

Structural Approaches and Strategies  
to Identify and Remember Japanese Kanji

André Plante

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In

The Department

Of

Educational Technology

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## **ABSTRACT**

### **Structural Approaches and Strategies to Identify and Remember Japanese Kanji**

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Concordia University, 2007

Learning kanji seems to be the main difficulty for students of the Japanese language. Traditionally, kanji are identified and classified by their number of brush strokes, relationship to a root character or individual pronunciation. These classification methods are currently used in most reference documents. It soon becomes apparent that in order to consult a dictionary, students must have prior knowledge of the Japanese writing system. My hypothesis is that utilization of a search and retrieval method that is based on detailed description of the structure of Kanji may lead to improved recall of the Kanji under study. Such a method should promote better organized and more elaborated knowledge of the characters, based on underlying visual structure. A new on-line tool based on these visual and structural approaches was developed and compared with a traditional paper dictionary in a study involving 21 volunteers. Significant results in favour of the new search method were found.

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## **CHAPTER 1 - INTRODUCTION**

### **The Worldwide Popularity of Japanese Mass Culture**

During his address on the US-Japan Relationship delivered at Yale University a few years ago, Ambassador Hiroyasu Ando (2004) remarked that "despite our well known economic problems of the past decade, Japan's cultural influence has grown, more and more, when it comes to Japan, today's young people picture edgy, "cool" culture - things like fashion, design, animation, video games, films, and baseball. Some refer to this effect as "Japan's Gross National Cool".

It is becoming evident that around the world, knowledge of Japanese culture is seen as something desirable and that its influence is, more than ever, being felt in what we see, hear, wear, or eat.

### **Japan Foundation Survey**

Between July 2003 and March 2004, the Japan Foundation (2004), an organization established in 1972 to promote cultural exchange and Japanese language education, conducted its seventh survey on overseas educational institutions offering instruction in the Japanese Language. The survey showed that, as of 2003,

Japanese was being taught in 120 countries and seven regions outside of Japan, in more than 12,000 educational institutions, by over 33,000 teachers. The number of Japanese language learners was estimated to be nearing 2.4 million. This compares to less than a million students in 1990, and to less than 130,000 in 1979 when the Japan Foundation first began this survey.

According to the 2003-4 survey, 197 Canadian educational institutions were offering Japanese language instruction, classes were taught by 564 teachers, and students numbered 20,457. For more details, please see Table 1.1 below:

*Table 1.1 • Canadian Educational Institutions Offering Japanese Language Courses in 2004*

Academic									Non-Academic			Grand Total		
Primary & Secondary			Higher Education			Subtotal								
I	T	S	I	T	S	I	T	S	I	T	S	I	T	S
103	180	9471	39	101	7092	142	281	16563	55	283	3894	197	564	20457

*I= Institutions, T= Teachers & S= Students*

This global thirst for learning the Japanese language results in a greater need for tools and learning materials adapted to foreign learners. The following pages chronicle the development, implementation and evaluation of such a new tool, an online application designed to facilitate the process by which Japanese characters (kanji) can be found in a dictionary.

## **Weber's List of Most Influential Languages**

After looking at extensive census data from around the world, George Weber (1997) created a list of the world's most influential languages. Weber considered six factors in developing this list:

- a. Number of native or home speakers
- b. Number of secondary speakers
- c. Number and population of countries using the language
- d. Number of major fields using the language internationally
- e. Economic power of countries where used
- f. Socio-literary prestige

Overall, Weber ranked Japanese as the eighth most influential language. This ranking seems to be in agreement with the worldwide growth in the popularity of Japanese mass culture and the growing attractiveness of cultural experiences such as home-stays or the Japan Exchange and Teaching Program (JET).

## **Language Learning Among University Students**

In 2005, the author administered a short survey (see appendix A) in order to probe language learning issues faced by university students. I chose to present the findings early in this dissertation as the data gathered illustrates the diversity of today's classroom and students' interest in learning new languages.

The respondents were students in a joint program between the Sheridan College Institute of Technology and Advanced Learning and the University of Toronto at Mississauga. The program, Communication, Culture and Information Technology (CCIT), introduces students to the theoretical, practical and technological issues in communication and their impact on culture.

Volunteers participated in the survey before the start of a guest lecture delivered to students of "CCT 200 - Intercultural Communication". This class met weekly in a large lecture hall at Sheridan College in Oakville, Ontario, just west of Toronto.

A total of 131 surveys were received, four were discarded due to largely incomplete sections of the questionnaire, leaving us with 127 adequately completed surveys.

The respondents were 54% female and 46% male. 61% were between the age of 20 and 24 while an additional 35% were between 15 and 19 (most likely 18 or 19-year olds because they are in their second year of university). A very small number of respondents were between the ages of 30 and 34.

The large majority (70%) declared having been raised in one language while 27% were brought up in a bilingual environment. A few more indicated that they were raised in a multilingual (three or

more languages) environment. Of those raised in only one language, 42 out of 89 respondents (or 47%) were educated in English; 17 (or 19%) in Chinese (five in Cantonese; eight in Mandarin; two in Taiwanese Chinese and two did not specify); six in Urdu; five in Polish; four in Korean, The remaining were raised in Arabic, Ethiopian, French, Italian, Serbian, Swahili or Tamil.

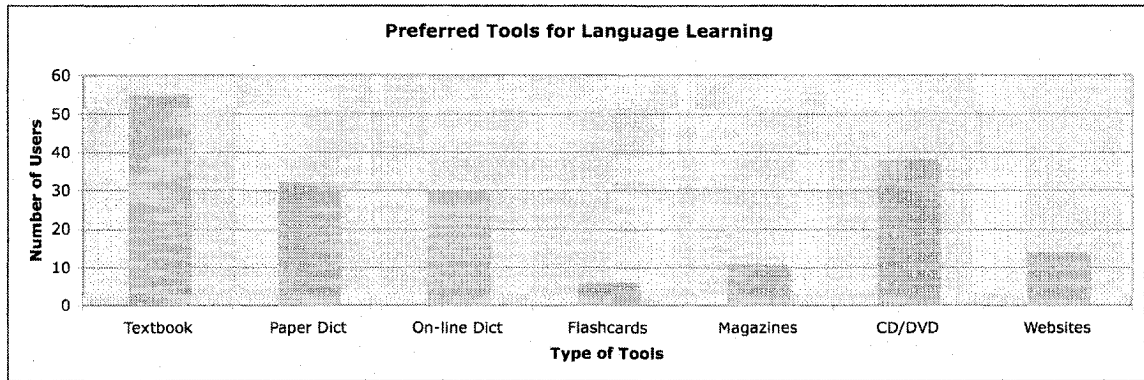
In this classroom, respondents as a group could have carried on a conversation in over 30 different languages. Although 70% were raised monolingual, by the time of the survey, only 27% remained that way (all English speakers in this case, since fluency in English is needed to enter this university program). Roughly three out of four respondents answered that they could now carry on a conversation in two or more languages.

Not surprisingly, about the same proportion, 73% or 93 out of 127, answered that they enjoyed learning new languages. Most respondents, 62 out of those 93, enjoyed learning new languages for travelling and/or in the event that they work abroad.

Of the same 93 respondents, 38% said that they were currently studying French or considering studying it; 35% were learning or considering Spanish. Interest in Japanese was at 19%

followed by Chinese at 9%. (Respondents could select more than one answer)

Figure 1.1 • Preferred Tools for Language Learning



Again, of those 93 respondents, 55 used textbooks as one of their learning tools, 38 used CD/DVDs, 32 used paper dictionaries and 30 used online dictionaries. A few respondents also mentioned using small portable electronic dictionaries, free online translation services and conversation with native speakers as a way to improve their language skills. (Respondents could select more than one answer.)

Of the total 127 respondents, 92 or 72% responded that they were curious about the meaning of Chinese/Japanese characters. The majority of these respondents (64%) declared not knowing any Chinese/Japanese characters, an additional 20% knowing very few (1 to 100 characters) while, at the other end of the



spectrum, 15% declared knowing the meaning of 1001 or more characters.

We could conclude from this survey that interest in language learning is high amongst these university students and that they use a wide selection of support tools, especially textbooks, dictionaries (both traditional and on-line) and CD/DVD technologies. They are motivated by travel and the possibility of work abroad. After French and Spanish, there is a marked interest in learning Japanese and Chinese and an even bigger curiosity about understanding the meaning of Chinese/Japanese characters.

### **Japanese Language Learning**

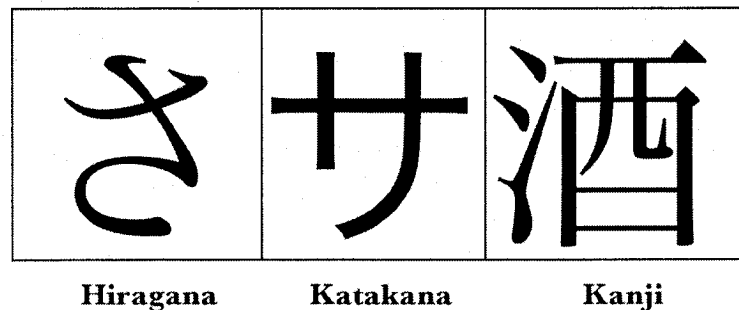
The US Defense Language Institute of Foreign Language Center (2003) categorized languages from level I (easiest) to level IV (hardest), based on the difficulty native speakers of American English may have in learning a foreign language. Japanese is considered a category IV Language. The National Virtual Translation Center (2005) estimates that this translates to roughly 2200 class hours to attain professional fluency compared to a category I language, such as Italian which would only require 600 hours to reach an equivalent fluency level.

Learning a language ideally encompasses a number of activities and it is often the integration of these activities that makes for an overall beneficial experience. Although the author believes in the benefits of a holistic approach to learning, it should be noted that the research presented in the following pages will concentrate mostly on the reading and memory skills required by a beginner to acquire her first few hundred Japanese characters.

### **The Japanese Writing System**

*Figure 1.2 • The Japanese Writing System is a Blend of Three Script Types*

---



It is important to understand that the Japanese writing system is a blend of three traditional script types: hiragana, katakana and kanji (see Figure 1.2) and also, more and more commonly, the Roman alphabet.

Table 1.2 • Basic Japanese Syllabary written in Romaji, Hiragana and Katakana

a あ ア	ka か カ	sa さ サ	ta た タ	na な ナ	ha は ハ	ma ま マ	ya や ヤ	ra ら ラ	wa わ ワ	n ん ン
i い イ	ki き キ	shi し シ	chi ち チ	ni に ニ	hi ひ ヒ	mi み ミ		ri り リ		
u う ウ	ku く ク	su す ス	tsu つ ツ	nu ぬ ヌ	fu ふ フ	mu む ム	yu ゆ ユ	ru る ル		
e え エ	ke け ケ	se せ セ	te て テ	ne ね ネ	he へ ヘ	me め メ		re れ レ		
o お オ	ko こ コ	so そ ソ	to と ト	no の ノ	ho ほ ホ	mo も モ	yo よ ヨ	ro ろ ロ		o を ヲ

Hiragana and katakana (see Table 1.2) are syllabic systems that employ symbols for syllables (Kess & Miyamoto, 1999) and are referred to collectively as kana. They each consist of a relatively small number of characters, approximately 50, plus a few simple variants that are mutually exclusive with regards to their shape and individual pronunciation. Hiragana characters are used to spell out native Japanese words and suffixes while the katakana script is used mostly for neologisms and foreign words. Graphically speaking, kana are greatly simplified Chinese characters drawn with just a few simple brush strokes and therefore do not generally present a major difficulty for the learner.

Kanji characters are of Chinese origin and number over 6000 in the Japanese writing system. Kanji employ symbols for words and therefore are a logographic system (Kess & Miyamoto, 1999). Of those symbols, between 1000 and 3000 are needed to read newspapers or more formal publications.

Historically, a large number of Chinese characters came to be used as direct textual translation of Japanese words and still share the same meaning; other Chinese characters simply approximated the pronunciation of Japanese words and were integrated into the Japanese writing system without sharing the same meaning as their Chinese counterparts.

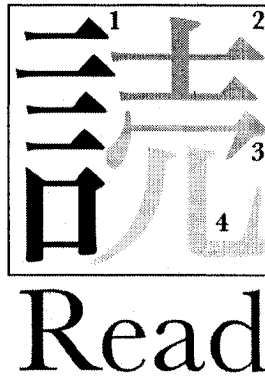
## CHAPTER 2 - LITERATURE REVIEW

### The Challenge of Learning Kanji

According to de Courcy and Birch (1993) "Learning kanji seems to be the major problem for students developing literacy in Japanese." Komori and Zimmerman (2001) also acknowledged this challenge: "For learners of Japanese, one of the major stumbling blocks in their development of reading proficiency is acquiring a vast knowledge of kanji." This concern is also shared by a number of other authors such as Slaven Bilac, Timothy Baldwin and Hozumi Tanaka (Bilac *et al.* 2002; Gamage, 2003; Shimizu & Green, 2002 and Kubota, 2003).

Learning kanji presents a complex challenge (Bilac *et al.* 2002). The large number of kanji is a challenge in itself, but the fact that the foreign learner is being confronted with complex and unfamiliar organic shapes further complicates the matter. Most kanji have a very high spatial frequency (comprise a large number of brush strokes) and are made up of several segments called graphemes (see Figure 2.1). In comparison, the Roman alphabet characters are more geometrical and simpler graphically.

Figure 2.1 • Graphemes in Kanji for the Word "Read"



Yaeko S. Habein (2000), in her book *Decoding Kanji*, writes that approximately 2300 different kanji are used in ordinary newspaper and magazines but not all of these are used with the same frequency. Studying kanji means learning each character's form, meaning and readings (as each kanji has more than one reading or pronunciation).

### **The Teaching of Kanji to Japanese Children**

Kanji are taught to Japanese children through calligraphy and the rote learning of 214 traditional radicals or root characters. The combination of a radical and other graphemes form the basis of every kanji. It usually takes 6 years in the Japanese Educational System (grade 1 to 6) to acquire the first 1006 kanji characters also known as Kyoiku kanji or Educational kanji set (Henshall, 1988). This is then followed by an additional 939 characters, which completes the Joyo kanji set of 1945 official characters determined

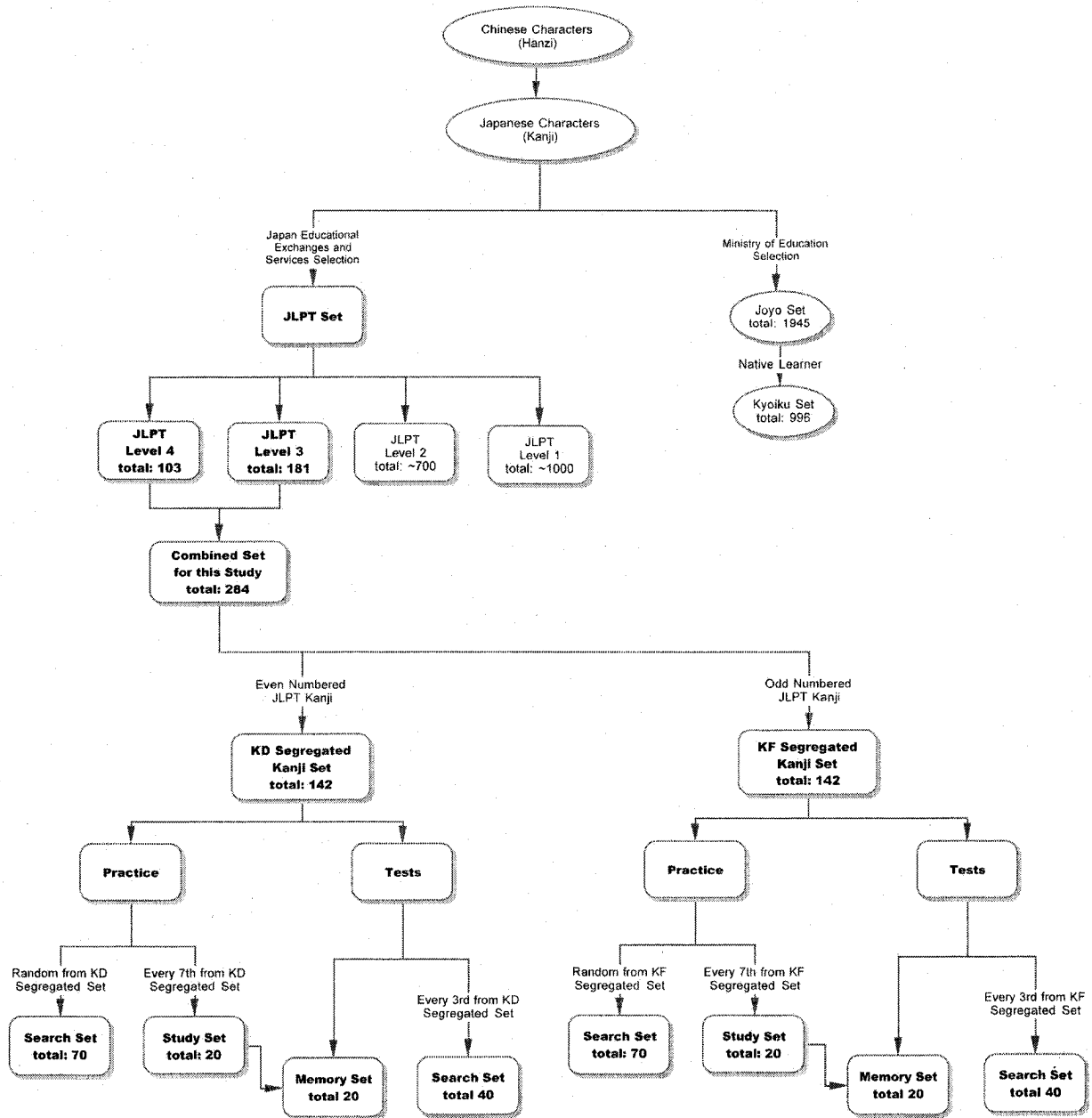
by the Japanese Ministry of Education. This extremely lengthy process is not, in most cases, well suited for foreign learners.

### **The teaching of Japanese to Foreigners**

The Japanese Language Proficiency Test (JLPT) is a standardized evaluation tool designed and administered yearly by the Japan Educational Exchanges and Services (JEES). It evaluates the Japanese language ability of non-native students. It divides the most frequently used 2000 kanji into four levels from easiest to hardest. JLPT Level 4 (the easiest) consists of 103 kanji characters, and JLPT Level 3 adds another 181 characters to the required kanji list. These two JLPT levels are fairly similar in their composition to the first three grades of the Kyoiku kanji set. Graphically simpler characters (easier to draw) tend to be presented earlier in the Kyoiku kanji set so that they are learned first, whereas the JLPT kanji is ordered more in terms of how relevant the characters are to adult learners.

My research will focus on the 284 kanji group formed by combining JLPT Levels 4 and 3. Please see Figure 2.2 for a visual flowchart explaining how the characters were chosen for the various components of this study.

