Kanji Retrieval by Recursive Location of Elements Using HyperCard

Anil Bhatia

Abstract: There are a number of Japanese-English computer dictionaries. However, they do not provide the Japanese language student with an adequate means of retrieving kanji (Chinese characters). The study here outlines the implementation and evaluation of a computer-based kanji finder. The electronic kanji finder was implemented on a Macintosh using HyperCard, with regard to student needs, based on sound pedagogical and human factor principles. An evaluation of the implementation based on a comparison of the retrieval methods of a traditional dictionary was made, giving students access to both the computer-based dictionary and Nelson's paper kanji dictionary. The two retrieval methods were compared based on human factors criteria. The results of the comparison show that the electronic dictionary has several features which are better than the traditional paper dictionary. The findings go against previous research which show that electronic fact retrieval is worse than traditional retrieval using reference books (B. Shneiderman, 1987). The conclusion discusses some of the implications of the results for students of Japanese.

Keywords: Kanji (Chinese characters) retrieval, Japanese language learning, hypertext design, information retrieval, CALL, HyperCard

Introduction

Defining the problem: One of the main problems in learning logographic script languages like Japanese or Chinese is that there are so many characters. Here we focus on the problem of looking up kanji in a kanji dictionary within a self study context. When French language students come across a word they do not know, it is easy for them to look in a dictionary to find the meaning. However, students of Japanese cannot do the equivalent because kanji do not have the same inherent order. There are various paper dictionary methods for locating kanji. Most dictionaries assume that the student knows how to pronounce the unknown character, or else the dictionary assumes that the English equivalent is known. Nakajima and Yokokura point out "in visual processing of kanji, it is often the case that the reader may...not necessarily know how to pronounce (the character)" (Nakajima and Yokokura, 1988. p. 76). Most Japanese
dictionaries assume a priori that the student knows the reading of the character. We refer to this as the 'KWYALF syndrome' (Know What You Are Looking For syndrome). KWYALF is rarely the case (see below). Without knowing the reading the only other method of finding the character in the dictionary is by way of stroke count. As will be shown later, stroke counts are not a viable key for locating kanji. Once the reading of the character is ascertained, its meaning can be found using a standard Japanese-English (J-E) dictionary. So the method used by most students is to ask the teacher (or a native speaker) what the reading is. This means that students of logographic languages are tied to their teachers’ apron strings much longer than students of other languages. For persevering students, one of the main gates to freedom came with the publication of Nelson’s Japanese-English Character Dictionary (A. Nelson, 1969). Nelson’s dictionary is a definitive reference source which contains a logical approach for locating a kanji whose reading is unknown. However, most beginners and intermediate students find the dictionary very intimidating. Although it contains all the information, locating the information is another matter. Attempts to find a kanji using Nelson’s dictionary are frustrating and off-putting for most students because they are faced with the prospect of choosing from the 214 traditional radicals which are presented on a stroke count basis (see below).

Given the KWYALF syndrome, locating a kanji is as easy as locating an English word in an English dictionary. In anticipation of the problem of finding the reading of kanji, study texts are notorious for giving the reading of target kanji to be learned. But the vast amount of general reading material (such as newspapers, magazines, sign-boards, advertisements, etc.) are ridden with unknown kanji, presenting a swamp for any student who dares to venture beyond the safety of these study texts. Therefore English speaking learners of Japanese ... require anew set of strategies for mastering kanji (Nakajima and Yokokura, 1988. p. 80). In addition to these strategies, new tools are required. "Adult learners want control over the materials they use, they impose their own learning styles, and require opportunity to move through the text in non-linear fashion. They are interested in what is immediately applicable" (J. DeJoy, 1989. p. 39). This research suggests that they need tools which allow them to instantly access a dictionary to find the reading and meaning of a kanji they happen to come across. This is revealing when compared with the following: "Hypertext is characterized by its interconnectivity" (G.P. Landlow, 1989. p. 179). It provides the student with a means for moving through text in a non-linear fashion, going from one semantic link to another, thereby allowing the student to form his or her own understanding by relating a word to other words which are within that semantic context. From the students' point of view, hypermedia systems provide a new approach to information retrieval, one which can bend to meet their requirements. A clearer description of hypertext is given in the following sections.
One of the main arguments of this paper is that students need the right tools for venturing into uncharted territory by themselves, tools which acknowledge independent, self-motivated learning at a student’s individual pace, giving the student more control over the learning environment, and allowing the student to choose what is to be learned (A. Kristjansdottir, 1989) (J. DeJoy, 1989). The implementation of this philosophy leads one to build a system which allows the student to move from a state of "no information" to one of "complete information." The kanji finder program detailed in this study is the first step along this path.

