smartphones with keyboards” than electronic dictionaries.

The number of dictionaries installed also increased with each model change; however, in 2012 and with the regular inclusion of nearly 200 dictionaries in a device, makers explored strategies to develop HUEDs as language learning tools rather than trying to increase dictionary count. Companies included large quantities of audio and video data: for example, one year of audio recordings of English conversation program from NHK Radio, or videos from the English learning animated program “Little Charo”. With steps such as these, each company ingeniously reinvented their HUEDs, not as imitations of smart devices, but as dictionary-centric learning devices specialized for language learning.

4. Current Status & Future Challenges for HUEDs

Nearly ten years have elapsed since the introduction of the first Stage IV HUEDs. In the midst of smart devices’ unrelenting spread, unit shipments of HUEDs in 2014 were about 1.42 million units, a mere half or so of the maximum in 2007. Users of dictionary applications on smart devices and web-based dictionaries have increased with each passing year, especially among university students and working adults. Seiko Instruments, which had primarily sold models intended for working adults ever since the release of the very first HUED model, ceased HUED sales in 2015.

HUEDs aimed at students, on the other hand, are used even today by many junior-high and high school students, since smartphone use during classes is prohibited at nearly all junior-high and high schools. As a result, recent student-model HUEDs that come installed with English certification exam (e.g., TOEIC, TOEFL) preparation materials, or listening materials for studying English for everyday use have increased in number, more so than those that come with increased numbers of dictionaries. The Galapagosization of Japanese HUEDs is clearly perceivable in the heavy compilation of study materials besides dictionaries, examples of a trend that are nearly absent outside of Japan.

Smart devices will continue to be adopted at levels beyond its current levels hereafter if e-textbooks are adopted in classroom educational settings, it will likely to become commonplace for students to operate tablets installed with dictionary applications during lessons. Modern HUEDs cost more than tablets and yet lack the versatility of the latter. However, looking at them from a different perspective, these HUEDs, with their unique Japan-specific sustained evolutionary development influenced by user demands, boast many strong points. The ability to access detailed information by jumping across hundreds of dictionaries, the ability to use them immediately after powering on, long battery life, and the lack of distraction due to the absence of internet connectivity are among the advantages of HUEDs.

In this paper, I primarily aimed to provide an overview of the 25 years of HUEDs—including their predecessors, the HEWBs—in Japan to summarize the current state of HUEDs to researchers outside Japan who are not familiar with them. Each dictionary medium must continue to coexist to move forward, while users take advantage of the properties of each: one such direction is to improve dictionary applications and web-based dictionaries for smart devices with reference to the functions and operability of Japanese HUEDs.

NOTES

Title

- 1) This paper is an expanded and completely updated version of Sekiyama (Website).

Section 1

- 1) Japanese HUEDs have followed a different course of evolution from other countries because their product development has proceeded according to domestic needs.

Section 2

- 1) For example, inputting “?pel?in?” would result in the suggestion “spelling” being displayed.
- 2) This HUED contained the contents of *Merriam Webster’s Collegiate Dictionary 10th Edition*.
- 3) The TR-700 cost 48,000 yen.

Section 3

- 1) The SR-8000 was even equipped with example search and quick search, the same functions that would characterize Stage II models.
- 2) In lieu of color LCD displays and touch panels, Seiko Instruments released the first models with user dictionary creation and language drill creation in 2008.

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