Figure 2.2 • Kanji Selection for this Study





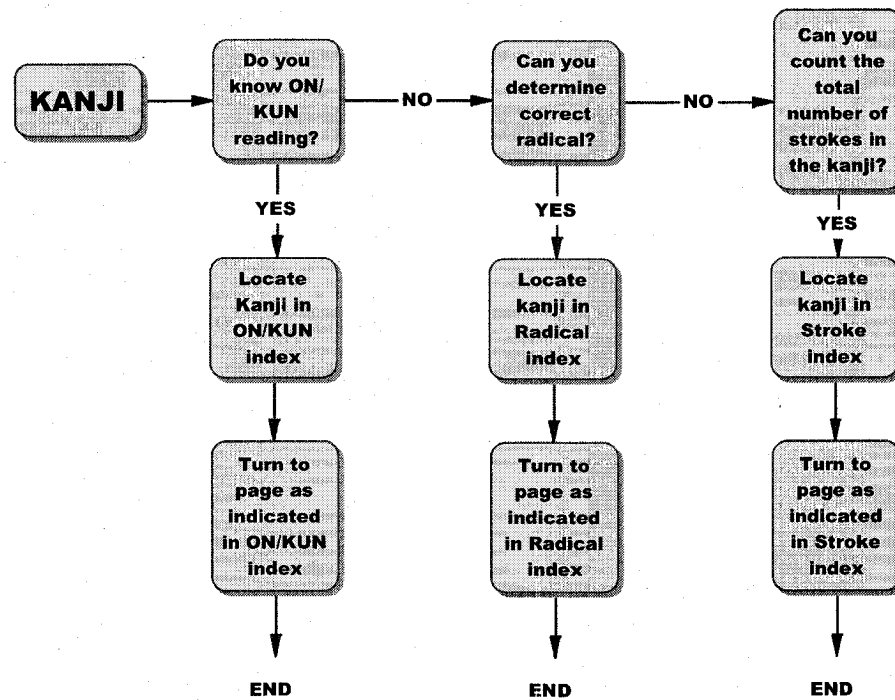
Kanji groupings such as those found in the language proficiency exam for entrance into Japanese Universities (Nihongo Ryuugaku Shiken) and the more business-oriented JETRO (Japan External Trade Organization) vocabulary lists could also be used as sets for the database, depending on the users targeted.

### **Current Kanji Dictionary Search Strategies**

When comparing kanji to orthographic systems – which employ symbols for individual phonemes (Kess & Miyamoto, 1999), such as English, German, French, Spanish etc. – more effort and additional steps are required for locating a word in a dictionary (Komori & Zimmerman, 2001).

Traditionally, kanji are classified and ordered using a limited number of methods. These classification methods are currently used in most dictionaries, phonebooks and indices. The flowchart depicted in Figure 2.3, adapted from a popular dictionary, the *Kodansha's Pocket Kanji Guide* (1994), now renamed *Kodansha's Elementary Kanji Dictionary*, illustrates this process.

Figure 2.3 • Kanji Dictionary: Traditional Search Methods



The first classification method is based on the various kanji pronunciations, also known as on/kun readings. Basically, kanji are clustered with others sharing the same first syllable and ordered following the same structure as the Japanese kana syllabary (see Table 1.2).

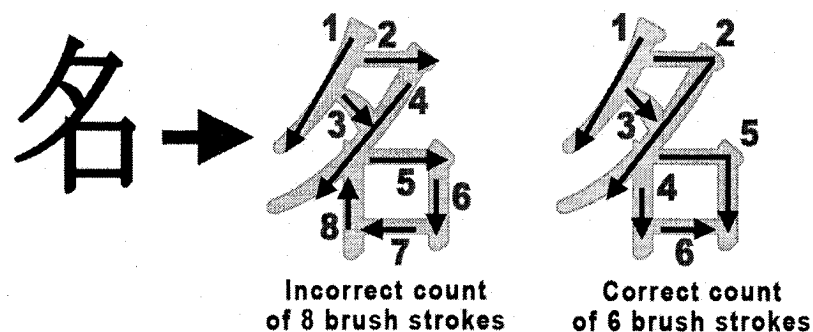
The next method identifies and classifies characters according to their etymological relationship to a group of root characters called radicals (see Table 2.1). This radical, or a simplified variant, appears within each related kanji as one of the principal graphemes.

Table 2.1 • Radicals

Radicals	Related Kanji			
口	名	古	可	品
刀	切	分	初	券

Finally, when all else fails, the total number of brush strokes required to draw a kanji is used as a basis to create a stroke count index. To be accurate, this method requires an intimate knowledge of calligraphy as certain strokes can often be quite complex graphically and therefore lead to inaccurate final count for a beginner learner. For an example of a stroke that could be easily misconstrued as being made up of two, please look at stroke #2 in Figure 2.4.

Figure 2.4 • Counting Brush Strokes



It soon becomes apparent that an individual wanting to consult a Japanese dictionary must have prior knowledge or skills in

calligraphy, identifying radicals or familiarity with the correct pronunciation of kanji. As a consequence, dictionary searches are very challenging for non-native beginner learners lacking these skills.

As early as 1937, Arthur Rose-Innes published the *Beginners' Dictionary of Chinese-Japanese Characters* in an effort to create a simpler Japanese-English Dictionary (Breen, 1993). A later effort by Andrew Nelson in 1962 was met with a lot of enthusiasm and his book soon became a classic. Nelson retained the use of the radicals while creating some new practical rules for determining which radical a character would be listed under. He also listed many characters under their correct radicals, as well as their "incorrect" ones (easily or often mistaken). John Haig, in *The New Nelson Japanese-English Character Dictionary* (Haig & Nelson, 1997), replaced Nelson's look-up system with the Universal Radical Index: In Haig's method, a character can be found under any known radical or graphemes within it.

Father Joseph R. De Roo (1980), with his two-corner technique and Jack Halpern (1990), with his SKIP method (System of Kanji Indexing by Pattern), have also dealt with this access problem and have designed hybrid kanji look-up systems based on the shape of the character or its components. Unfortunately

Halpern's method still relies partly on the ability of the user to count kanji strokes, which, as stated earlier, depends on knowledge of calligraphy. These two men and their methods have been most influential in my research for a structural approach to finding kanji. I had the opportunity to correspond with Father De Roo about my work in the late nineties up till his death in 2001 at the age of 69, which was a great loss to our field of research.

Bilac, Baldwin and Tanaka (2002) have also identified this problem and elected to pursue a solution based on the On/Kun readings as well as the use of kana as an interface to query an electronic dictionary. This method requires that the user be able to approximate a kanji reading and translate it syllable by syllable in kana script in order to look up the unknown character in an electronic dictionary. Again, this method relies on a fair knowledge of the Japanese language and extensive knowledge of radicals and their readings and is therefore definitely not suited for beginners.

Using a multi-radical method, Jim Breen has created an extensive online kanji dictionary. Its interface (see Figure 4.10) is simple and forgiving but still requires, to a certain degree, knowledge of radicals and graphemes (Breen, 1993). This interface will be discussed later on in relation to a short survey conducted to compare Breen's application to the software developed for this study.

Laurence Matthews (2004) has recently published an interesting study aid that is designed to help “serious learners of Japanese” find Joyo kanji from their appearance alone. In the same manner as in Halpern’s SKIP method, the kanji are divided into groups by pattern but are also further organized into 64 sub-categories that should make them easier to find.

Unfortunately, in its current printed version, this study aid requires a great amount of manual labour by the reader in order to create the book’s tabbing system. Each page has to be cut by hand and without this considerable effort the book is not truly functional. This is most certainly due to the prohibitive cost of die-cutting individual page tabs and such a complex production step probably did not make economical sense to the publisher.

### **Research into New Approaches**

Although the various approaches mentioned above improve the likelihood of locating a character in a dictionary, they all still require a considerable amount of prior knowledge of the Japanese writing system.

In a study by Matsunaga and Crosby (1997), in which non-native speakers were asked to write kanji characters, the most frequent errors involved the mismatching of segments or graphemes.

This might indicate the importance of teaching the spatial arrangement of kanji segments, at least at the beginner level.

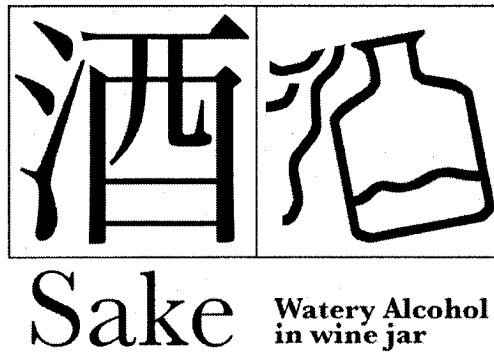
There is also evidence that non-native learners who had prior writing demonstrations by calligraphers have a better understanding of the structure of kanji (Matsubara et al. 1993). During such a demonstration, the learner can see each individual part of a kanji being drawn in isolation, often emphasized by the pauses made by the calligrapher during the actual process of drawing each grapheme of the character.

In a series of preliminary eye-tracking experiments (Matsubara, 1993) in which the fixation distributions (exactly where the eye fixate on a kanji) of various beginner and intermediate non-Japanese kanji learners were recorded, only the beginner learners who had received initial training about kanji structure displayed similar fixation distributions as the intermediate learners.

Matsubara concluded that having kanji structure instruction should be an important part of kanji learning and that in fact, if introduced early in the process, may expedite learning. It thus seems that the knowledge of the inherent structure and layout of a character's components may help simplify kanji learning for the beginner learner.

Figure 2.5 • Henshall Kanji Textual Mnemonic and a Graphical Mnemonic by the Author

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Once found in a dictionary, the kanji and its meaning must be committed to memory. Traditional methods include writing down the new character repeatedly or using flashcards as an aid to instruction.

### **Mnemonic Devices**

Some visual and textual mnemonic materials (see Figures 2.5 and 4.17) have also been developed and popularized by Henshall in *A Guide to Remembering Japanese Characters* (1988), Rowley in his book *Kanji Pict-o-Graphix* (1992) and Kusuya in her book series *Kanji Starter* (2001). These pictographs are often based on the historical development of kanji but can as well be new artistic creations that help to understand the meanings, rather than how the characters have evolved from the past.



## **CHAPTER 3 – CONCEPTS BEHIND THIS PROJECT**

The difficulty for beginner learners in identifying, finding in a dictionary, and later memorizing a character are the basic issues I will be exploring in this dissertation. The solutions I will be pursuing will not require prior knowledge of the Japanese Language System but instead will be based on simple structural and graphical rules, which will hopefully assist the learner in understanding the structure of kanji. The methods tested will take into account that the learner may not know how to count calligraphic brush strokes, may not know the pronunciation or is unable to identify the radical character related to the kanji being studied.

### **Hypothesis**

My general over-arching hypothesis is that utilization of a search and retrieval method that is based on detailed description of the structure of Kanji may lead to improved recall of the Kanji under study.

Such a method should promote better organized and more elaborated knowledge of the characters, based on underlying visual structure.

More specifically, participants in the study will:

- find more kanji in a given amount of time using the proposed structural search and retrieval method than with a traditional paper dictionary.
- find kanji with greater accuracy using the proposed structural search and retrieval method than with a traditional paper dictionary.
- recall more kanji that they learned using the proposed structural search and retrieval method than with a traditional paper dictionary.
- recall for longer kanji that they learned using the proposed structural search and retrieval method than with a traditional paper dictionary.
- perceive it is easier finding kanji using the proposed structural search and retrieval method than with a traditional paper dictionary.
- perceive it is easier to learn how to find kanji using the proposed structural search and retrieval method than with a traditional paper dictionary.
- judge it more enjoyable finding kanji using the proposed structural search and retrieval method than with a traditional paper dictionary.

### **Why Not Use Character Recognition to Solve This problem?**

It may appear that writing a character with a stylus onto a touch-sensitive screen might be an easy solution to this problem; however, this poses many challenges, both from the technical and human perspectives.

As stated earlier, kanji are more complex graphically than the Roman alphabet. From a human perspective, it makes it difficult for a beginner to reliably transcribe the character by hand-drawing it to a device. Technically, Intelligent Character Recognition (ICR) software not only looks at shapes but also at the stroke order as some of the clues to identify which kanji is currently being written. Drawing kanji with the correct stroke order is a skill that very few, if any, non-native beginners possess.

Realistically, the technology still struggles with low recognition rate and requires the use of dedicated hardware and software. With my background in Visual Arts and Graphic Design, I consider myself to have strong graphic skills (observation, rendering, etc.) and my personal experience with character recognition has not been overly positive. If my most recent experience with the Canon V80 Electronic Dictionary (see Figure 3.4) might serve as an example, the recognition software seems to analyse the stroke order as well as the rhythm (speed and pauses between strokes) which makes it nearly impossible for beginner and perhaps even intermediate learners to use this as an entry method.

### **Using a Scaffolding Approach**

The concept of the zone of proximal development postulated by Vygotsky (1978) refers to activities that can happen at

any point in a learner's development. Some are within the learner's competence, others can be accomplished with guidance, and others lie outside the learner's scope.

Vygotsky wrote about constructing a “scaffold” around the learning activity so that learners have direct access to the chosen focus. The use of scaffolding techniques works especially well when teaching a specific aspect of basic skills. He believes scaffolding enables learners to reach beyond their current competencies and explore new understandings and skills. It is within this concept of “scaffolding” that I will look at solutions for the challenge at hand.

As mentioned earlier, this research will concentrate on methods that will help non-native beginner learners and put an emphasis on the kanji needed in order to pass level 4 and level 3 (the two easiest levels) of the Japanese Language Proficiency Test.

The process will follow a user-centered approach to developing and evaluating the various methods that the author intends to implement as components of an interface to a kanji electronic dictionary.

The concepts listed below were collected from the various literature (or, in the case of “stroke intersections”, conceived by the author) and by looking at the problem from a purely visual/structural

point of view. I explored these concepts through the development of prototypes and the most successful ideas were included in the final design:

### **I- Simple Geometry of Graphemes (Lines, Squares, etc.)**

Kanji are made up of several graphemes, some of which have simple geometric forms. A kanji may have mostly vertical lines, mostly horizontal lines or be a combination of diagonal, horizontal and/or vertical lines. These lines may interact and create enclosures like squares, rectangles or other polygons.

In this particular case, a little knowledge of geometry would be used as a scaffolding approach and enable the creation of a vocabulary that the learner can then use to describe the appearance of Japanese characters.

*Figure 3.1 • Examples of Kanji With Simple Geometric Features*

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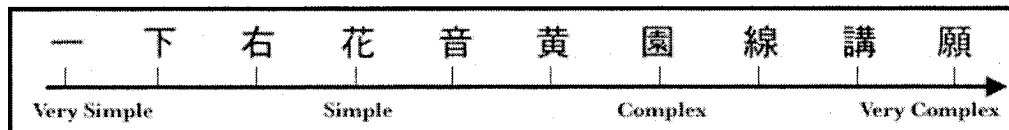
<b>Horizontal lines:</b> 一 二 三 目 重 ...	<b>Vertical lines:</b> 川 山 仲 刊 肌 ...
<b>Squares:</b> 囚 回 石 因 品 ...	<b>Diagonal line(s):</b> 人 今 珍 友 私 ...

---

## II- Level of Complexity (Spatial Frequency) of Kanji Characters

Kanji vary in complexity, and determining the precise number of brush strokes is often a problem for the beginner learner, resulting in an inexact stroke count. A more forgiving descriptive method could possibly be designed using scales, simple language, and examples of what would be considered a simple or complex kanji.

Figure 3.2 • A Scale Representing the Various Degree of Complexity of Kanji Characters

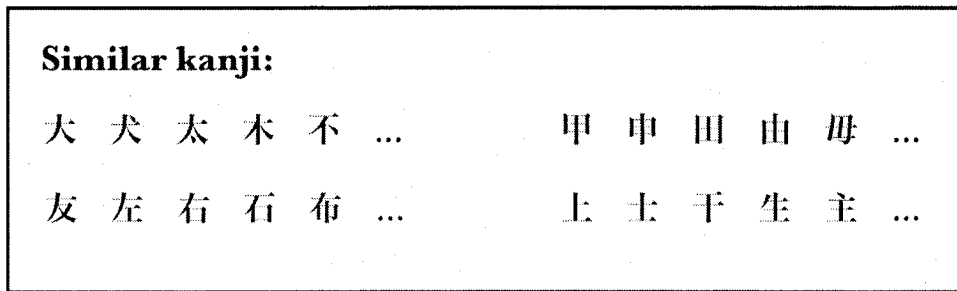


## III- Visual Similarity of Certain Groups of Kanji

One of the most difficult aspects of learning kanji is the fact that many of them look so much alike (Habein, 2000). This is a problem when consulting a traditional reference document but could actually become an advantage in the interface of a computer-assisted learner dictionary.

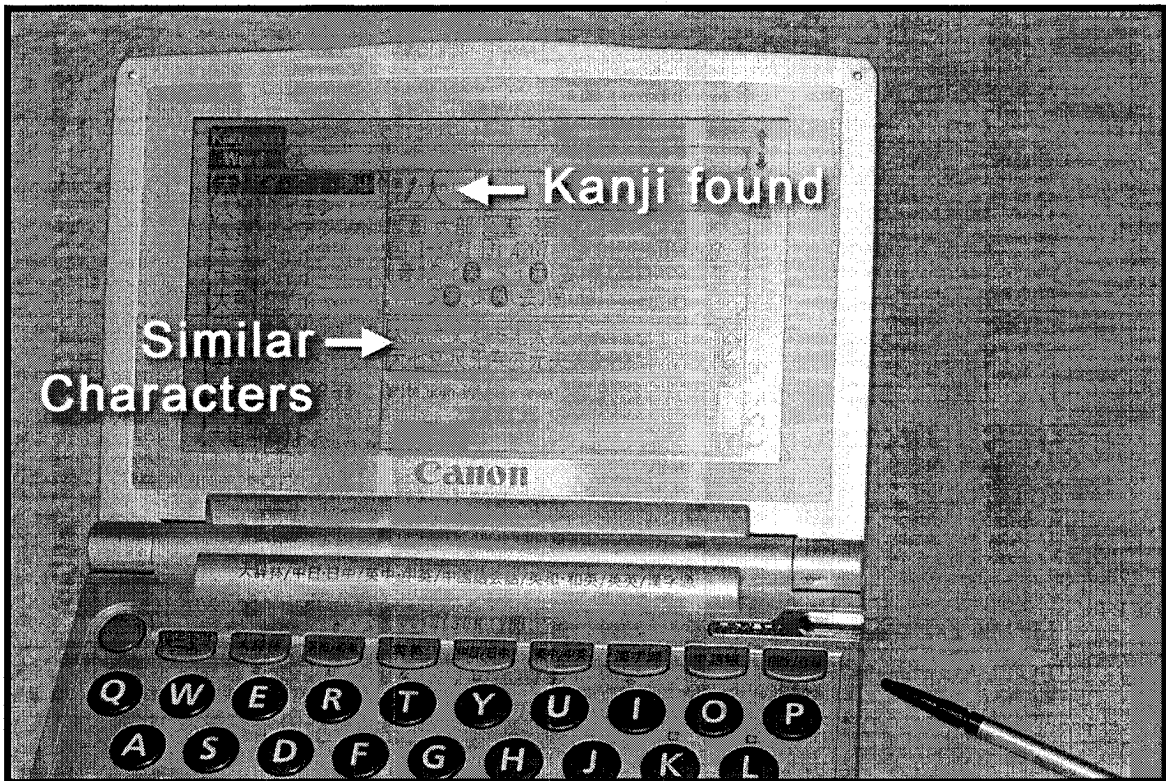
Lists of similar kanji (see figure 3.3) could actually be used as a search method or included as an alternative in a remedial search algorithm. The similarities found between characters could be used to shortlist look-alike kanji and create search menus.

Figure 3.3 • Examples of Kanji With Similar Features.



As of spring 2005, Canon has implemented such a remedial search strategy in the V80 and V90 models (2006) of its popular wordtank series of portable electronic dictionaries (see Figure 3.4).

Figure 3.4 • Canon V80: Similar Kanji Search Interface

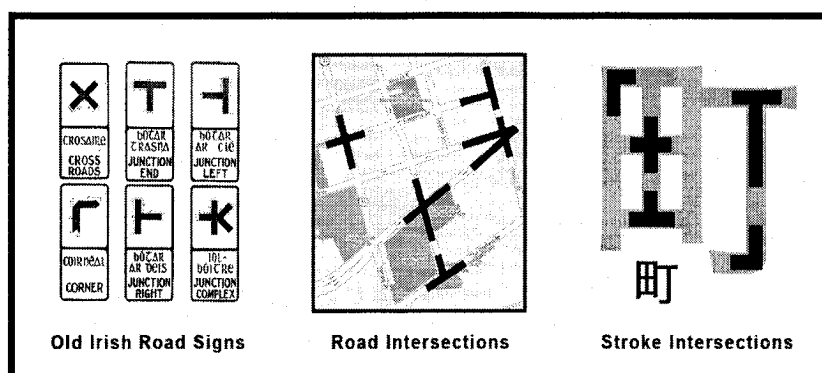


#### IV- Stroke Intersections

This concept came to me from lateral thinking. As Edward De Bono explained in his book “The Use of Lateral Thinking” (1967) and on his current website, using established methods may not always yield a solution. It is following this principle of creativity that I tried to imagine a completely different method to describe kanji.