Standard methods for locating Kanji
There are four main keys for finding kanji: Reading, radicals, elements, and stroke counts.

1) Reading, or the pronunciation, is the easiest way of locating a kanji, but most students have no idea what the reading of the kanji is, so they cannot use an ordinary J-E dictionary.

2) "Radicals" are those recurring component shapes which have historical significance, but even native speakers find them inadequate.

3) "Elements" are the recurring shapes which have lost their prominence and are not included in the traditional list of 214 radicals. They serve as a basis for the Kanji Finder dictionary implemented in this study, and have recently become noted in the publication of alternative dictionaries (alternative to the traditional radicals).

4) "Stroke counts" are an accurate way of locating kanji, if you can count the strokes. Native speakers also make one or two guesses when they are counting, and are not at all surprised if they make a mistake.

The Nelson Dictionary Method
Nelson's dictionary was a major breakthrough in allowing non-native speakers to find the reading, and thereby the meaning of any kanji. The dictionary uses a combination of radical and stroke count concepts. The 214 traditional radicals are laid out according to their stroke count. Each radical has a reference. The following is a task analysis using Nelson's dictionary:

1) Count the strokes in the radical.
2) Locate the radical in the list based on the above stroke count.
3) Search for the reference given under the located radical.
4) Count the remaining number of strokes (not including the radical part).
5) Locate the page of the kanji using the above stroke count as a sub-heading.
An informal investigation of students' use of Nelson's dictionary was made prior to developing the Kanji Finder stack. The investigation revealed deficiencies in the dictionary system which caused students to make errors.

There were 4 types of errors,

1) Stroke counting.
2) Choosing the wrong radical.
3) Choosing a shape which is not a radical.
4) Failing to recognize a radical because of variation in shape.

1) There is a heavy reliance on stroke counting in the above task analysis (1 & 4). Because of this, students had ample opportunity to make errors.

Recommendations made by D. Sharpe & M. Willshire (1989. p. 59) state:

"Do not make the user think and make decisions more than necessary. The more decisions a student has to make, the more opportunity for errors, especially when the decisions are not directly related to the task at hand."

Stroke counts are not directly relevant to the task of finding the meaning of a kanji. They are incorporated into the system as a means of finding the kanji.

2) The assumption implicit in task (1), is that the student can recognize the (one) correct radical. This is by no means an easy task, and students were often lost because the radical could not be determined. Choices had to be made between one or more candidates, thereby forcing the students to occasionally make incorrect guesses. For example the following kanji has more than one possible radical candidate:

3) In some cases where the students thought the radical could easily be determined, the radical was not included in the list of 214 traditional radicals. Some kanji elements look as if they should be included as a radical, but when the students searched for the shape they found it was not there. For example, the following element is assumed (even by native Japanese) to be a radical:
and the top element of the following kanji was assumed to be a radical by all students:

学

4) Even though the radical is listed, it has to be seen. The students often failed to see the connection between the elements in the kanji and the radicals presented in the list. Along with this, there are subtle differences between hand written and printed kanji which also serve to confuse the unwary student.

Kanji Finder Program
1) Implementation. Kanji Finder is a one-megabyte HyperCard stack consisting of about 900 cards and 30 backgrounds, implemented on a Macintosh computer. It requires two megabytes of main memory, hard disk, Japanese OS (Kanji Talk), and a special font (made for the purpose of this study). Although it is implemented on a Macintosh computer the design principles may be transported to any computer. The ideal hardware design would be a portable electronic dictionary such as Canon's Word Tank and Sony's DD-1, but with an enhanced screen format.

2) Design Issues. The goal of our design was to develop a kanji dictionary with special features. These special features come under a general heading of "user friendliness." More specifically, the goal was to design an electronic dictionary which would minimize the previously mentioned negative aspects of print-based technologies, and at the same time introduce a variety of search techniques, thereby increasing the chances of success whilst maintaining an efficient retrieval time.

Human factors were taken into consideration when designing the system "because we should provide an environment that encourages learning and we should take advantage of our human factors experience to help provide such an environment" (D. Sharpe and M. Willshire, 1989. p. 59).

The learning curve was also an important design issue. A learning curve is the time taken to learn how to use the dictionary, and also retention of this information. So, if students come to use the dictionary again after six months of non-use they do not have to re-learn the program again.
Although hypertext describes the interconnection of non-linear text in a network environment which allows the user to jump from one place in the text to another, this may not be altogether a good thing. The number of links available may also serve to complicate the learning or search task (Gary Marchionini and Ben Shneiderman, 1988). The connections are explicitly placed when authoring. So hypertext systems may be seen as a two-edged sword. On the one hand there is the possibility of infinite links, but these links lead to problems of navigation, such as "where am I?" and "how do I get back to where I was ten minutes ago?" It is easy to get lost among the myriad of connections. Glushko explains: "the hype of hypertext is that links are powerful and exciting— the user might start reading about Buffalo and end up reading about the Buffalo head nickel. For designers using a reference book to answer the dialogue questions, however, this model of hypertext is misguided. The challenge for hypertext designers is to understand the users' task, and to support links that follow from some model of the users' need for information in some particular context" (Glushko, 1989. p.297). The design of Kanji Finder was firmly based on this presupposition.

Marchionini and Shneiderman note that "Designers must know how users seek information in traditional print forms if they are to produce effective interfaces for new systems" (Gary Marchionini and Ben Shneiderman, 1988. p. 75). By analyzing a user's interaction with Nelson's Dictionary, a number of problems were isolated², which influenced the design of the kanji finder program. For example, Sharpe & Willshire (1989) recommend that the user should not have to make more decisions than necessary, such as having to decide the one and only relevant radical when using Nelson's dictionary. In Kanji Finder the user is not requested to disambiguate the similar shapes so that the list of radicals matches the shape in front of him or her. Instead, Kanji Finder works with the principle that it bends to meet the request of the student. Selecting from a list of elements which may occur anywhere within a given kanji is cognitively an easy task, when compared with Nelson's dictionary. The more decisions a student has to make, the more opportunity for errors, especially when the decisions are not directly related to the task at hand. Stroke counting was felt to be irrelevant to the task of finding kanji, and was superfluous when using the Kanji Finder, since it is used only to speed up the retrieval process.

Frisse (1988) noted the different ways in which users interact with traditional reference books, in that they use highlighters, annotate their reading, mark specific locations, and are prone to interruptions, to name but a few common styles. All of these styles indicate the need to personalize the system to meet different requirements.
The above-mentioned styles of interaction were all taken into account when designing the Kanji Finder program. All retrievals can be saved in a user's electronic notebook, and personal notes can be appended.

J. Jackson & R. Roske-Hofstrand (1989) demonstrated that clicking is better than circling for two or less objects, and hence the standard pointing/clicking interface was maintained in our implementation.

3) Search strategies. Kanji Finder uses a scan and select method and has a task analysis as follows:

Select at least one of the elements occurring in the kanji by location (top, bottom, left, right).
Key in maximum and minimum stroke count (optional, used to narrow the search).
Key in the reading (optional, used to narrow the search).
Start search and wait for results.

The Kanji Finder program has no need for the student to count strokes, or to be able to recognize the traditional radicals. In place of the radicals, a list of elements is presented on the basis of their frequency. By selecting one or more of these as a key, the program searches through its database and retrieves the characters which contain that element.

Recursive Kanji
The concept of recursive kanji is that often a kanji character is contained inside another kanji. For example, contains two simpler kanji  and . Assuming that a kanji character can be broken down into constituent parts, which contain either elements or known kanji, the student can select (or type in) any of these constituent parts to locate the character. Complex kanji often contain simpler kanji which the student should know, and so using the concept of recursive kanji is a logical extension of utilizing previously learned kanji. Paper dictionaries would need an extensive cross reference system for implementing this kind of search method.

Three different search strategies are presented to the user, and may be employed independently or in combination. The main search strategy is that of selecting an element by clicking on it. Once several elements have been selected the user can then select a Boolean AND/OR search strategy, with a default of AND. Another key for searching is stroke count. However, the significant difference between the electronic
version and the print version is that the stroke count is not an integer, but a range of integers. So users who do not know the exact value of the stroke count may put a minimum and maximum value to allow for errors in counting. It also allows the Kanji Finder to narrow the number of retrieved items.