Since many of the traditional methods concentrate on the individual brush strokes by either counting each one or looking at the order or the direction in which each stroke is painted, I first thought about looking at the possible interactions between strokes. In a kanji, strokes cross, overlap, run parallel and merge into each other. I came to the realisation that there were similarities between these interactions and our real-life road system.

Figure 3.5 • Kanji Stroke Intersections



Taking advantage of this visual metaphor (see Figure 3.5) could possibly yield an interesting interface component. The



vocabulary (intersection, junction, bridge, etc.) and concepts (crossing, merging, etc.) associated with the road system could be used to effectively describe stroke interaction in kanji.

### V- Shape of Kanji (Symmetry, Composition)

Although a kanji as a visual unit always fits in a square envelope (see Figure 3.8), it may be more or less symmetrical; its segments may be side by side or on top of each other. A segment may also surround another one, completely or partially framing it, as seen in Figure 3.6.

Figure 3.6 • Various Shapes and Compositions of Kanji



These internal compositions are well known to calligraphers and some classification methods make use of these patterns together with stroke counts as in the case of the SKIP method (Halpern, 1990). It is probable that the use of an interface that could combine a kanji complexity scale and a selection of shapes would simplify a kanji dictionary search.

## VI- Frequency of Use

The National Language Research Institute in Tokyo has classified the first 2000 kanji by their frequency of usage in modern newspapers (Gakken, 1982). In 1981, the Japanese Ministry of Education, Science, Sports and Culture had also compiled frequency of use statistics and had based its 1945 Joyo Kanji list and curriculum on this ranking (Halpern, 1999).

*Table 3.1 • The First 20 Joyo Kanji Ranked by Their Frequency of Use*

Frequency of Use																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
日	一	十	二	大	三	人	会	国	年	中	本	五	四	出	上	時	同	長	東

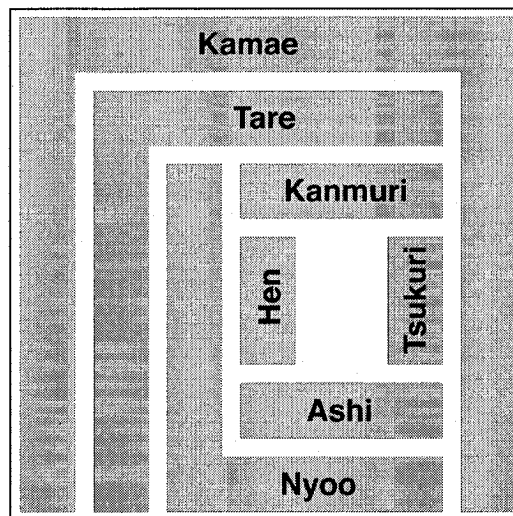
Although not structural in nature, this ranking information (see Table 3.1) might be useful in establishing which kanji

characters to learn first, in ordering results for a computer-based query and/or included in a “smart search” algorithm.

## VII- Equidimensionality

There are also traditional structural elements of kanji characters (see Figure 3.7 for the nomenclature) that could be used to facilitate identification (Kaiho & Nomura 1983). A simple example of this can be seen in the kanji 外 (outside, foreign) in which two graphemes stand side by side, the left portion being called the Hen, the right being the Tsukuri.

Figure 3.7 • Equidimensionality Principle in a Complex Kanji



The principle of equidimensionality is defined by the use of a grapheme shrunk in size to form part of a more complex character. As an example of this principle, the kamae is a structure resembling

a doorframe used either in isolation or as part of another character. The characters 円 (circle, yen) and 猜 (envy, jealousy) are good exemplars of this principle in which 円 is repeated and scaled down at the bottom right of the kanji 猜.

### VIII- Spatial Envelope

A further but subtle difficulty is that, as mentioned earlier, kanji characters always fit within a square envelope (see Figure 3.8) and all characters use the same relative area in a line of text. Furthermore, Japanese words, which sometimes comprise two or more kanji, are not usually separated by spaces and punctuation as their English equivalents are in sentences using roman letters.

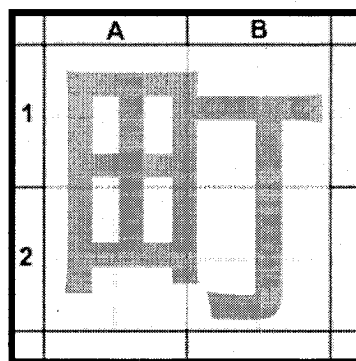
Figure 3.8 • Comparison of Envelope Between Roman Letters and Kanji Characters

PROPORTIONAL FONT	MONOSPACED FONT (Same Width)	KANJI (Same Height & Same Width)
A	A	魚
i	i	大
m	m	男

This could be compared to using a monospaced font in which every letter has identical width to write words of a sentence where spaces and punctuation have been deleted. In other words, the envelope of each kanji character in a given line of text is similar to any other. The reader may not easily know where a word ends and where the next begins. This obviously affects the ease with which Japanese text is read.

If we look at this spatial envelope concept in a more positive light, the idea of grid and quadrants may come to mind. Quadrants could be used to describe where certain features of the character are in relation to others. For example, in the kanji shown in Figure 3.9, one could say that a “T” shape brush stroke begins in quadrant B1 and ends in a right angle bend in quadrant B2.

*Figure 3.9 • Grids and Quadrants*



Interestingly enough, a similar type of grid is used as guidelines printed in the background of kanji calligraphy exercise books used by Japanese elementary students.

In conclusion, it is believed that the concepts discussed in this chapter, independently or collectively, have the potential to simplify the kanji search and identification process for non-native beginner learners.

## **CHAPTER 4 - DEVELOPMENT OF A NEW LEARNING TOOL**

### **From Concepts to Working Software**

An application needed to be developed in order to test these various concepts. This is an iterative process by which a prototype is created, tested and refined several times over the software development cycle. This is how Kanjiform, the prototype application that was designed for this study, first started. It began as a Filemaker Pro database in which a small group of Japanese characters were entered into the record and their attributes described in a purely graphic and structural manner.

### **Early Prototypes**

Filemaker Pro is a moderately easy database application to learn and use. The databases it generates can be accessed via the Internet, although the end-user also needs a personal copy of Filemaker Pro on his or her computer in order to be able to interact with the records. In this regard, while it is a good tool for prototyping due to its simplicity, it would not be ideal for easy dissemination of the final version of Kanjiform. Thus, a parallel search for a completely web-based solution was also initiated early in the design process.

In Filemaker Pro, a record was created for each kanji and information about each character was entered in fields on an input layout. Fields included information available on the character from other sources such as existing dictionaries, various indices and other learning materials. New graphic and structural information generated by studying each kanji was recorded in a series of ever growing fields as a characteristic that is either present or absent from the character under scrutiny (see Figure 4.1). It quickly became apparent that a binary approach to this classification problem was not sufficient. A third option such as “I don’t know”, “not sure” or “uncertain” was needed in order to include characters that were ambiguous or where the graphic characteristic was not clearly obvious and could be overlooked. This resulted in adding a third menu option that ultimately greatly enhanced the search functionality.

Kanjiform, the new structural approach, would require at least two types of interface: a “Search” module and a “Study” module.

### **Search Module**

The “Search” components might feature simple questions such as “Does the kanji contains at least one line that is vertical?”



or “Does the kanji contains any T intersection?” as illustrated in Figure 4.1.

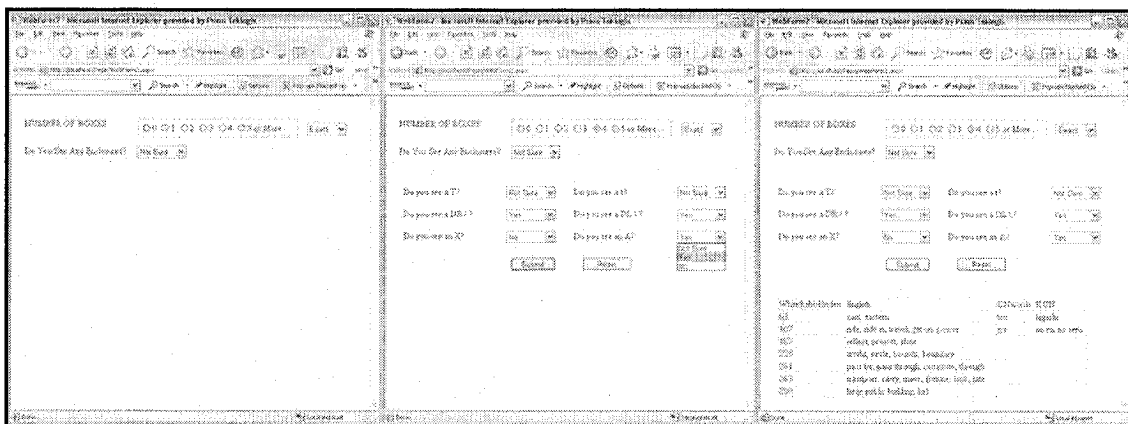
Figure 4.1 • An Early Filemaker Database Prototype of the “Search” Interface

<p><b>Does the Kanji contains at least one line that is...</b></p> <p>Vertical <input checked="" type="radio"/> Yes <input type="radio"/> No</p> <p>Horizontal <input checked="" type="radio"/> Yes <input type="radio"/> No</p> <p>Diagonal from Left to Right <input checked="" type="radio"/> Yes <input type="radio"/> No</p> <p>Diagonal from Right to Left <input checked="" type="radio"/> Yes <input type="radio"/> No</p>	<p><b>Does the Kanji contains any fully enclosed regions?</b></p> <p>How many square or rectangle boxes?</p> <p><input checked="" type="radio"/> 0 <input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 or more</p> <p>Any other type of enclosures <input type="radio"/> Yes <input checked="" type="radio"/> No</p> <p>KanjiPattern is... <input type="text" value="Side by Side"/></p>	<p><b>Does the Kanji contains any intersections?</b></p> <p>T (at least 1 horizontal or 1 vertical line) <input checked="" type="radio"/> Yes <input type="radio"/> No</p> <p>tee <input checked="" type="radio"/> Yes <input type="radio"/> No</p> <p>X (no horizontal or vertical line) <input type="radio"/> Yes <input checked="" type="radio"/> No</p> <p>A <input type="radio"/> Yes <input checked="" type="radio"/> No</p>
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The on-line version of the “Search” interface (see Figure 4.2) would ideally allow an extended use of logic in order to determine which questions would be asked. For example, if a user answers that a particular kanji contains a square box, the interface would recognize that the character also contains at least one vertical and one horizontal line and the system would fill in the on-line form accordingly.

Sequential versus random access to the questions on the “Search” interface may depend on their overall number and complexity. *A priori*, two approaches seem possible: an all-in-one page with a fill-in form or a sequence of steps on several pages as often used in software such as installation wizards.

Figure 4.2 • “Search” Sequence Using an Early On-Line Interface Prototype



## Formative Evaluation of Search Components

A user-centered approach was followed to design and refine Kanjiform. Formative evaluations were performed in order to help identify and fine-tune the various components required in the final application. Some of these evaluations were informal discussions with users while others were more structured in which questionnaires and task-oriented activities were used to gather data and comments from participants interacting with the various prototypes.

So, in order to test the software implementation of some of the concepts discussed in chapter 3, the author ran a series of short task-oriented tests in the fall of 2005 with a group of 26 design students (see Appendix B). All but one were aged between 20 and 24, the exception being slightly younger. 62% of the group were

female. 85% did not know any kanji, one participant knew a few (less than 10) and two participants knew 1001 or more.

- ***Horizontal Line***

When asked to identify kanji containing at least one horizontal line from a series of five in which three actually contained the feature, 22 out of 26 participants completed the task without any errors. Two participants failed to identify one of the characters and one student left out two. One participant saw horizontal lines in all five of the kanji in the series.

These results confirm that identifying kanji with at least one horizontal stroke is an easily manageable task.

- ***Vertical Line***

When asked to identify kanji containing at least one vertical line from a series of five in which two actually contained the feature, 15 out of 26 participants completed the task without any errors. Three identified the two characters correctly but also saw vertical lines in kanji that did not have any. Seven participants failed to identify one of the characters while the remaining participant failed to identify one of the two kanji but also selected one kanji that did not contain a vertical line.

It should be noted that the first kanji “六” contained a very short vertical line (often called a dot in calligraphy) in its upper portion and this is the character that was often overlooked, showing perhaps a threshold as to what can be defined as a line by the participants.

• ***Counting Boxes***

Participants did very well overall when asked “how many square or rectangular box(es) can you count?” in each kanji from a series of four. An example, kanji A or “早”, showing a count of two boxes was also provided as a reference. The objective behind asking this question was to find out if there was an implicit or common agreement about how one would count these features.

Kanji B in the list or “思” is classified in the database by the author as a 4-box character. Seventeen participants counted correctly four boxes, while seven others counted five boxes (most likely counting the large box created by the four smaller boxes put together). The two remaining participants somehow counted either one or seven boxes. As seen in Table 4.1, the mean for this answer was 4.27, the median was 4 and the standard deviation was 0.96 including the two extreme answers.

Kanji C in the list or “計” is classified by the author as a one-box character. Twenty-five participants counted correctly, while the remaining participant somehow counted six boxes. As seen in Table 4.1, the mean for this answer was 1.19, the median was 1 and the standard deviation was 0.98 including the extreme answer.

*Table 4.1 • Descriptive Statistics for Box Counting Question*

<b>NUMBER of BOXES</b>	<b>B =4</b>	<b>C =1</b>	<b>D =6</b>	<b>E =1</b>
<b>N Valid:</b>	26	26	26	26
<b>N Missing:</b>	0	0	0	0
<b>Mean:</b>	4.27	1.19	6.39	1.00
<b>Median:</b>	4.00	1.00	6.00	1.00
<b>Std. Dev:</b>	0.96	0.98	1.42	0.00
<b>Range:</b>	6.00	5.00	7.00	0.00
<b>Minimum Value:</b>	1.00	1.00	1.00	1.00
<b>Maximum Value:</b>	7.00	6.00	8.00	1.00

Kanji D in the list or “買” is classified by the author as a six-box character. Seventeen participants counted correctly six boxes, while seven others counted eight boxes (most likely counting the two large boxes created by the smaller boxes put together). The two remaining participants somehow counted either one or seven boxes. As seen in Table 4.1, the mean for this answer was 6.39, the median was 6 and the standard deviation was 1.42 including all the answers.

Kanji E in the list or “別” is classified by the author as a one-box character. All 26 participants counted correctly. As seen in Table 4.1, the mean and median was obviously 1 for this answer and the standard deviation was 0.

Overall the descriptive statistics for this question seem to show that there is an implicit agreement amongst participants about how one would count “boxes”. The erroneous answers are indicative of some common counting mistakes and will be addressed with clearer instructions and examples displayed on the interface itself (see Figure 4.3).

Figure 4.3 • Detail of On-Line Instructions Related to Counting Boxes

出	= 0 (obvious)
年 □	= 1 (simple...)
時 日	= 2 (not 3... don't count the larger rectangle as in 日 □)
目 日	= 3 (not 4 as in 日 □ nor 6 as in 日 □ □ □)
東 日	= 4 (not 5 as in 日 □ nor 9 as in 日 □ □ □ □ □)
買 日	= 5 or more (in this case 6, not 8 or 12...)

• **Stroke Intersections**

When asked to identify kanji containing a capital “T” intersection from a series of five in which three actually contained

the feature, 100% of the participant identified the first kanji correctly and all but one identified the second kanji correctly. The last kanji in the list “元” proved much more difficult with only 54% observing the feature. The confusion probably arose from the character showing the flat top attribute of a capital “T” in the upper portion and a bend typical of a lowercase “t” in its lower portion.

This confusion probably highlights a need for a less specific nomenclature for the stroke intersections. In this case a “T” intersection (without the word “capital” preceding it) could be differentiated from a four-way intersection as in the case of a plus sign “+” or a lowercase “t”.

#### • ***Complexity Scale***

Participants did very well when asked to place a kanji along a seven-point scale (see Figure 4.16) featuring examples of simple to complex kanji. The objective behind asking this question was to find out if there was an implicit or common agreement about how one would estimate complexity using such a scale.

Kanji C in the list or “前” is classified in the database by the author as a 6 on the complexity scale. Thirteen participants placed the kanji correctly at 6 on the scale, while six participants rated it as

a 5 and six others as a 4. The remaining participant rated the kanji as a seven. As seen in Table 4.2, the mean for this answer was 5.35, the median was 6 and the standard deviation was 0.89.

*Table 4.2 • Descriptive Statistics for Complexity Scale Question*

<b>COMPLEXITY</b>	<b>C = 6</b>	<b>D =2</b>	<b>E =3</b>	<b>F =7</b>	<b>G =1</b>
<b>N Valid:</b>	26	26	26	26	26
<b>N Missing:</b>	0	0	0	0	0
<b>Mean:</b>	5.35	2.08	2.96	6.65	1.46
<b>Median:</b>	6.00	2.00	3.00	7.00	1.00
<b>Std. Dev:</b>	0.89	0.56	0.60	0.63	0.51
<b>Range:</b>	3.00	2.00	3.00	2.00	1.00
<b>Minimum Value:</b>	4.00	1.00	1.00	5.00	1.00
<b>Maximum Value:</b>	7.00	3.00	4.00	7.00	2.00

Kanji D in the list or “中” is classified in the database by the author as a 2 on the complexity scale. 18 participants placed the kanji correctly at 2 on the scale, while five participants rated it as a 3 and three others as a 1. As seen in Table 4.2, the mean for this answer was 2.08, the median was 2 and the standard deviation was 0.56.

Kanji E in the list or “出” is classified in the database by the author as a 3 on the complexity scale. 20 participants placed the kanji correctly at 3 on the scale, while three participants rated it as



a 4 and two others as a 2. The remaining participant rated the kanji as a 1. As seen in Table 4.2, the mean for this answer was 2.96, the median was 3 and the standard deviation was 0.60.

Kanji F and G followed the same pattern. Table 4.2 shows their descriptive statistics as well.

Overall the descriptive statistics for this question seem to show that there is an implicit agreement amongst participants about how to rate kanji on a complexity scale.

This test, if administered on the complete database set, would also be a good way to actually rate each kanji based on a large group agreement.

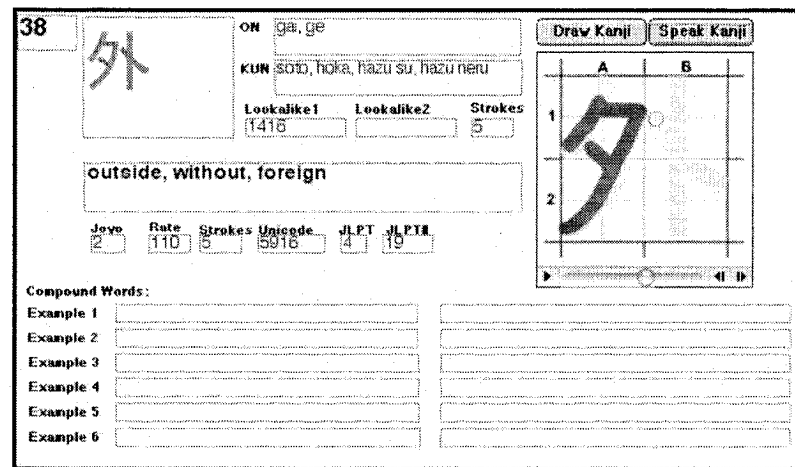
It should be noted that on the final interface, to provide for some uncertainty, kanji ranked at a level 3 would also be found in the resulting list if level 2 or level 4 had been selected.

### **Conclusion from Tests**

These tests together with countless constructive comments from students and colleagues form the basis of the continuous improvement cycle needed to create an effective software.

The tests helped confirm that participants were able to distinguish important features in kanji and could more or less agree as a group on how one would count certain features and rank the apparent complexity of a character compared with others. These findings will help decide how the interface will be designed and what level of support (instructions and examples) is needed.

Figure 4.4 • Early Filemaker Database Prototype of the “Study” Interface



## Study Module

The “Study” interface should include the usual Japanese and English translation, a description of important structural features related to the specific kanji (not included in the early FileMaker prototype seen in Figure 4.4) and a large animated window showing the traditional stroke order for the kanji. Other features might include an audio sample, similar kanji, mnemonic materials, examples of usage, etc.

## **Software Development**

As the Filemaker Pro prototypes evolved, a decision was made to create the final on-line database using Microsoft Access and the interfaces with Microsoft.net (pronounced "dot net"). The data entered so far in Filemaker Pro were exported to MS Access as a tab file with the exception of the actual Japanese characters which, due to font management issues, had to be tediously cut and pasted from a MS Excel spreadsheet into the MS Access database.

At that point, the author enlisted the help of a software developer in order to reproduce the functionalities of the interfaces that had been created earlier. An interesting collaboration ensued from this partnership, and many challenging questions were raised on issues of software efficiency and end-user experience.

It quickly became clear that creating an experimental software was a different process from developing industrial software for which all specifications are normally set prior to the first line of software code being written. It must be said that the developer managed very well the uncertainty of an ever-evolving project and that once the philosophical shift required was understood, collaboration and sharing of ideas were very successful.

As with any software development tool, we found some limitations as to what could be done, discovered work-around solutions where possible and/or used other software features to compensate.

## **Design Issues**

### **• *Interface Response Time***

Developing educational software also involves making programming decisions that at first glance may appear wasteful as far as how a software developer is trained to write code for efficiency and speed of program execution. A good example of this came when I decided to forego the usual "Submit" button on the search page. From an educational point of view, I wanted the learner to see the results of his/her selection in real time, every time they clicked an option, in order to be able to build on and refine their search criteria. From a software engineering point of view it required multiple screen refreshes, slowing down the application. The issue at hand here was machine time versus end-user time. In this case, I argued that I did not mind if the application would be a few nanoseconds slower if, at the end, the user could make better and faster decisions on a human time scale.

### • ***Ideal Interface Versus the Real World***

During the design of the search interface, we went through several layout changes brought on by information architecture issues, technical software limitations, cross-platform Internet browser incompatibilities and on-screen space concerns.

Figures 4.5 to 4.9 illustrate a representative sample of the type of challenges we faced as we progressed toward a workable prototype solution.

### • ***Screen Size***

Kanjiform search and study interfaces were designed to fit horizontally within a screen size of 1024 by 768 pixels. Some vertical scrolling might occur when the results list is very long, but as the user refined the search, scrolling would quickly become unnecessary.

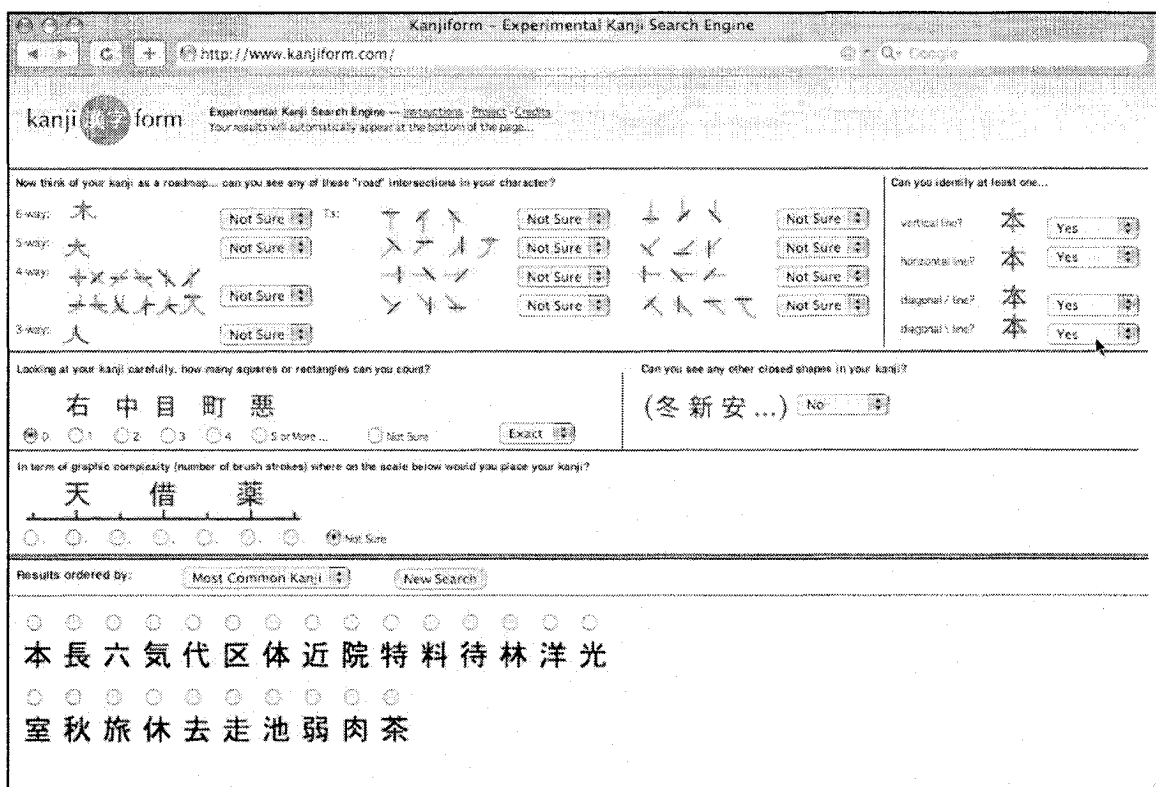
This screen size was selected based on data (w3schools, 2005) about the global trends as of July 2005 showing that 69% of computer users are viewing information on a screen size of 1024x768 pixels (XGA) or more. Thecounter.com also reports 70% penetration of screens equal or larger than XGA. Although global averages may not always be relevant to specific designs and audiences, the author believes that these statistics are comparable

with hardware available to college and university students enrolled in programs requiring the use of computer technology.

• **Information Architecture**

In the cases of Figures 4.5 and 4.6, my excitement for the concept of stroke intersections is reflected in the layout by its emphasis and its position on top of the page. It quickly became apparent that this was not optimal and that if simpler concepts were presented first, this might influence positively the perception of how easy to use the entire interface really is.

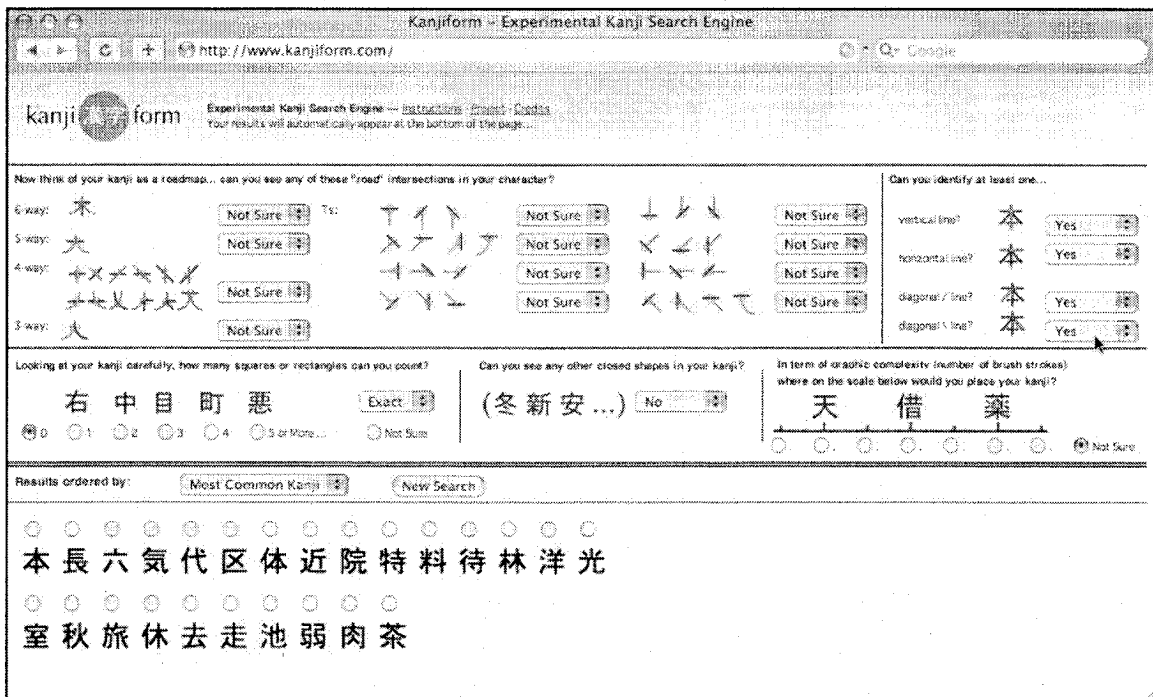
Figure 4.5 • Early Interface Mock-Up With Stroke Intersections as First Section



## • Compactness of the Interface

In Figure 4.6, an attempt at making the interface as compact as possible is shown. The benefit of making the interface use less window space is that there would be more space left for the results and for the study interface. Unfortunately, since buttons, fonts, and menus appear in different sizes and shapes on various web browsers and operating systems, it proved to be very difficult to design the interface in a compact fashion. White space is needed as a buffer to accommodate as many computer environments as possible. This compromise had to be made in order to insure that Kanjiform remains accessible by as many users as possible.

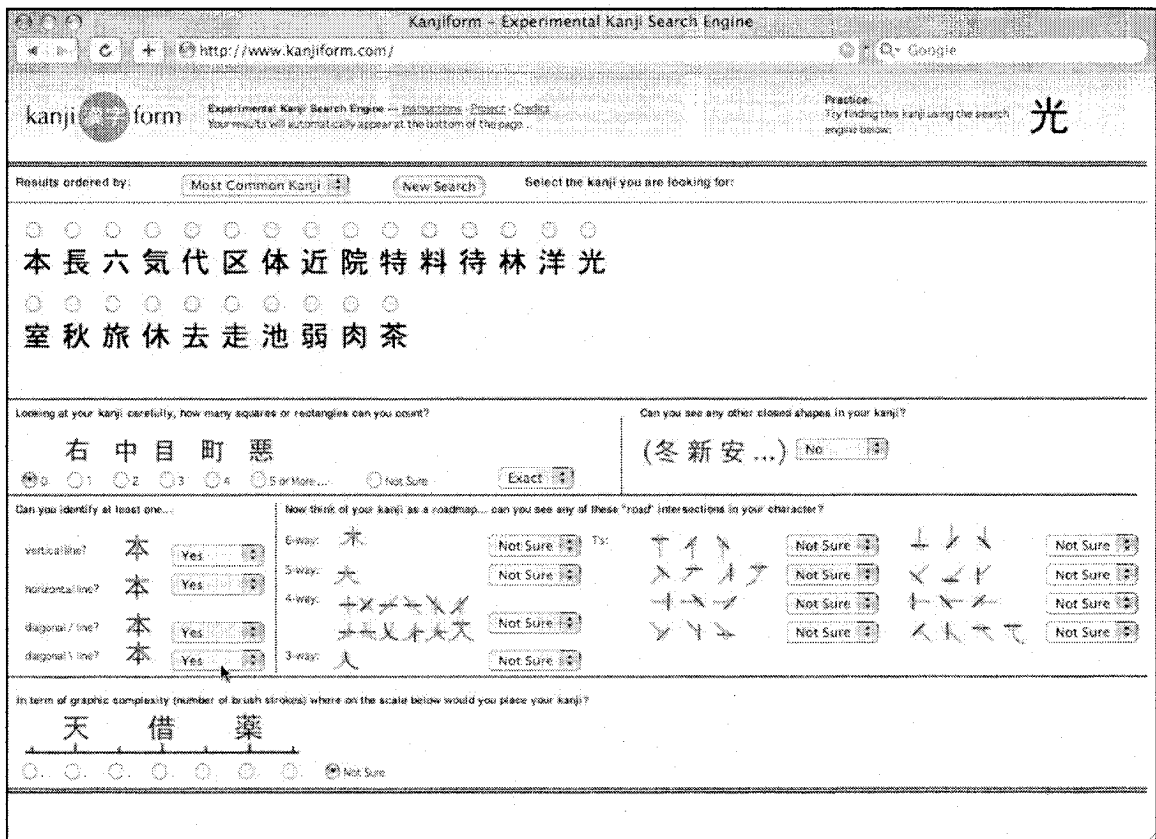
Figure 4.6 • Early Compact Interface Mock-Up



• **Results Window**

Figure 4.7 shows an attempt at placing the search results at the top of the page. We were first thinking of another window which would overlap with the search page, but this proved difficult technically, and confusing as well as inefficient from the user's perspective. The results window would sometimes cover most of the search interface or get hidden behind the main window. Software communication between windows was also a major issue as windows would sometimes not refresh properly.

Figure 4.7 • Early Interface Mock-Up With Results Appearing at the Top

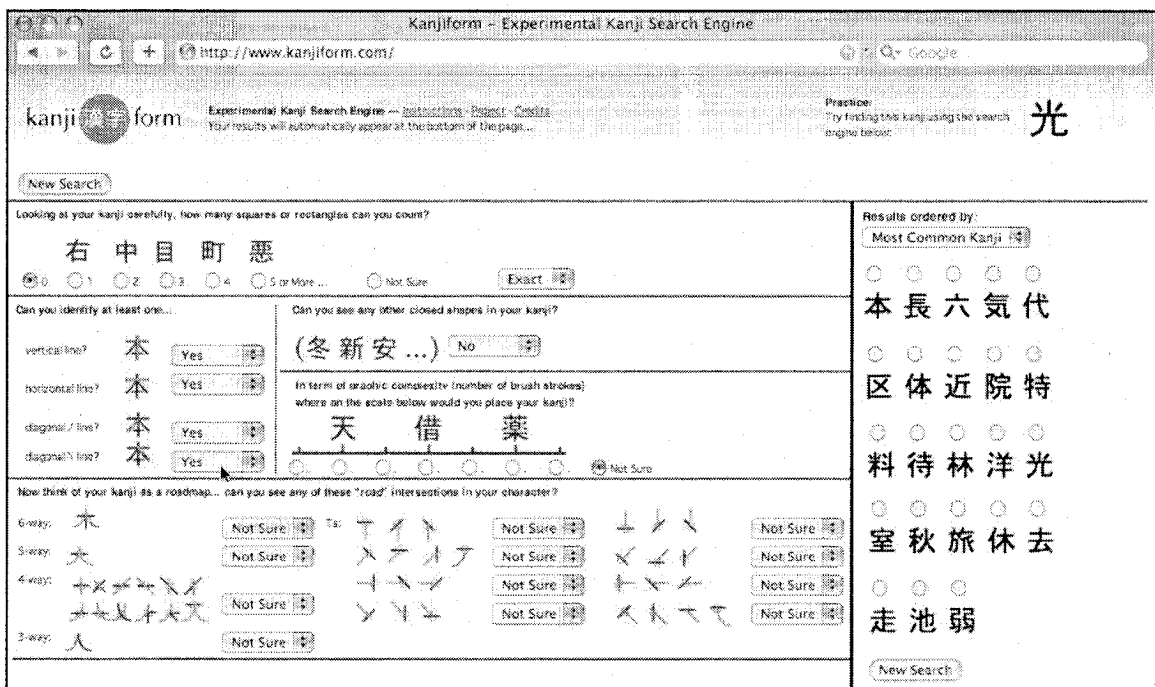




Placing the results in the same window but near the top seemed to be the next best option. Unfortunately, this created another problem in that, if the results list was exhaustive, the search interface would be pushed further down in the browser page, therefore requiring extensive scrolling.

Figure 4.8 shows another attempt at positioning the results list other than at the bottom where it can sometimes trigger the need for scrolling. Placing the results on the right side seemed fairly logical but could potentially create sideways scrolling issues and proved difficult to achieve technically across all platforms.

Figure 4.8 • Early Interface Mock-Up With Results Appearing at the Side



The tall and narrow shape of the area, although adequate for a list of results, may also cause interesting layout challenges when the list is ultimately replaced by the study interface.

• **Final Prototype Interface**

Figure 4.9 • Final Interface Designed for the Summative Evaluation

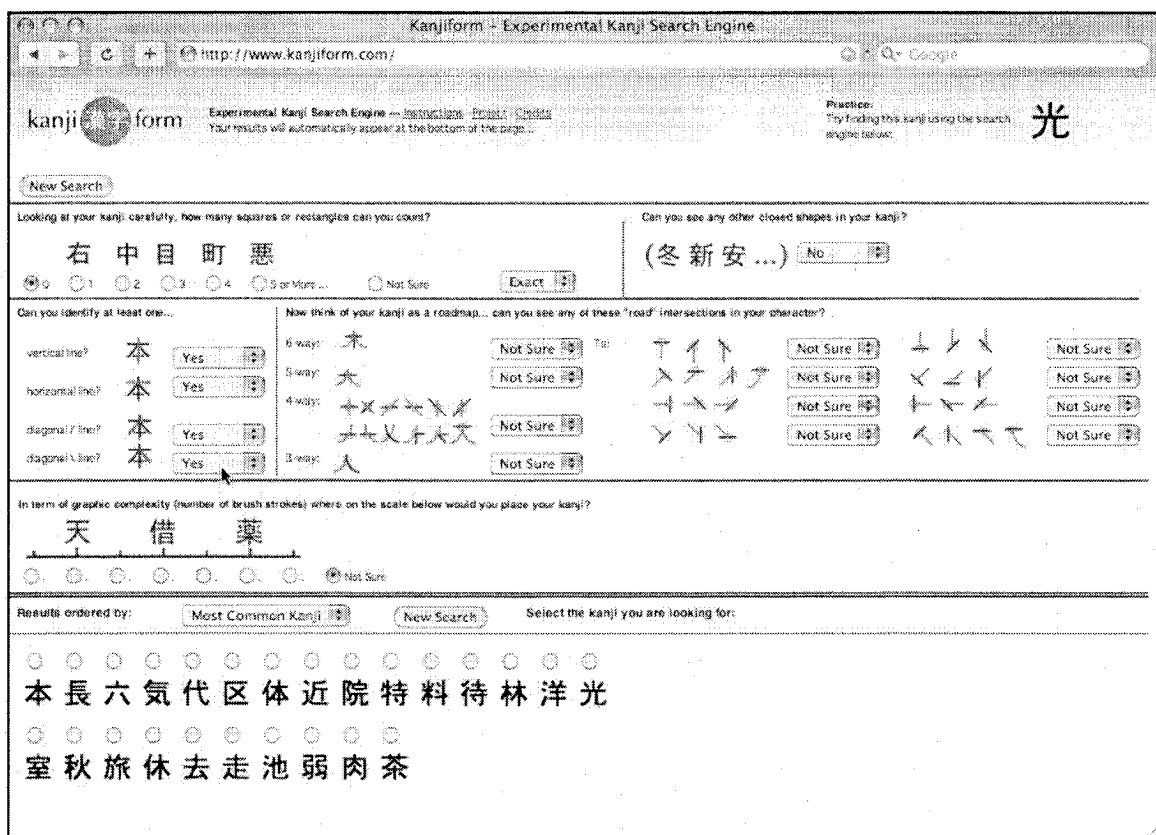
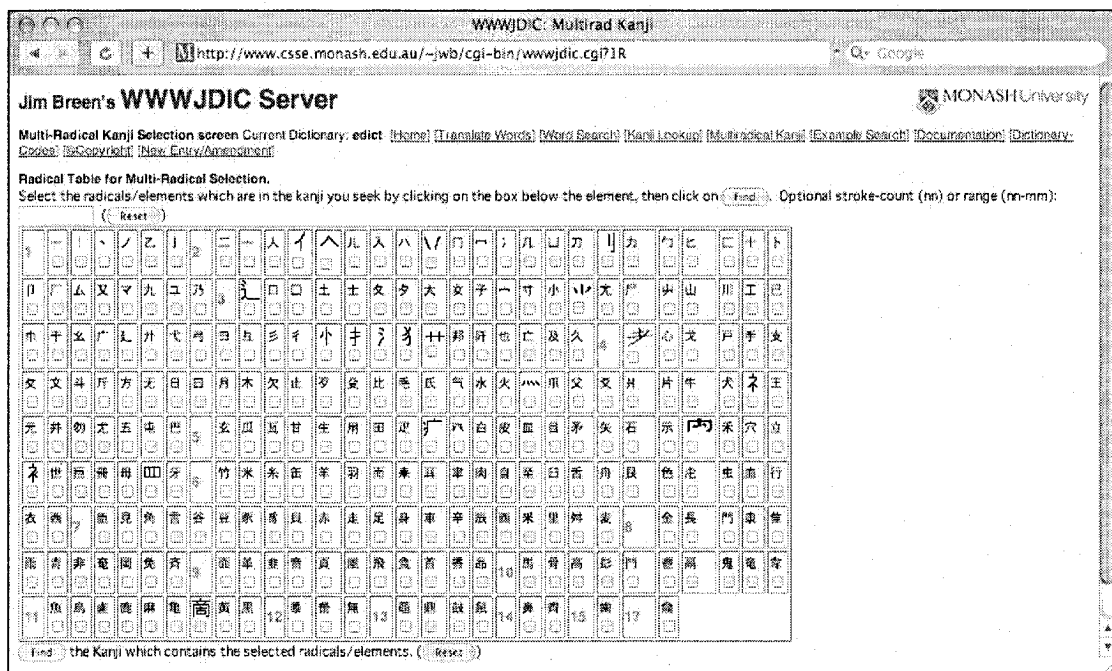


Figure 4.9 shows the most stable design across all platforms. Like most design projects, it is the result of a series of compromises but each made with the user in mind. This final prototype shows the interface that will be tested during the summative evaluation.