A less useful feature (remembering KWYALF), is the ability to specify the reading of the character, or its English meaning. Improvements are being made to allow the user to specify more vague English terms than the exact English equivalent.

So, for example, the exact English equivalent for "person" is the character 人 (hito), but there are many others which can also correspond to this in a kanji compound (for example 手 which literally means "hand", as in 選手 as in (senshu) "player").
"Researchers must identify and incorporate screen design strategies that are relevant to CBI (Computer-Based Instruction) instead of simply adapting techniques associated with print based technologies" (M. Hannafin, 1989, p. 156).

The screen design was dominated by four questions:

1) In which order should the elements be displayed?  
2) How many of the elements should be presented?  
3) In which format (row, diagonal, or column)?  
4) How many windows should be on the screen at one time?

1) In which order should the elements be displayed?
A. Cohen's research (1976) into the most commonly used radicals of Chinese kanji was used as a basis for the order in which elements should be presented. Cohen showed that 68 radicals allow access to 96% of all Chinese characters.

This research on Chinese kanji was adapted for Japanese kanji. The order of presentation of elements in Kanji Finder is not based on stroke count. An analysis of the frequency of usage of elements was made. Results of the analysis revealed that a few elements occur in most kanji. For example, the eighteen most frequent left hand elements occur in 75% of the kanji. The remaining 35 elements occur in less than 25% of the kanji. Because of the results of this analysis it became obvious that the vast majority of the elements would only rarely be selected. Figure 3 displays elements which occur by location only on the left hand side of a kanji. Similar results were found for the other elements which occur in other positions. In each case (top, left, right, and bottom) an
analysis of the distribution frequency was made. A decision to present the elements which occur most frequently in Kyouiku kanji on the first row for each location (top right, bottom, left) was made. So the layout of characters on the screen follows a strict top-left to bottom-right sequence, with the most frequently used element given at the top-left. In comparison to this, Nelson's Dictionary lays out radicals according to their stroke count. The format of the screen display compared to the layout in Nelson's dictionary is evaluated in the results.

2) How many of the elements should be presented?
It is possible to display over 500 elements on the screen at the same time, but this would go against existing guidelines (Ed. G. Salvendy, 1987 and K. Boff, L. Kaufman, and J. Thomas, 1986). The distance between the subject’s eye and the screen was approximately 50cm. At that distance the height of the element (17mm) subtended an angle of about 1 degree which is well over the 24 minutes recommended for visual search by the guidelines.

Using these parameters, up to 80 elements could be presented on the screen as shown on the next page.

3) In which format (row, diagonal, or column)?
The screen format was decided according to the tentative results given by H. Emurian and B. Seborg (1990), which show that a tightly packed column display is easier to search than any other format.

With the electronic version any number of elements could be chosen, and each extra selection narrowed the number of possible retrieval items. Nelson’s Dictionary allows only one radical to be chosen.

4) How many windows should be on the screen at one time?
When faced with a choice of implementing the dictionary with only a single window screen or multiple screens showing concurrently, we decided the former was more appropriate.

The recommendations given by Jonassen (1989) and J. Hendrickson (1989) suggested that one window on a screen at any one time would be an ideal environment for the electronic dictionary. Thus the implementation was based on HyperCard. There are hyper-media presentation tools such as SuperCard which allow numerous windows to be open all at the same time, but these tools were rejected in favor of HyperCard, because “search strategies are less efficient with multiple active windows” (J. Hendrickson, 1989. p. 221).
Comparing the Two Dictionaries
The objective of this study was to compare the effectiveness of a print based kanji retrieval dictionary with that of an electronic kanji retrieval dictionary for students of Japanese.

The test objectives were as follows:

1) With which technique can selections be made more quickly?
2) Which technique is more reliable?
3) Which technique is preferred by students?

Hypothesis
Research hypothesis: We anticipate that those students who have access to this tool will be better equipped to find and learn the kanji which they seek, compared to those students who do not have access to this tool. Learning is defined here as the long term recognition of a given kanji, in terms of spreading activation memory theory.

Null hypothesis: There will be no difference in the number of correctly defined words between students using a paper dictionary and students using an electronic dictionary.