## Formative Evaluation of Kanjiform through a Comparison

Some of the best and the most exhaustive research pertaining to kanji and database development has undeniably been conducted by Jim Breen of Monash University in Australia. Professor Breen has developed a number of databases and query interfaces and made them available on the Internet via a website called WWWJDIC server. Multi-Radical Kanji Selection (see Figure 4.10) is one of the several query methods currently available on the site. It exploits the flexibility of the database in being able to locate a kanji based on any of its parts, even if it is not the official radical.

Figure 4.10 • WWWJDIC Server Multiradical Kanji Interface



## **Aesthetics and Emotions in Design**

My training as a graphic and interface designer always influences the way I look at software applications. I personally believe that no matter how well a software application technically functions, beginner users are often overwhelmed by the lack of apparent design, lay-out and/or aesthetics. If, in addition, the language used as part of the interface is highly technical and/or a large amount of options are available, the user might simply give up due to the excessive cognitive load. I suspect this would be the case with WWWJDIC.

Donald A. Norman (1983), author of the famous treatise on usability, *The Psychology of Everyday Things* (later re-published under the title *The Design of Everyday Things*), in which he took a purely logical and dispassionate view of everyday objects, has modified his position of late. He now incorporates emotions and aesthetics in his formula for good design.

In his latest book "Emotional Design" (2004), Norman notes that, until recently, emotions were an ill-explored part of the human psychology and most scientists thought of emotions as a problem to be overcome by rational, logical thinking. The modern view is that emotions play a critical role in learning, creativity and aid in decision-making.

In reviewing the work of Kurosu and Kashimura on the design of Automated Teller Machines (ATMs), Norman began to explore the link between aesthetics and ease of use. The main result of the ATM study is that attractive devices were perceived to be easier to use. Interestingly, this study was repeated in Israel and the results supported this even more than the study in Japan. Norman goes on to explain how this works on a visceral level. In short, according to Norman, attractive things do work better – their attractiveness produces positive emotions, causing mental processes to be more creative, more tolerant of minor difficulties.

Bejal Chawda (2005), a usability expert, writes that aesthetics is crucial in design, because it is our perceptions, beliefs and what we are aware of that influence our decisions, not necessarily our behavior. The danger which exists for developers is ignoring the influence of aesthetics and thus unintentionally creating a product which is believed to have poor usability, even though in reality it may have been fairly easy to use. The consequence of this could be a product that is just not accepted.

Let's bring our attention back to Professor Breen's experimental interface. The author understands that it was not necessarily designed with beginners in mind and that Professor Breen's forte is computer science and lexicography, not interface

design, making the comparison between Multi-Radical Kanji Selection and Kanjiform.com somewhat unfair. Nevertheless, the multi-radical search page is presumably the most straightforward for beginners and perhaps with some design investment could be perceived to be easier to use by first-time users.

### **Comparison Results**

All this taken into consideration, I had nonetheless the boldness of asking a few graphic design students participating in one of my guest-lectures on interface design to compare the two interfaces.

The questionnaire (see appendix C) was administered prior to the lecture and the two software interfaces were presented as examples to compare. It was made clear that participation was on a voluntary basis and that no evaluation marks would be given for this within their design course. A total of 23 students aged mostly between 20 and 24 (91%) and 25 and 29 (the remaining 9%) participated, 52% were male. All had individual access to a Dual G5 Apple Desktop Computer and a 17inch colour screen to review the two interfaces.

It should be noted that it is unlikely but possible that some participants had prior knowledge that Kanjiform had been designed

by the presenter. Since the answers to the questionnaire were kept anonymous and that the work did not count towards any marks in the course, this prior knowledge should not have overly biased the results.

### **Inviting Appearance**

To the question, “Which of the two sites looks more inviting to you at first glance?”, two respondents chose the multi-radical kanji interface of wwwjdic (see Figure 4.10) and 21 selected Kanjiform (see Figure 4.9). To the further question probing “Why?”, a large number of comments were written by the respondents which can be summarized under the following four themes:

- ***Visual Organisation***

The respondents commented on the use of hierarchy in Kanjiform. This can be seen through a sampling of comments regarding this organisational aid: “hierarchy of info through the layout makes the page easy to navigate”, other respondents commented that Kanjiform looks more “organized” and “categorized”. All these comments relate to breaking up the content on the page in some logical manner into manageable chunks of information for the user.

The respondents also mentioned the overall layout of the page as something that is important to how the interface is perceived. One respondent commented that “wwwjdic Multiradical kanji has a large block of characters that appears intimidating” while others wrote that Kanjiform was “not as cluttered/intimidating” and “neater, less cluttered, more organized” and made “good use of white space”.

- ***Use of Colour***

The use of colour was also noted by some participants. A few respondents believed that the warm colour palette used in Kanjiform made it more inviting and less overwhelming. One respondent emphasized the importance of choosing an adequate colour palette and remarked that “wwwjdic Multiradical kanji uses a colour scheme and layout that blends into itself (confusing)”.

Colour can also be used as an organizing principle and in the case of Kanjiform one respondent noticed that the information was clearly “separated by red lines”.

- ***Apparent Ease of Use***

Many respondents seemed to associate good interface design with ease of use. Kanjiform “seems easier to find relevant characters”, “easier to navigate”, “User-friendly” with “less chance of



feeling frustrated". Information on Kanjiform "does not look overwhelming like on multi-radical site".

- ***Aesthetics***

Comments were in favor of Kanjiform, as it "is more visually appealing, easier to look at", "looks pretty", "aesthetically pleasant" and "looks well put together". A respondent actually remarked that "Multi-Radical Kanji is not pleasant to look at because of its grid layout". This might show that a lack of balance between structure and aesthetics might actually be perceived as a negative by some.

A few respondents mentioned that Kanjiform seemed "more modern looking" and the heavy use of tables in wwwjdic makes it "look outdated".

These comments combined with those on ease of use in the previous section seem to agree with Norman's writing (2004) that attractiveness produces positive emotions, causing mental processes to be more creative, more tolerant of minor difficulties.

### **Interface for the Beginner**

To the question, "Look at the two sites for a minute or so, which one seems better suited for a beginner?", only one chose the

multi-radical kanji interface of wwwjdic, while 22 believed Kanjiform seemed better suited for a beginner learner.

### **Simple Language**

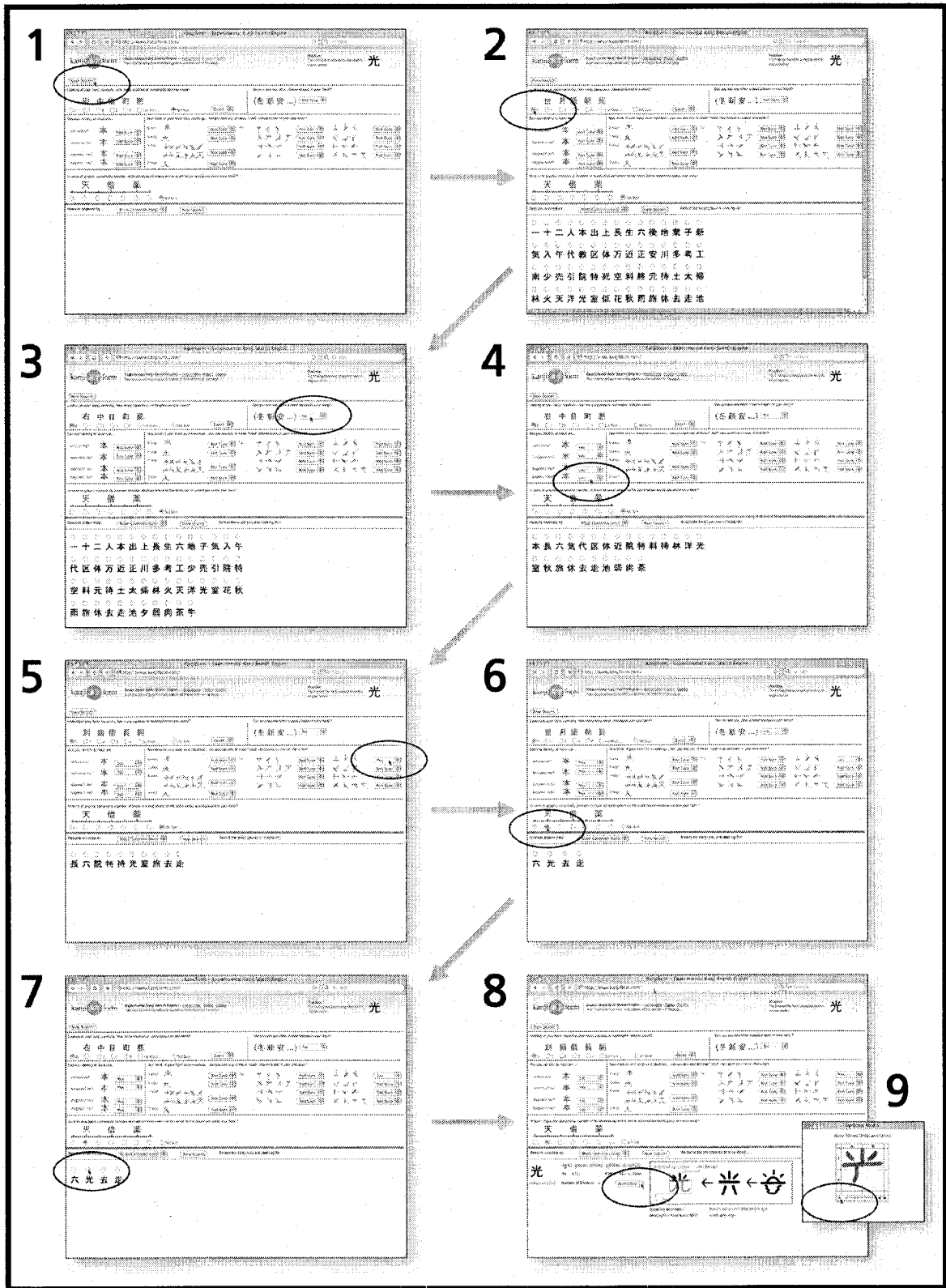
To the question, "Which of the two uses simpler language?", two respondents selected the multi-radical kanji interface of wwwjdic while 21 selected Kanjiform.

### **Conclusion to Comparison**

Although the goal of software engineering is to develop applications that work flawlessly, an equal amount of attention should be spent on the interface design in order to facilitate interaction and support the user in his/her task.

I purposely chose WWWJDIC, a great search engine application, as a comparison to Kanjiform to test if good interface design and aesthetics helped beginner users perceive an application as easier to use and the results of this small survey do seem to point in that direction.

Figure 4.11 • Steps to Search Sequence With Kanjiform (Mouse Location is Circled)



## **Kanjiform Online Software Demonstration**

It might be useful at this point to demonstrate and describe which steps a Kanjiform user has to take in order to find a kanji. As seen earlier in Figure 4.9, the user is only presented with one simple webpage. The search engine is self-contained on this one page. Links to the instructions, information about the project and credits are provided on the top of the page for first time users. A kanji is also randomly selected and displayed on the top right portion of the banner as a practice exercise each time the webpage is accessed.

A “New Search” button appears twice, at the top, and at the bottom (as a redundancy feature) of the search area. This button is used to reset the search engines between queries.

### **• *Step 1: Looking for a Kanji***

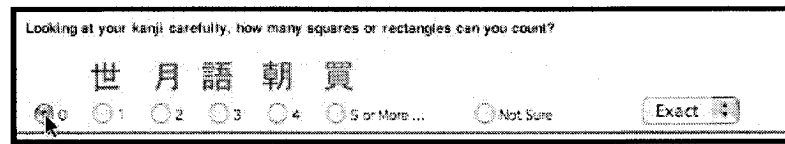
For the purpose of this example (Step 1, Figure 4.11), the user is looking for the kanji “光” meaning light, glow, shine or glitter.

### **• *Step 2: Squares and Rectangles***

As seen in Figure 4.12, this step shows the user answering the first question “Looking at your kanji, how many squares or rectangles can you count?” by selecting one of the numbered radio buttons. In the case of “光”, the user selects “0”.

Figure 4.12 • Step 2: Squares and Rectangles

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Looking at your kanji carefully, how many squares or rectangles can you count?

世 月 語 朝 買

0  1  2  3  4  5 or More...  Not Sure

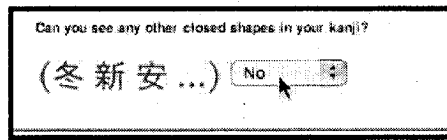
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The user is assisted in his/her decision by graphic examples in the form of small icons placed directly above the radio buttons. The icons for this particular question are animated and rotate through a series of variants for each answer. This particular approach paired with the instructions page (see Figure 4.03) has been very successful at clarifying earlier confusion with this particular question. Results of the query, in this case, are displayed as a large list of kanji at the bottom of the webpage. It should be noted that no “submit” button is included in the interface since each time a user clicks on a radio button or a pull-down menu, the query is submitted directly to the database in order to display the resulting kanji list which can then be used to refine the on-going search.

• **Step 3: Closed Shapes**

Step 3 (see Figure 4.13) shows the user answering the next question “Can you see any other closed shapes in your kanji?” by selecting “No” in the pull-down menu. This triggers another call to the database and narrows down the number of possible kanji and displays a smaller list at the bottom of the webpage.

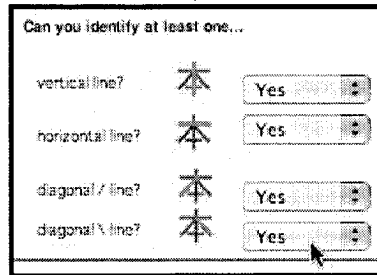
Figure 4.13 • Step 3: Other Closed Shapes



• **Step 4: Vertical, Horizontal and Diagonal Lines**

As seen in Figure 4.14, step 4 shows the user notifying the database that he/she was able to “identify at least one diagonal line in the kanji” further narrowing down the possibilities. An even shorter list is now displayed, this time with about 20 results. The user at this point could choose to browse the results list and find the character or move on to another question in order to refine the query.

Figure 4.14 • Step 4: Vertical, Horizontal and Diagonal Lines



• **Step 5: Stroke Intersections**

This step (Figure 4.15) shows the user selecting an upside down “T” intersection found in the upper portion of the kanji “光”.

This action narrows the results even more and a list of 10 kanji

remains. Again, the user at this point could choose to browse the results list and find the kanji. For the sake of this demonstration, the user moves on to the next step.

Figure 4.15 • Step 5: Stroke Intersections

Now think of your kanji as a road map... can you see any of these "road" intersections in your character?

6-way: 木  Yes:

5-way: 天

4-way:

3-way: 人

• **Step 6: Complexity Scale**

As seen in Figure 4.16, step 6 shows the user selecting, with the help of a scale, the level of graphic complexity of the kanji being searched. This roughly equates to counting the number of strokes in a traditional dictionary search. However, in this case, it is done by visually comparing and matching the character searched to exemplars placed above a seven-point scale. The list has been reduced furthermore and now shows four possible matches.

Figure 4.16 • Step 6: Complexity Scale

In terms of graphic complexity (number of brush strokes) where on the scale below would you place your kanji?

天 借 薬

• **Step 7: Selecting from the List**

In step 7, the user can now easily identify the right kanji from the short list and select it by clicking on the corresponding radio button.

• **Step 8: Study Interface**

Step 8 shows the kanji and its accompanying study interface (see Figure 4.17). Learning materials available in this prototype include an English translation, On and Kun Japanese pronunciations, various mnemonic devices, a button linking to a short video excerpt of the kanji being written by a native Japanese, various ranking and levels as well as indices to other reference materials.

Figure 4.17 • Step 8: Study Interface

光 light, glow, shine, glitter, sparkle  
ON: KOO KUN: hiko ru, hikari  
Nelson # 1358 Number of Strokes: 6 Animation...

Radical: 火: Fire 小: Small  
Henshall Mnemonic: Person carries fire that shines light  
Description from Kanji ABC: small, one, legs

Most Common Kanji # 439  
Radical: 111  
JLPT Level: 3  
Joyo Level: 2  
Nelson # 1358  
Hesper # 2091  
White Rabbit Placard # 109

It should be noted that the prominent placement of the Nelson index number right under the kanji is only for the purpose of this study (see Figure 5.1). This number usually refers to a specific



character in the original Nelson dictionary, but in this case, is used as a unique identifier for each character in the database.

In the centre of the study interface, the student can see a graphic showing the various components, or graphemes, of the kanji. The components were identified from the systemic approach to kanji developed by Foerster and Tamura (1994). Mnemonic pictographs created by Daiki Kusuya (2001) are also illustrated.

As a further aid to the student, Henshall (1988) and Foerster & Tamura (1994) textual mnemonics appear below the graphic.

- ***Step 9: Animation***

By clicking on the “animation” button located near the translation, the video can be displayed and controlled in a small separate window.

### **Brush Stroke Animation in the Study Interface**

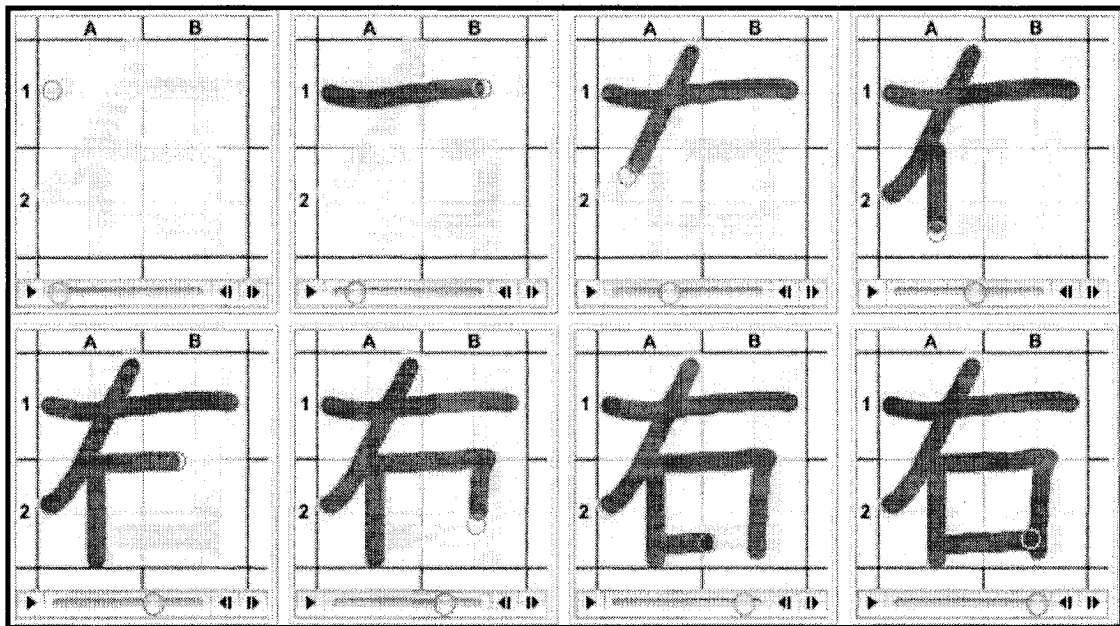
As mentioned above, as part of the “Study Interface”, we created a library of short digital video excerpts showing the brush strokes for each kanji. The student would access these video excerpts by clicking on the “Animation...” button (see Figure 4.17). These video files are not typical computer animations, but live

screen recordings of the brush strokes as they were being drawn by a Japanese writer.

The files were produced with the help of a Wacom pen tablet and recorded with SnapzProX, a professional screen capture tool made by Ambrosia Software (2006). The Wacom pen tablet is a computer peripheral with a flat surface on which the user can draw with a stylus and the resulting image is digitized. Although this type of tablet is used mostly by graphic artists nowadays, the technology behind the Wacom pen tablet was, interestingly, developed in Japan in the early 1980's as an alternative kanji input device to the QWERTY keyboard (Wacom, 2006).

Using a computer graphic file as a template for each kanji, the Japanese writer was asked to write over each kanji in a natural manner (see Figure 4.18). It took some time to get accustomed to the technology, but after some practice, writing with the stylus became quite natural for the operator. As each kanji was drawn, SnapzProX was activated and recorded the resulting brush strokes. This recording method yielded very natural looking calligraphy and preserved the exact brush stroke order and writing rhythm, which would have been extremely difficult and time-intensive to replicate with computer animation.

Figure 4.18 • Digital Recording of Kanji Brush Strokes



The author would have preferred to see the animation directly integrated into the study interface as opposed to being displayed in a floating window, but technical limitations related to the display of dynamic media in the .net environment prevented this.

### Conclusion to the Demonstration

It is important to understand that steps 2 to 6 can be performed in any order and that the user, informed by the ever updating results list, usually can locate the kanji in fewer steps than in the above demonstration.

It is also interesting to note that participants, throughout the course of the study, have indicated preferences as to which

module(s) of the interface they preferred, used repeatedly and found more effective while conducting search queries. This will be discussed in more detail in the results section of the summative evaluation.

## CHAPTER 5 – METHODOLOGY

### Experimental Method

A summative evaluation in the form of a series of quasi-experiments was chosen in order to compare the newly developed structural method, Kanjiform (treatment KF) with a traditional method, the Kodansha Elementary Kanji Dictionary (treatment KD), a paperback book widely used by beginner learners (Kodansha 2001).

Over a period of a few sessions, under controlled environments, two groups of randomly assigned volunteers (Group A & B) received training in both the traditional and structural methods. They were required to look up, identify and study a considerable number of kanji and their individual meanings. Participants were tested on their newly learned search skills. As well, the participants were tested to find out if there were any significant benefits to using the structural approach over the traditional method in recalling kanji characters.

In order to account for any possible order effect, participants for each group were subjected to the treatments in reverse order. (Group A, received treatment KD followed by treatment KF, while Group B received KF followed by KD).

Participants were tested individually after each treatment on their search skills as well as for recollection of kanji and their meaning.

• ***Characteristics of the Participants***

Following completion of the final prototype in the fall of 2005, students were recruited to participate in the summative evaluation of Kanjiform. A poster was created (see appendix D) and distributed around the college. The poster made mention of the considerable amount of time the participants would have to invest in the study as well as requesting to fill out a small detachable form with contact information, gender, age and prior knowledge of Chinese or Japanese characters, if any. As a reminder, the study was also mentioned at the end of some of the author's design guest lectures delivered around the same period of time.

In the days after the posters had been distributed around the college, 34 volunteers applied and 21 were selected as they met the "less than 101 kanji known" criterion that was set for the quasi-experiment. In actual fact, 15 participants had no prior knowledge of kanji, five knew a few (less than 11) and one knew more than 12 but less than 101.

It should be noted that the author was not at the time and is not presently teaching any of these students. He is part of the

college administration and often participates in guest lecture series offered to the student population.

Of the total 21 participants, 12 were female and nine male and they ranged in age from 18 to 21 (mean of 19.71). All described their computer skills as "Good" or "Very Good" with the exception of one volunteer describing it as average.

As discussed earlier, in an effort to address concerns about treatment order effect, participants were then randomly divided into two groups. Group A consisted of 6 females and 4 males for a total of 10 and group B was made up of 6 females and 5 males for a total of 11.

The participants were university undergraduates enrolled in various programs related to communication, culture, information technology, visual arts, art history and design, offered by the Sheridan Institute of Technology and Advanced Learning in partnership with the University of Toronto. Students enrolled in these unique programs are typically high achievers as they must meet University of Toronto's stringent academic entry requirements and maintain a high grade point average throughout the length of the program they are enrolled in.

These participants were not paid and their work during the study was not marked as a component of any courses. In order to compensate the volunteers for their efforts, they were entered in a lottery and all received a prize ranging in value from a gift certificate to a small mp3 music player.

• **Study Timeline**

During the study, I met with each participant once a week, over a period of four weeks during November and December 2005.

*Table 5.1 • Timeline for Groups A and B*

Group	Meeting 1	Meeting 2	Meeting 3	Meeting 4
<b>A</b>	<ul style="list-style-type: none"> <li>• KD Training</li> </ul>	<ul style="list-style-type: none"> <li>• KD Search Test</li> <li>• KD Memory Test 1</li> <li>• KF training</li> </ul>	<ul style="list-style-type: none"> <li>• KF Search Test</li> <li>• KF Memory Test 1</li> <li>• KD Memory Test 2</li> <li>• User Survey</li> </ul>	<ul style="list-style-type: none"> <li>• KF Memory Test 2</li> <li>• Debriefing</li> </ul>
<b>B</b>	<ul style="list-style-type: none"> <li>• KF Training</li> </ul>	<ul style="list-style-type: none"> <li>• KF Search Test</li> <li>• KF Memory Test 1</li> <li>• KD training</li> </ul>	<ul style="list-style-type: none"> <li>• KD Search Test</li> <li>• KD Memory Test 1</li> <li>• KF Memory Test 2</li> <li>• User Survey</li> </ul>	<ul style="list-style-type: none"> <li>• KD Memory Test 2</li> <li>• Debriefing</li> </ul>

Volunteers were first trained in one of the two methods depending on their group and were also given study materials which were to be tested on week 2. After the search and memory tests, they received training for the alternative method, were given study materials and tested on week 3. During the third meeting, participants were also re-tested (delayed recall) on the first method



learned and given a short user survey. They then came back on week 4 and were re-tested (delayed recall) on the last method they had learned and given a debriefing. (see Table 5.1)

- ***Settings***

Testing was done in a quiet office on the Trafalgar campus of the Sheridan Institute of Technology and Advanced Learning in Oakville, Ontario. Volunteers were individually tested on the days they were scheduled to be on campus.

Students sat at a round table and depending on the current treatment, had access to either to a laptop computer or a printed dictionary. The author delivered instructions for all meetings by following a set protocol (see appendix E) therefore insuring an adequate level of consistency.

## **Instruments**

- ***Study Materials***

In order to avoid a confounding effect with the characters used in the two approaches, two sets of 142 characters were randomly selected from the total 284 JLPT level 4 and 3 kanji sets and allocated exclusively to each treatment. In order to select kanji for each treatment, the reference number scheme established recently by Hodges and Okazaki (2004) was followed. As seen in

Figure 2.2, odd numbered JLPT Characters were used to develop tests and learning materials for Kanjiform (see appendix F) while even numbered JLPT kanji were used for the traditional approach (see appendix G).

It should be noted that JLPT kanji are ranked first by difficulty in 4 levels, then ranked within each level by traditional radical order and stroke count. The two sets created for this study should therefore be equivalent as far as their difficulty level and overall graphical complexity is concerned.

Each set was further divided to create practice, learning and test materials as depicted in the lower portion of Figure 2.2.

• ***Homework Package***

During the first individual meeting, volunteers were instructed on how to use the tool and given a “study package” consisting of a random list of 70 kanji to find in order to practice his or her searching skills (see appendix H). This initial list was randomized for each participant in order to minimize the likelihood of group work.


Another 20 random kanji (the same for all participants) were provided together with an exercise booklet (see appendix I).

Participants had to find the kanji and work with the exercise booklet in order to memorize the English meaning.

Osaka, a simple and highly readable Japanese font was chosen for all printed documents and web interface. It is somewhat reminiscent of familiar sans-serif fonts, similar to Arial or Helvetica, with simple lines and minimal embellishment.

Figure 5.1 • Kanjiform Search Homework With Nelson Index as Unique Number

---

My Code: _____		<b>Kanjiform.com</b>		
<b>Find the kanji and fill in the appropriate information:</b>				
	Nelson #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0   0.5   1 min   2 min   3 min   more	Any comments? _____ _____

---

Volunteers were told to work a maximum of two hours on the list of 70 kanji and up to three hours on the list of 20 kanji. For the list of 70 kanji, volunteers had to find each kanji using the tool being tested and write down a unique identifier for each one: the Nelson index for Kanjiform (see Figure 5.1) or the page number for the paper dictionary (see Figure 5.2). They were also required to check a box to qualify each individual search as easy, moderately easy, difficult or impossible and estimate on a time scale how long it took to find each kanji. Space for comments was also provided. For the list of 20 kanji, the volunteers had to find and study the English

meaning of each kanji using the tool being tested and the exercise booklet provided. The volunteers were presented with various exercises in the form of multiple-choice questions, cloze, etc. The booklet also contained a summary page to be filled in by the student as a learning aid. Homeworks were not monitored and the results were self-reported.

Figure 5.2 • Kanji Paper Dictionary Homework With Page Number as Unique Identifier

My Code: _____		<b>Kodansha.dict</b>	
<b>Find the kanji and fill in the appropriate information:</b>			
行	Page #:	This kanji was:	I spent this amount of time:
	[ ]	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0   0.5   1 min   2 min   3 min   more
			Any comments? _____ _____

### • Search Skills and Memory Test

The search skills test consisted of a table of 40 kanji presented as part 1 of the overall test for that day (see Figure 5.3 & appendix J). The volunteers were presented with the directive to find, in no particular order, as many kanji as possible with the help of the search tool under study at the time.

The instructions also mentioned that the search activity was to be within a monitored 15-minute period. Furthermore, an example of how to fill out each cell of the table with either the page number or the Nelson Index appeared at the end of the instructions.

Figure 5.3 • Kanji Search Skill Test

**Kanji Dictionary Study Questionnaire** My code: \_\_\_\_\_

**PART I**

**Kanji Search Skills**

(Within a monitored 15-minute period)

1- Using the Kodansha Dictionary, find (in no particular order) as many of the following kanji characters as possible and write in the space provided the dictionary page number (NOT the kanji number found in the index pages) corresponding to each Kanji:

Example: 親 p.437

三	九	今	先	円
北	半	古	国	大
学	山	店	日	木

Part 2 of the test consisted of a series of questions similar as far as formatting to those in the exercise booklet and covered the 20 characters studied during the previous week. The memory test (see Figure 5.4 and appendix J) was designed to evaluate recall of the character's meaning, not its Japanese translation or pronunciation. For example, for the character “古”, volunteers had to remember the meaning “old” and not the Japanese pronunciation “furu-i” or “ふるい”.

A week later, a delayed recall test (see appendix K) used the same questions but in different order. Distractors in multiple-choice questions were also arranged in different order. Study

materials were not available for the week prior to this test as it had been collected back by the researcher. Although the memory was tested twice, search skills for a particular tool were tested only once.

Figure 5.4 • Kanji Memory Test Questions

5- Select the correct Kanji for each blank space by entering its number in the appropriate blank below:

1. 音    2. 兄    3. 手    4. 立

We saw a poor kitten that had a broken a leg and could not \_\_\_\_\_ (stand) on it. My \_\_\_\_\_ (elder brother) took it in his \_\_\_\_\_ (hands). Reassured, the little cat made a purring \_\_\_\_\_ (sound/noise).

6- Connect with an arrow each kanji and its corresponding English meaning:

楽	mountain
日	state/country
山	music
電	sun
国	lightning

7- Which of the following kanji means "old"? (circle the right answer)

a. 日    b. 古    c. 兄    d. 田

### • User Survey

During their second-to-last visit, volunteers were given an opportunity to comment on their month-long experience by filling in a survey (see Appendix L). The survey also contained two questions about how specifically they had used each tool.

### Equipment Used

With the exception of the homework portion of the experiment, which were completed on the volunteers' own

computers, participants were tested individually using the same computer (Apple Powerbook G4, see Table 2 below for details) and a typical college broadband access to the Internet. Meetings were conducted between the hours of 11 am to 6 pm with no readily noticeable difference in network speed.

*Table 5.2 • Computer Hardware Used During the Meetings*

<b>Laptop Hardware Overview</b>	
Machine Name:	Apple PowerBook G4 17"
CPU Type:	IBM PowerPC G4
CPU Speed:	1.67 GHz
Random Access Memory:	1.5 GB
LCD Display:	1440 x 900
Depth:	32-bit Color (Millions)

The software used during the experiments was Microsoft Internet Explorer 5.2 running on Mac OS X (10.4.2). The web browser software was used to connect to a commercial ISP (Internet Service Provider), namely Bluegenesis.com, on which resided the online prototype at the time of the experiment. The server space provided by the ISP contained the Microsoft Access database and the .net interface.

## CHAPTER 6 – EVALUATION OF KANJIFORM

This chapter will report on the results of this study. It should be noted that I have taken the liberty of injecting some commentary and discussion throughout this chapter in order to minimize confusion due to the large number of research questions that would have to be referenced in a separate discussion chapter.

### **Report of Statistical Analysis of Kanji Quasi-Experiment**

One potential issue with having two treatments (Kanjiform and Kodansha Paper Dictionary) with a within-subject design is the possibility of order effect. An order effect manifests itself as a differential effect of the treatment based on sequence, or in other words, an interaction between order and treatment. As a strategy to counteract this possibility, a counterbalanced design was used in which group A started with the kanjiform treatment, followed by the Kodansha paper dictionary while group B did the paper dictionary treatment first, then kanjiform.

The results were then tested for the presence of an order effect. As seen in Appendix M, the multivariate tests revealed a statistically significant value for Pillai's trace (.99) at a p value of .05, indicating a significant interaction effect of the order on the dependent variables. The between-subjects tests showed that Group



A significantly outperformed Group B on the kd\_found measure,  $F(1, 19) = 5.20$ ,  $p = 0.04$ , Mean Square.

Error for the kd\_found measure = 80.80, partial eta-squared (variance explained) = 0.21, power of analysis = 0.58. No statistically significant differences were observed for the kf\_found dependent measure across the two groups.

This finding is tempered by the following considerations: First, significance was barely achieved ( $p=0.49$ ). In addition, a test for homoscedasticity (i.e., homogeneity of variances and covariances), Box's M, was found to be of the value 10.54 and significant at  $p = 0.03$ . This means that the MANOVA model did not meet one of its key assumptions. In addition, Box's M is extremely sensitive to violations of the assumption of normality. Tests for normality of kf\_found and kd\_found using the one-sample Kolmogorov Smirnov Test, yielded results showing that both variables are not normally distributed: for kf\_found ,  $p = 0.67$ , while for kd\_found,  $p = 0.54$ . These results render the MANOVA calculations highly suspect.

Clearly, the results concerning any presence of an order effect and their impact on further strategies for analysis of the data, noted above, needs to be viewed in light of the circumstances that

in conducting this MANOVA, the assumptions of homoscedasticity and normality have been violated, sample size is small, and significance was barely achieved. In short, the result does not constitute what may be called strong evidence of an order effect.

Bearing these results and considerations in mind, non-parametric 2-independent sample Mann-Whitney U tests of differences for the two dependent variables (i.e., kf\_found and kd\_found) in question were subsequently conducted. No significant differences were found for either variable across the two groups. While, these non-parametric tests do not measure interactions, they do provide a basis for collapsing the groups.

Similar analyses were conducted for other key variables. In terms of the dependent variable, kf\_mem and kd\_mem - no interactions or differences were observed - both parametrically and non-parametrically.

These additional null results encountered in the search for interactions that might indicate an order effect further strengthen the case for collapsing the data across the groups, thereby increasing n and the power of the remaining comparisons reported in this study.

The two volunteer groups were therefore combined into a single sample for the purpose of analyses. When comparing the

efficiency of the two techniques, a dependent means test (t-test) was used in order to eliminate confounding variables such as prior knowledge of kanji characters, as well as other individual differences amongst participants.

• **Practice**

Since all practice measures were self-reported, it is impossible to verify their accuracy; however, it should be noted that significant correlations were found between the search practice measures and those of the search test (see Table 6.1). This provides a certain degree of confidence that the participants were honest in their reporting.

*Table 6.1 • Practice and Test Kanji Search: Descriptive Statistics*

	Mean	Std. Deviation	N
<b>KF_Practice:</b> How many kanji found out of the 70 random characters provided for practice	63.71	11.34	21
<b>KF_Found:</b> How many kanji found out of the 40 random characters provided for testing within 15 minutes in controlled environment	37.71	3.76	21
<b>KD_Practice:</b> How many kanji found out of the 70 random characters provided for practice	38.86	18.69	21
<b>KD_Found:</b> How many kanji found out of the 40 random characters provided for testing within 15 minutes in controlled environment	17.14	4.35	21

The 21 participants found on average 63.71 out of 70 characters during the Kanjiform search practice and 35.71 out of 40 during the search test. A significant positive correlation ( $r = 0.55$   $p$ -value  $< 0.01$ ) was found between the two measures showing that the participants who did well during practice also did well in the test (see Table 6.2).

Table 6.2 • Practice and Test Kanji: Search Correlations

		KF_Practice	KF_Found	KD_Practice	KD_Found
KF_Practice	Pearson Correlation	1	.55**	.03	-.12
	Sig. (2-tailed)	.	.01	.90	.61
	N	21	21	21	21
KF_Found	Pearson Correlation	.55**	1	.20	.35
	Sig. (2-tailed)	.01	.	.39	.12
	N	21	21	21	21
KD_Practice	Pearson Correlation	.03	.20	1	.54*
	Sig. (2-tailed)	.90	.39	.	.01
	N	21	21	21	21
KD_Found	Pearson Correlation	-.12	.35	.54*	1
	Sig. (2-tailed)	.61	.12	.01	.
	N	21	21	21	21

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

The Kodansha Paper Dictionary searches, in which 21 participants found an average of 38.86 out of 70 characters during the practice and 17.14 out of 40 during the test, also resulted in a

significant positive correlation ( $r = 0.54$   $p\text{-value} < 0.05$ ) between practice and test condition measures, as seen in Table 6.2.