Dependent Variable
The function of the dictionaries is to provide a reading of a character. The main performance variable (correctness) was judged according to standard readings of a kanji character. There was no subjective input in deciding whether an answer was correct or not, so there was no need for inter-rater reliability testing. For the purpose of the study, the time allowed for both dictionaries was equivalent (30 minutes) and hence the number of kanji retrieved within that time was recorded. Any correct reading of a kanji was acceptable. The subjects were allowed to give up and go on to the next kanji if they could not find it. Errors were recorded in terms of attempts to find a kanji which resulted in failure. Performance under stress could have been measured by asking the subjects to find all kanji within the time limit, but this was felt to be an extreme requirement. Demands on memory could only be measured through a task analysis. Subjective pleasure in using either dictionary was recorded by an e3dt questionnaire and an interview to elicit further information on the subjects' subjective preferences about the dictionaries.
Independent Variables
Nelson’s dictionary was chosen as a representative print based dictionary, primarily because of its widespread use. The electronic Kanji Finder dictionary was developed according to the goal objectives.

Control Variables
Task and Human were selected as the control variables. The task given to students was to find the reading of as many kanji as possible within a 30-minute time period. The subjects were presented with a list containing only kanji’s. The two lists were generated by a random character generator program which assigned a random kanji character to either group A or group B such that there was no overlap between the characters in both groups.

Subjects
User types were selected on the basis of

1) their Japanese ability
2) their previous computer experience
3) their previous usage of Nelson’s dictionary

The subjects were students of the Japanese government’s language learning program. The students enter the normal graduate university course after six months intensive Japanese training in the classroom. Therefore all of the students have a high degree of motivation to learn Japanese. Prior to entering the course the students were divided into three ability groups. A sample of students from each group was chosen.

Experienced computer users (programming experience in any language) were rejected from the sample, and likewise students who had any previous experience using Nelson’s dictionary were also rejected.

Method
A brief training session was given for both sets of groups. An example from the question sheet was chosen at random by the student and the experimenter went through the procedure of finding one kanji using the dictionary as an example. Once the student felt at ease using the dictionary, the experiment was started and the students were left on their own for 30 minutes. Nelson’s dictionary was presented in paper form, and Kanji Finder was presented in electronic form. Upon completion of the exercise, an exit questionnaire was completed by the subjects’.
For the purpose of the experiment, all interactions with the Kanji Finder were automatically recorded using a screen recorder. These interactions could then be played back to gain further information which was used for analyzing sources of errors, and timings of selections.

<table>
<thead>
<tr>
<th>Results</th>
<th>Total found</th>
<th>Tried</th>
<th>Failed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nelson's Dictionary</td>
<td>78</td>
<td>181</td>
<td>103</td>
</tr>
<tr>
<td>Kanji Finder</td>
<td>153</td>
<td>170</td>
<td>17</td>
</tr>
</tbody>
</table>

As can be seen from the summary of results above, the total number of kanji found doubled, while the number of kanji tried remained about the same. However, the number of attempts which failed show the most striking improvement. The implications of this are extensive for students of Japanese. There is strong evidence to suggest that motivation is closely linked to confidence and satisfaction (M. Hannafin, 1989). Confidence increases when students believe that success is possible. One of the main reasons students fail to master kanji, or even fail to attempt to learn kanji is because they do not believe that success is possible. Until now, the computer tools for learning kanji were not available. This study has demonstrated that a high degree of success of finding kanji is possible, independently of teachers or native speakers. Learning is also closely linked to motivation. The hypothesis laid claim to enhanced learning by using the Kanji Finder program. This can only be indirectly substantiated by the results of the experiment, and can be further substantiated by long term use of the program.

**Subjective Preferences**
Students overwhelmingly preferred the electronic dictionary, shown by their desire to carry on using the dictionary even after the 30-minute experiment had finished. The exit questionnaire also reflected the same preference. This may have been due to the novelty of the electronic dictionary (well known as the Hawthorn effect), so long-term testing is necessary.

The students expressed a subjective preference for the layout given on the screen, with comments relating to the ease of finding an element. The layout in the dictionary presenting all 214 radicals was not preferred by the subjects.
Selections
The students nearly always chose one element per character when using the computer. The time taken to find the correct element was analyzed with results clearly indicating that it was easy for the students to locate an element on the screen (M=25.3 secs/element, SD=16.7 secs/element).