• **Practice: Kanji Search**

On average, participants using Kanjiform were much more successful finding the characters than when they used the Kodansha Paper Dictionary. The participants found on average 63.71 out of 70 characters when they used Kanjiform, and 38.96 out of 70 with the alternative method (see Table 6.3). This was statistically significant with a  $t^*$  of 5.28 and  $p\text{-value} < 0.01$  as seen in Table 6.4.

Table 6.3 • Practice Kanji Search: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
<b>Pair 1</b>	KF_Practice: How many kanji found out of the 70 random characters provided for practice	63.71	21	11.34	2.47
	KD_Practice: How many kanji found out of the 70 random characters provided for practice	38.86	21	18.69	4.08

• **Discussion**

Although the kanji characters to be found were random for all participants, it is highly unlikely that this would be the cause of such a discrepancy between the techniques.

Table 6.4 • Practice Kanji Search: Paired Samples Tests

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
<b>Pair 1</b>	KF_Practice - KD_Practice	24.86	21.57	4.71	15.04	34.68	5.28	20	.00

However, one must also keep in mind that there is no indication that the characters that were claimed to have been found were actually correct. This will be investigated under a controlled environment in a later comparison for accuracy.

Also, as this was an unsupervised exercise, it is quite possible that students did not respect the 2-hour limit imposed upon them. In addition, the limit of characters could have impeded this comparison since students who found 70 characters, whether they had attained the 2-hour limit or not, simply stopped. In future studies, if a time limit is imposed, the number of kanji characters to find should not be pre-determined.

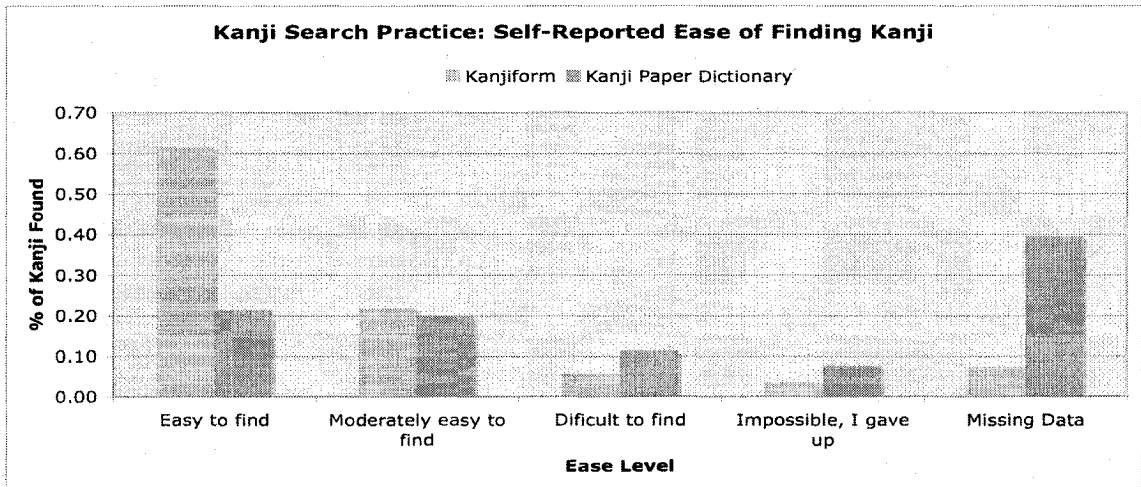
Lastly, as Table 6.5 shows, another interesting finding was that there was no significant correlation between the two methods, meaning that students who did well using the Kanjiform method did not necessarily succeed with the KD method. This may serve as added proof for the efficiency of the KF technique.

Table 6.5 • Practice Kanji Search: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	KF_Practice: How many kanji found out of the 70 random characters provided for practice & KD_Practice: How many kanji found out of the 70 random characters provided for practice	21	.03	.90

• Practice: Ease of Use

Figure 6.1 • Kanji Search Practice: Self-Reported Ease of Finding Kanji



After looking at the distribution (see Figure 6.1), it was decided to combine the numbers for “easy” and “moderately easy to find” answers in order to allow for a higher yield of responses (see Table 6.6). It was found that there was a significant difference favouring the Kanjiform method ( $t^* = 6.93$ ,  $p\text{-value} < 0.01$ ), but no significant correlation (see Table 6.8).

Table 6.6 • Ease of Finding Practice Kanji: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	kf_easy + kf_mod	58.38	21	11.47	2.50
	kd_easy + kd_mod	29.00	21	19.60	4.28

Table 6.7 • Ease of Finding Practice Kanji: Paired Samples Tests

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	kf_easy + kf_mod - kd_easy + kd_mod	29.38	19.44	4.24	20.53	38.23	6.93	20	.00

### • Discussion

It should be noted, again, that these results were self-reported by the participants and one must wonder what criteria they used to determine how easy it was to find the characters.

Another important factor that may have affected this comparison is the fact, as mentioned earlier, that the volunteers were not assigned the same characters to find. It is therefore possible that in cases where participants did not find all 70 characters, they concentrated on and found the easier ones and gave up on the others. Although a significant difference exists



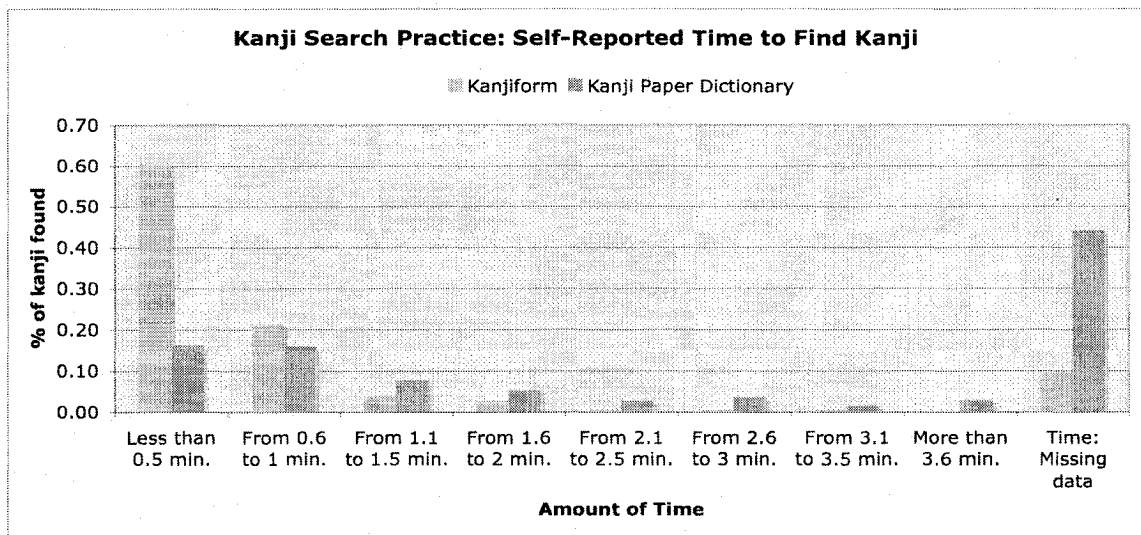
between Kanjiform and the alternative, it is suggested to not attribute too much weight to this comparison, for the reasons adduced.

Table 6.8 • Ease of Finding Practice Kanji: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	kf_easy + kf_mod & kd_easy + kd_mod	21	.31	.18

• Practice: Time on Task

Figure 6.2 • Kanji Search Practice: Self-Reported Time to Find Kanji



Based on the distribution illustrated in Figure 6.2, it was decided to combine the numbers for “number of characters found in less than 30 seconds” and those found in “between 30 and 60 seconds” in order to allow for a higher yield of responses (see Table 6.9). As seen in Table 6.10, it was found that there was a significant

difference favouring Kanjiform ( $t^* = 8.46$ ,  $p\text{-value} < 0.01$ ), but no significant correlation (see Table 6.11).

Table 6.9 • Practice Kanji Found in Less Than 60 seconds: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	kf_under30+kf_60	57.38	21	10.88	2.38
	kd_under30+kd_60	22.57	21	16.61	3.63

Table 6.10 • Practice Kanji Found in Less Than 60 seconds: Paired Samples Tests

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	kf_under30+kf_60 - kd_under30+kd_60	34.81	18.85	4.11	26.23	43.39	8.46	20	.00

### • Discussion

Although a significant difference exists between Kanjiform and the alternative, it is suggested to not put as much weight on this comparison due to the self-reported nature of the data.

Table 6.11 • Practice Kanji Found in Less Than 60 seconds: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	kf_under30+kf_60 & kd_under30+kd_60	21	.11	.64

• **Kanji Search Test**

The next measures were done under conditions constituting a controlled environment as explained in the methodology chapter. The results therefore should provide more robust comparisons than those gleaned from the practice data.

As seen in Table 6.12, a mean of 35.71 of kanji were found using Kanjiform versus 17.14 using the Kodansha Dictionary. This difference was significant ( $t^* = 18.37$ ) with a p-value of  $< 0.01$  (see Table 6.13).

*Table 6.12 • Kanji Search Test: Paired Samples Statistics*

		Mean	N	Std. Deviation	Std. Error Mean
<b>Pair 1</b>	KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	35.71	21	3.76	.82
	KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	17.14	21	4.35	.95

Although the correlation between the two was higher than in the practice (evidence that one could predict that if students did well in one method, they would do well using the other) this association still was not significant ( $r = .35$ ,  $p > 0.1$ ) as seen in Table 6.14.

However, the enormous discrepancy in the efficiency of the two methods in yielding results cannot be ignored.

Table 6.13 • Kanji Search Test: Paired Samples Tests

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	KF_Found - KD_Found	18.57	4.63	1.01	16.46	20.68	18.37	20	.00

• **Discussion**

Similarly to the practice comparison, since three participants were able to find the maximum amount of characters in less than 15 minutes, future trials should allow for them to continue until they have reached the time limit. These three cases are discussed in further details in the later section entitled “Which Method is Faster?”.

Table 6.14 • Kanji Search Test: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 minutes in controlled environment. & KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 minutes in controlled environment.	21	.35	.12

• **Which Method is More Accurate?**

To prove that a kanji had been found using the tool under study, a unique identifier from either the Kanjiform Study Interface or the Paper Dictionary (see Figure 5.3) had to be transcribed on the test sheet by the participant. The test sheets were then checked and kanji with erroneous identifiers were deducted from the participant's count.

To take a marksmanship metaphor, accuracy is defined as making the mark once you have taken a shot, as in the number of successful hits divided by the number of attempts. In the case of our investigation, I calculated the accuracy as a percentage rate by dividing the number of accurate kanji by the overall number of kanji found (erroneously or not) by the participants.

*Table 6.15 • Speed and Accuracy: Paired Samples Statistics*

		Mean	N	Std. Deviation	Std. Error Mean
<b>Pair 1</b>	kf_accu/kf_found (percentage)	.99	21	.02	.00
	kd_accu/kd_found (percentage)	.92	21	.08	.02
<b>Pair 2</b>	KF_kanji_per_minute (x/15min)	2.41	21	.30	.07
	KD_kanji_per_minute (x/15min)	1.14	21	.29	.06

As seen in Table 6.15, the Kanjiform method with a mean of 99%, outperformed the traditional dictionary measure (92%). The

dependent means test was significant ( $t^* = 3.99$ ,  $p\text{-value} < 0.01$ ) in favour of Kanjiform (see Table 6.16). No correlation was found between these variables (see Table 6.17).

Table 6.16 • Speed and Accuracy: Paired Samples Tests

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
<b>Pair 1</b>	kf_accu/kf_found (%) - kd_accu/kd_found (%)	.07	.08	.02	.03	.11	3.99	20	.00
<b>Pair 2</b>	KF_kanji_per_minute (x/15min) - KD_kanji_per_minute (x/15min)	1.27	.35	.08	1.11	1.43	16.53	20	.00

Table 6.17 • Speed and Accuracy: Paired Samples Correlations

		N	Correlation	Sig.
<b>Pair 1</b>	kf_accu/kf_found (percentage) & kd_accu/kd_found (percentage)	21	-.23	.33
<b>Pair 2</b>	KF_kanji_per_minute (x/15min) & KD_kanji_per_minute (x/15min)	21	.29	.20

• **Which Method is Faster?**

I calculated how fast participants were at finding kanji under a controlled environment by simply dividing the number of kanji found by the allowed time for the search, which was 15 minutes. With means of 2.41 for Kanjiform and 1.14 for the

Kodansha Paper Dictionary (see Table 6.15), there were significantly more kanji characters found per minute using the Kanjiform method ( $t^* = 16.53$ ,  $p\text{-value} < 0.01$ ) as seen in Table 6.16. No correlation was found (see Table 6.17).

### • *Discussion*

As discussed earlier in this chapter, three participants were able to find all 40 kanji using the Kanjiform method, the first completing the task in exactly the 15 minutes allotted, the second in 14 minutes and the third and fastest in 13 minutes as witnessed by the author. The shorter amount of time needed by these two individuals to find all the characters was considered and the formula used to calculate their kanji per minute rate was adjusted by dividing their results accordingly by 13 or 14.

The results of this and the previous section show that not only is Kanjiform a faster method to find kanji, it is also more accurate.

### • *First Kanji Memory Test*

With means of 16.71 for Kanjiform and 15.38 for the alternative (see Pair 1 in Table 6.18 and 6.19), no significant difference was found between the two measures of the first memory

test. Again, no significant correlation was found as seen in Table 6.20.

• **Second Kanji Memory Test**

A significant difference was found in favour of Kanjiform between the delayed recall measures KF\_Memory 2 (15.76) and KD\_Memory 2 (13.57) with a  $t^*$  of 3.005 and a  $p$ -value  $< 0.01$  (see Pair 2 in Table 6.18 and 6.19)

Table 6.18 • Kanji Memory Test 1 and Test 2: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
<b>Pair 1</b>	KF_Memory: number of kanji remembered after 1 week practice, max 19/19	16.71	21	2.85	.62
	KD_Memory: number of kanji remembered after 1 week practice, max 19/19	15.38	21	3.83	.84
<b>Pair 2</b>	KF_Memory 2: number of kanji remembered 1 week after 1st test... no studying or review done... max 19/19	15.76	21	2.98	.65
	KD_Memory 2: number of kanji remembered 1 week after 1st test... no studying or review done... max 19/19	13.57	21	4.39	.96
<b>Pair 3</b>	KF_Memory: number of kanji remembered after 1 week practice, max 19/19	16.71	21	2.85	.62
	KF_Memory 2: number of kanji remembered 1 week after 1st test... no studying or review done... max 19/19	15.76	21	2.98	.65
<b>Pair 4</b>	KD_Memory: number of kanji remembered after 1 week practice, max 19/19	15.38	21	3.83	.84
	KD_Memory 2: number of kanji remembered 1 week after 1st test... no studying or review done... max 19/19	13.57	21	4.39	.96



It is also interesting to note that there is a significant positive correlation ( $r = 0.65$ ,  $p\text{-value} < 0.01$ ) between the two measures as seen for Pair 2 in Table 6.20. This means that learners who did well on one test also did well on the other.

• **Discussion**

The widening gap in the results found between the first and second memory test, which lead to the second test being significant, perhaps points to some advantage related to using a structural approach for increased long-term memory recall or deeper learning. Further investigation may need to be completed to determine why the second memory test yielded significance while the first did not.

Table 6.19 • Kanji Memory Test 1 and Test 2: Paired Samples Tests

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
<b>Pair 1</b>	KF_Memory - KD_Memory	1.33	4.21	.92	-.58	3.25	1.45	20	.16
<b>Pair 2</b>	KF_Memory 2 - KD_Memory 2	2.19	3.34	.73	.67	3.71	3.01	20	.01
<b>Pair 3</b>	KF_Memory - KF_Memory 2	.95	1.32	.29	.35	1.55	3.30	20	.00
<b>Pair 4</b>	KD_Memory - KD_Memory 2	1.81	2.16	.47	.83	2.79	3.84	20	.00

• **First and Second Kanjiform Memory Tests**

With means of 16.71 for KF\_Memory and 15.76 for the delayed recall measure KF\_Memory 2 (see Pair 3 in Table 6.18 and 6.19), the first Kanjiform memory test significantly outperformed the second, and the correlation was significant. KF\_Memory outperformed KF\_Memory 2 ( $t^* = 3.30$ ,  $p\text{-value} < 0.01$ ) and the two measures had a correlation coefficient of 0.898 ( $p\text{-value} < 0.01$ ) as seen in Table 6.20. This is typical of the effect of time on recall.

Table 6.20 • Kanji Memory Test 1 and Test 2: Paired Samples Correlations

		N	Correlation	Sig.
<b>Pair 1</b>	KF_Memory: number of kanji remembered after 1 week practice, max 19/19 & KD_Memory: number of kanji remembered after 1 week practice, max 19/19	21	.23	.32
<b>Pair 2</b>	KF_Memory 2: number of kanji remembered 1 week after 1st test... no studying or review done... max 19/19 & KD_Memory 2: number of kanji remembered 1 week after 1st test... no studying or review done... max 19/19	21	.65	.00
<b>Pair 3</b>	KF_Memory: number of kanji remembered after 1 week practice, max 19/19 & KF_Memory 2: number of kanji remembered 1 week after 1st test... no studying or review done... max 19/19	21	.90	.00
<b>Pair 4</b>	KD_Memory: number of kanji remembered after 1 week practice, max 19/19 & KD_Memory 2: number of kanji remembered 1 week after 1st test... no studying or review done... max 19/19	21	.87	.00

### • ***First and Second Kodansha Paper Dictionary Memory Tests***

The first Kodansha Paper Dictionary memory test significantly outperformed the second, and the correlation was significant. With means of 15.38 for KD\_Memory and 13.57 for KD\_Memory 2 (see Pair 4 in Table 6.13 and 6.15), KD\_Memory outperformed KD\_Memory 2 ( $t^* = 3.84$ ,  $p\text{-value} < 0.01$ ) and the two measures had a correlation coefficient of 0.87 ( $p\text{-value} < 0.01$ ) as seen in Table 6.20.

### • ***Discussion***

To summarize, in both of these cases, the first memory test significantly outperformed the second, and in both cases the correlations were significant.

It should be noted, however, that future trials should either allow for a higher maximum (since many participants achieved the maximum score) or instead implement a time limit whereby participants are asked to remember the meaning of as many characters as they can.

### **User Survey Results**

As mentioned earlier, during their second-to-last visit, volunteers were given an opportunity to comment on their month-long experience by filling in a survey (see Appendix L). The two lead

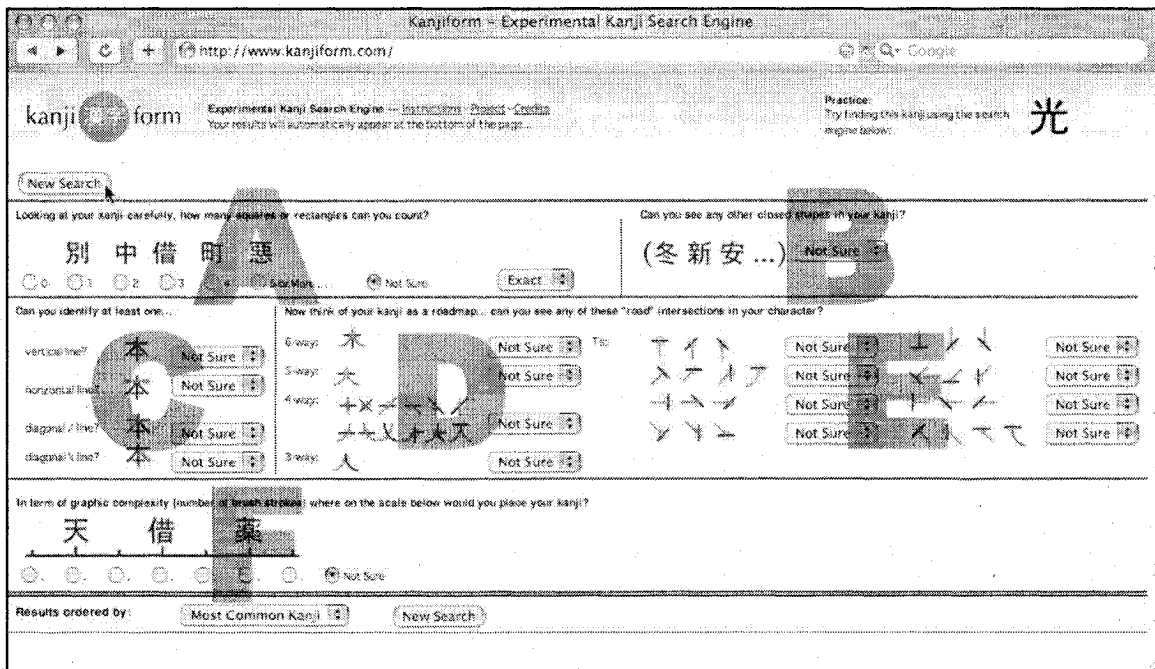
questions of the survey investigated the user preference for various interface features available for Kanjiform and the paper dictionary.