Limitations and Extensions
Quality of information and System integration
Kanji Finder is part of a larger project involving a multi-media dictionary for students of Japanese. A dictionary front end which allows users to move through the boundaries of one stack to another is being considered, thereby linking independently produced dictionaries together. At the moment, Kanji Finder has just individual kanji in its database, giving students pointers to entries which were not available before. Once a retrieval has been made, the results show a number of possible readings. How can the student choose which one of these possible readings is the correct one? For example "toki" has two possible readings, "toki" and "ji." By linking the Kanji Finder with pointers into e3disting electronic dictionaries, it becomes possible to gain further information such as stroke order, compounds, usage, grammar, related words, and synonyms. The rationale for this is to allow students to go from a state of no information to one of complete information. The first step toward this goal was the implementation of Kanji Finder. Work is currently underway to integrate Kanji Finder with any dictionary, and to provide a general front end for other dictionaries.

Speed of retrieval
By analyzing the interactions, it became clear that Kanji Finder was too slow. HyperTalk, the programming language for HyperCard, is quite slow. After 63 seconds (average), subjects became restless and impatient, demonstrated by the aimless meandering of the mouse pointer across the screen during search time. Progress is being made to increase the programs output speed by rewriting some of the code into another language.

Miscellaneous Extensions
1) Sound may be added quite easily, and played back upon request by the user. The present implementation does not contain sound because of the required disk space.

2) Future goals do include a method for retrieving words which have a similar pronunciation, and we are now in the process of designing such an extension.
3) Selecting elements by direct handwritten input rather than the indirect method of selection is now in the prototype stage. The basic idea is still the same, but instead of selecting an element from a table, the user will be able to use a mouse or some other pen type device to make a selection.

**Further research**
This research will be expanded to see the resultant effects on learning, over a long-term period, rather than just the brief test session conducted in the experiment.

**Conclusion**
By recourse to well-developed performance models (symbolic and experimental), this research has demonstrated that a tool for finding kanji, based on sound human factor and pedagogical needs of students is a prerequisite for enhancing the learning environment. Tools of this nature serve to increase the awareness of the need for human factor based educational tools for learning kanji. The Kanji Finder program, as a model for kanji retrieval dictionaries, demonstrates that a well-designed dictionary, which serves the needs of students based on a task analysis, is successful.
## APPENDIX A

LIST OF KANJI PRESENTED TO SUBJECTS

<table>
<thead>
<tr>
<th>古:</th>
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<tr>
<td>黄:</td>
<td>陸:</td>
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APPENDIX B
EXIT QUESTIONNAIRE

Please mark an appropriate answer

1) The computer dictionary was worse than the paper dictionary

   Strongly agree 1 2 3 4 5 Strongly disagree

2) The paper dictionary was easier to use than the computer dictionary

   Strongly agree 1 2 3 4 5 Strongly disagree

3) The paper dictionary was faster to use than the electronic dictionary

   Strongly agree 1 2 3 4 5 Strongly disagree
4) Given a choice of either one, I would always use the paper dictionary
   Strongly agree 1 2 3 4 5 Strongly disagree
5) The electronic dictionary was confusing
   Strongly agree 1 2 3 4 5 Strongly disagree
6) The paper dictionary was confusing
   Strongly agree 1 2 3 4 5 Strongly disagree
7) There are no advantages in using the electronic dictionary
   Strongly agree 1 2 3 4 5 Strongly disagree
8) I enjoyed using the paper dictionary
   Strongly agree 1 2 3 4 5 Strongly disagree
9) I enjoyed using the electronic dictionary
   Strongly agree 1 2 3 4 5 Strongly disagree
10) The computer dictionary was too slow
   Strongly agree 1 2 3 4 5 Strongly disagree

Comments

Any comments you may have concerning either dictionary will be greatly appreciated.

Thank you for taking part in this research.
APPENDIX C
STROKE COUNT SURVEY

A survey presented to 20 students and 30 native Japanese showed that of the 13 "Kyouiku" kanji presented, students managed to give the correct stroke count 5% of the time, while native Japanese gave the correct stroke count 70% of the time. The mean error rate for Japanese was found to be + 1.7 strokes, whereas students' mean error rate was 1 5.3 strokes. These results indicate that the concept of "stroke count" is a very dubious key for locating kanji or radicals.

REFERENCES


NOTES

1 Known as 'the reading' of the character.
2 See previous section on Nelson's dictionary.
3 See Appendix A.
4 See Appendix B.
5 Touyou kanji are the basic 881 kanji which Japanese children must learn by the time they graduate from junior high school.

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