- ***Kanjiform***

The first question looked at the Kanjiform search interface: “While using the on-line search method (Kanjiform.com), which part(s), if any, of the interface did you find the most useful in pinpointing kanji characters? (Please CIRCLE the area on the picture below). Which part(s), if any, did you find the least useful? (Place a large X on the area).” Figure 6.3 shows the six areas of the interface that were singled out by the respondents in the process. Figure 6.4 shows the results as a bar graph.

A large number of respondents seemed to find features A, B & C (number of squares, other closed shapes and lines) most useful. No respondent identified features A or B as least useful. The relative simplicity of these features most probably played a role in their popularity. Not surprisingly, these features also proved to be the easiest to use during our formative evaluation.

Figure 6.3 • Kanjiform Most and Least Useful Search Interface Features

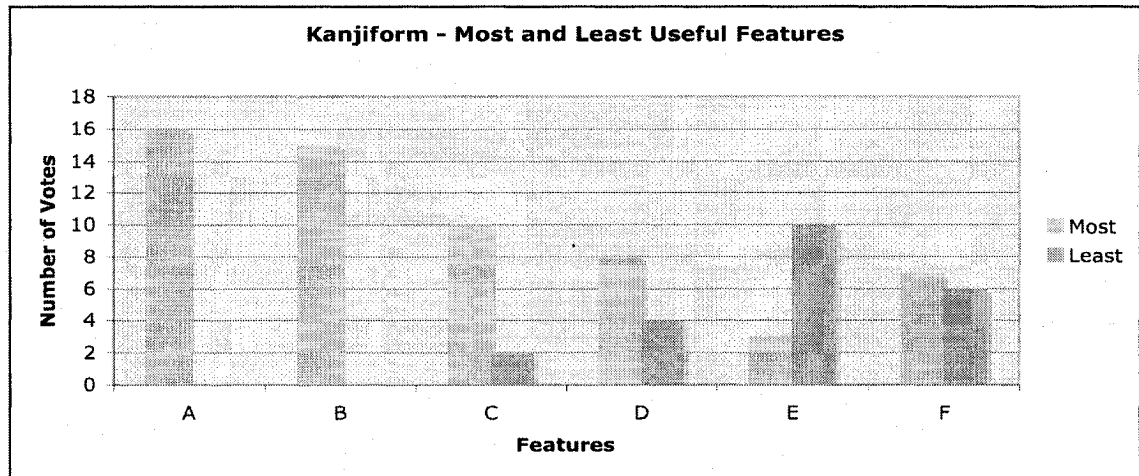


Features D, E and F (intersections, “T” intersections and the graphic complexity scale), got a mixed review. These features require a higher level of abstraction to be used effectively, which may explain the mixed response. Being slightly harder to use, it is not surprising that a beginner will try and use other functions first.

Although it is possible that the order of use is affected by the order of presentation, this ranking may also be interpreted as a post hoc validation of what was found through various iterations of the prototypes and how the interface evolved into its final layout. These iterations slowly migrated the simpler and most useful

features to the upper section of the interface and the less useful and reportedly more complex ones to the lower parts of the window.

Figure 6.4 • Kanjiform Search Interface: Most and Least Useful Features



#### • *Kodansha Dictionary*

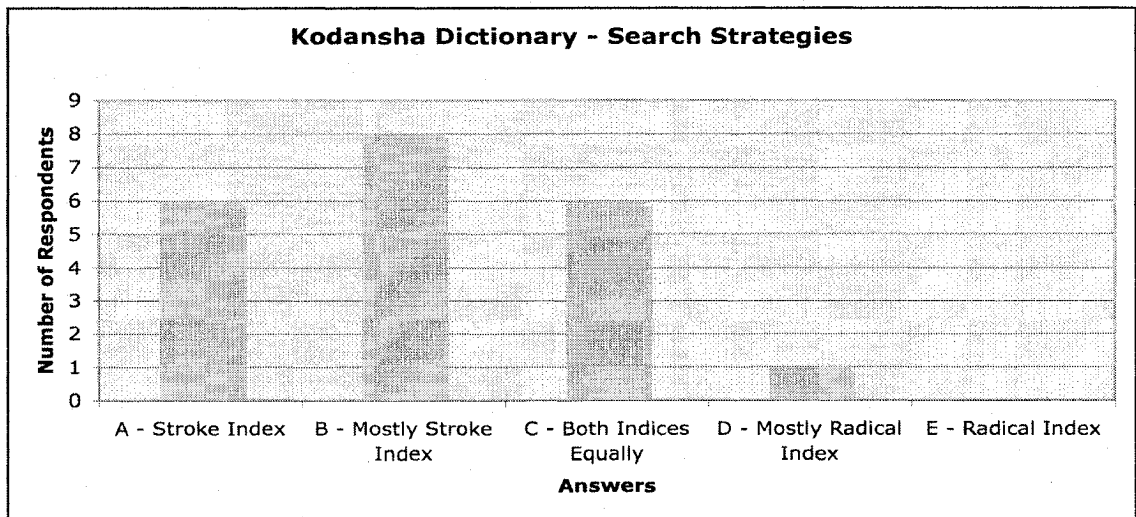
The training session for the traditional method covered the three most common search strategies used with a paper dictionary. Please review Figure 2.3 for a detailed explanation. Of these three strategies, the first, looking for a kanji by its pronunciation, is impossible to use for beginners. The two others, radical and stroke indices, involve a relative amount of deductive work but can be at the very least attempted by beginners. Counting strokes is most often used by beginners.

The graph in Figure 6.5 illustrates the results to the following question: "While using the traditional search method (the

paper kanji dictionary), how often did you use the Stroke Count Index relative to the Radical Index?" The range of possible answers was as follow:

- a. Exclusively used the Stroke Count Index
- b. Used the Stroke Count Index more often than the Radical Index
- c. Used both equally
- d. Used the Radical Index more often than the Stroke Count Index
- e. Exclusively used the Radical Index

Figure 6.5 • Search Strategies Used With the Traditional Dictionary



Results show that all participant used the stroke index at some point and that two thirds of them used it either exclusively or the majority of the times. Slightly less than a third of the respondents used both methods equally. Only one reported using mostly the radical index. None used the radical index exclusively.

These results again show that users tend to gravitate toward the most usable method available at a given time.

### **Rating the Overall Experience**

Using an ordinal scale, participants were asked to rate a series of statements about their experience with both the traditional and the online methods. They were asked to rate six statements by circling the appropriate words on a six-point scale from "strongly disagree" to "strongly agree".

#### **• *Which Method Makes it Easier to Find a Kanji?***

The first statement read: "The online search method (Kanjiform.com) makes it easier to find a kanji than the traditional method (the traditional kanji dictionary)." 14 participants (66.67%) strongly agreed and an additional 6 (28.57%) agreed with this statement for a strong combined result of 95.24%. The mean for this answer was 5.62, as seen for Pair 1 in Table 6.21.

The following statement echoed in reverse the first statement: "The traditional search method (the paper kanji dictionary) makes it easier to find a kanji than the online search method (Kanjiform.com)." 8 participants (38.09%) strongly disagreed and an additional 9 (42.86%) disagreed with this statement for a combined result of 80.95%. The four other respondents slightly



disagreed with the statement. The mean for this answer was 1.81, as seen for Pair 1 in Table 6.21.

Table 6.21 • User Survey: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
<b>Pair 1</b>	KF easier to find: The online search method makes it easier to find a kanji than the traditional method. 1 to 6 (1 being "strongly disagree", 6 "strongly agree")	5.62	21	.59	.13
	KD easier to find: The traditional search method makes it easier to find a kanji than the online search method. 1 to 6 (1 being "strongly disagree", 6 "strongly agree")	1.81	21	.75	.16
<b>Pair 2</b>	KF easy to learn: The online search method is simple to learn for a beginner. 1 to 6 (1 being "strongly disagree", 6 "strongly agree")	5.38	21	.67	.15
	KD easy to learn: The traditional search method is simple to learn for a beginner. 1 to 6 (1 being "strongly disagree", 6 "strongly agree")	2.67	21	1.20	.26
<b>Pair 3</b>	KF Enjoy: I enjoyed using the online search method. 1 to 6 (1 being "strongly disagree", 6 "strongly agree")	5.48	21	.51	.11
	KD Enjoy: I enjoyed using the traditional search method. 1 to 6 (1 being "strongly disagree", 6 "strongly agree")	2.38	21	1.32	.29

So, Kanjiform is clearly perceived by the users to be the easiest method to find a kanji. This was statistically significant with a  $t^*$  of 13.97 and a  $p$ -value  $< 0.01$  (see Pair 1 in Table 6.22).

Table 6.22 • User Survey: Paired Samples Tests

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
<b>Pair 1</b>	KF easier to find & KD easier to find	3.81	1.25	.27	3.24	4.38	13.97	20	.00
<b>Pair 2</b>	KF easy to learn - KD easy to learn	2.71	1.55	.34	2.01	3.42	8.01	20	.00
<b>Pair 3</b>	KF Enjoy & KD Enjoy	3.10	1.73	.38	2.31	3.88	8.20	20	.00

As seen in Table 6.23, there was a significant negative correlation ( $r = -.74$ ,  $p\text{-value} < 0.01$ ) between the measures. This simply means that respondents were consistent in rating the two contrary statements at each opposite ends of the scale.

Table 6.23 • User Survey: Paired Samples Correlations

		N	Correlation	Sig.
<b>Pair 1</b>	KF easier to find & KD easier to find	21	-.74	.00
<b>Pair 2</b>	KF easy to learn & KD easy to learn	21	-.33	.14
<b>Pair 3</b>	KF Enjoy & KD Enjoy	21	-.73	.00

• **Which Method is Simpler to Learn?**

Respondents were asked to rate the following statement to find out which of the two methods appeared to be the simplest to learn: “The online search method (Kanjiform.com) is simple to learn for a beginner.” 10 participants (47.62%) strongly agreed and an

additional 9 (42.86%) agreed with this statement for a strong combined result of 90.48%. The mean for this answer was 5.38, as seen for Pair 2 in Table 6.21.

The paired statement read: "The traditional search method (the traditional kanji dictionary) is simple to learn for a beginner." Three participants (14.29%) strongly disagreed and an additional 8 (38.10%) disagreed with this statement for a combined result of 52.39%. Five more respondents (23.81%) slightly disagreed with the statement. Of the five others remaining, three respondents (14.29%) slightly agreed and the last two (9.52%) agreed. The mean for this answer was 2.67, as seen for Pair 2 in Table 6.21.

Kanjiform is felt by the respondents to be simpler to learn and the traditional method is perceived as somewhat difficult by over half of the group. This was statistically significant with a  $t^*$  of 8.01 and a  $p$ -value  $< 0.01$  (see Pair 2 in Table 6.22). No correlation was found. (see Pair 2 in Table 6.23)

• ***Which Method is More Enjoyable to Use?***

Respondents were asked to rate the following statement to find out which of the two methods appeared to be more enjoyable to use: "I enjoyed using the online search method (Kanjiform.com)." 10 participants (47.62%) strongly agreed and an additional 11 (52.38%)

agreed with this statement for a combined result of 100%. The mean for this answer was 5.48, as seen for Pair 3 in Table 6.21.

“I enjoyed using the traditional search method (the paper kanji dictionary).” 7 participants (33.33%) strongly disagreed and an additional 6 (28.57%) disagreed with this statement for a combined result of 61.90%. Two more respondents (9.52%) slightly disagreed with the statement. Of the six others remaining, five respondents (23.81%) slightly agreed and the last one (4.76%) agreed. The mean for this answer was 2.38, as seen for Pair 3 in Table 6.21.

It is clear that Kanjiform provided an enjoyable experience compared to the traditional method. This was statistically significant with a  $t^*$  of 8.20 and a  $p$ -value  $< 0.01$  (see Pair 3 in Table 6.22).

Of note is also the strong negative correlation ( $r = -0.73$ ,  $p < 0.01$ ) between enjoying the Kanjiform method and using the traditional one. This means that a participant who enjoyed using the Kanjiform method clearly did not like using the traditional alternative (see Pair 3 in Table 6.23).

### **Comments From the User Survey**

In this section, comments written at the end of the user survey are reported and organized in categories derived from issues raised by the volunteers participating in the study. The author's own

comments and explanations are integrated throughout the text in order to clarify and put in context some of the issues.

- ***Technical Problems***

Amazingly, and to the credit of our programming and quality assurance efforts, the Kanjiform online prototype performed extremely well throughout the entire study. This robust platform provided a stable environment for the students to use Kanjiform at home and for conducting the battery of search and memory tests at the college.

Only one volunteer ever reported problems: “The website would not work on my home computer and the animations were slow on the school computers.” It is obviously hard to know what went wrong without any hardware and software configuration details, but the first problem is probably related to the Japanese fonts not being present on the home computer, resulting in an unusable interface. The author was actually pleasantly surprised that this was not a bigger issue during the study. It seems that American makers of operating systems (Microsoft and Apple) are now incorporating a multitude of foreign language fonts and do not require users to configure anything in order to display Japanese characters.

The second problem relating to slow animations could be interpreted in two ways: either slow download or slow display. It is possible that download time might have been slow depending on traffic on the network or laboratory sub-network. To minimize download time, the animation files were kept between 40 and 180 kilobytes in size, the large majority being below 100. If the volunteer meant that the animations were slow during the display, this might have been related to the fact that the files were designed to show the characters at a pace that would let beginners see each individual brush stroke being painted which may well appear to be slow to an eager student.

• ***Traditional Dictionary Versus Kanjiform***

Not surprisingly, many of the comments were comparisons between the two methods the volunteers had experienced over the past few weeks.

One volunteer reported having enjoyed the whole experience but finding Kanjiform easier to use: "This was fun and enjoyable. Having done the dictionary first, I found the online one easier, but I didn't really mind using the [paper] dictionary either. Both were good."

As we can see, this volunteer liked both approaches, which was uncommon in the group, most preferring Kanjiform as reported in the previous section.

Other participants mentioned the difficulty of counting strokes or finding the correct radical using the dictionary: “The book is hard, I found that I constantly miscounted the strokes and often just missed the kanji because they are so small and complex, hard to find.” This was echoed by another participant: “The dictionary (paper form) was way more difficult to use than the online website because different people count the strokes differently.”

Another volunteer felt more in control when using Kanjiform: “Sometimes I wasn’t sure of the radical/stroke count so the traditional method was harder. With the online, you pinpoint parts that stand out yourself and it could be virtually anything.”

Interestingly, this volunteer also went on to add a word of warning about being too specific with the search criteria: “...online if you tried to narrow it down to as specific as possible, it would eliminate the answer.” This is a common problem when doing online search. The more characteristics selected or described to narrow down a search, the greater the potential of one of these being wrong, therefore eliminating the kanji being searched from the final results.

Some of the ways this type of problems were addressed in Kanjiform included the ever present results list, the “not sure” and the “+ or – 1” options available on the search interface.

• ***Suggestions for Other Input Methods in Kanjiform***

At this late point of the study, having been subjected to both treatments, volunteers felt comfortable enough to offer suggestions as to how to better Kanjiform.

A few participants wished to integrate the traditional search method with Kanjiform: “After using the traditional method to find strokes, it seems to be an important tool for me. I’d like to see maybe an option of categorizing the stroke counts.” Another added: “Online version should have a “stroke count” +/-x function.”

Translation from English to Japanese was also on the volunteers’ mind. One participant wrote: “For the online method, the use of a search text box to input English meaning to find the kanji character would be a useful bonus to have on the website.” Another also thought this would be a good improvement: “The online kanji search works nicely. Maybe you could add a kanji search based on words you type in.”

These functionalities would be easy to implement since all the necessary information already exists in the database. During the



experiment, these were actually left out on purpose from Kanjiform. This was done in order to ensure that participants only used the newly developed structural approaches and therefore not confound the results of the two treatments.

- ***Ease of Use***

Kanjiform, as seen in the previous result section, appeared to be easier to learn and use. In support of this, one volunteer commented: "Kanjiform.com was very user friendly. It took me a long time to get used to using the paper dictionary... plus it is much more time-consuming than the on-line search method."

- ***Readability***

Quite a few participants commented on their concerns about the size of characters in the printed dictionary. It is not uncommon for dictionaries to be printed in very small font size as it makes economic sense since the smaller the font size, the less pages will have to be published. This is often a problem with beginner learners as the smaller the Japanese characters are printed, the less details becomes available for them to analyze. One participant summarized his experience in the following way: "Using the paper dictionary & using stroke count is even more difficult when a beginner has to used printed script as a reference. The more intricate the kanji, the more difficult using the dictionary gets."

Kanjiform was designed to display as large a kanji as possible, although the English text was kept fairly small in order to ensure the compactness of the interface. Two volunteers seemed to agree: "It is a lot better to use the electronic version especially if you don't want to weaken your eyesight." and "The site is easier and more user friendly because the kanji characters are larger and way easier to see. The dictionary was hard to see because the characters were way too small (especially for people who have vision problems)."

One more participant agreed with the fact that the printed characters were hard to read but saw the convenience in having a portable tool: "The book was also difficult because the characters and words are small (I have glasses), but it was more convenient." Although Kanjiform is already accessible on portable devices via the Internet, the main interface has not been designed for small displays such as those found on mobile phones and personal digital assistants currently available. True portability is certainly something that the author would like to pursue and this will be facilitated by the advent of better and faster mobile devices equipped with larger high-resolution displays, such as the ultra-mobile personal computers starting to appear on the market.

- ***Mnemonic Devices***

One volunteer had this comment to make on the mnemonic pictures used within the study interface: "Some of the images to help remember were a little obscure or ridiculous. I would suggest working little by little on an improved visual system." The author would agree that using images as a memory aid is a very complex undertaking and an area of research in itself. The humble attempt at using images such as those designed by Daiki Kusuya (2001) within Kanjiform may need to be further studied.

- ***Layout***

The same compromises we made in order to make the search interface as compact as possible may have had a somewhat negative effect on the design of the study interface. One participant noted that: "I found the animation and where the kanji form is explained on the online version a little congested. I felt there was a lot to look at and everything felt really close together."

- ***Discussion***

It became obvious that by the end of the study, participants were starting to realize how difficult learning kanji really is. One participant summarized the experience with the following comment: "All in all, I enjoyed this study and it really is an eye opener for me because this language (writing) is very difficult to learn."

The author is grateful for all the constructive comments made by the users. These are always very useful in improving software functionalities and will help shape the next versions of Kanjiform into a better and more powerful tool.

### **Limitations of the Study**

Bearing in mind the violations of normality apparent in the dataset, t-tests were the appropriate analyses. Multiple tests were conducted on the same group of participants, increasing the likelihood of type 1 or experiment-wise error. However, there is no simple solution for this, given that assumptions and sample size are not appropriate to MANOVA (which would enable one to establish the overall level of error across all comparisons at a chosen value) and given that the tests cannot reasonably be expected to function independently, thus excluding a Bonferonni adjustment as a solution.

## **CHAPTER 7 - CONCLUSION**

### **Accomplishments**

After a thorough literature review, and from personal experience as a language learner, I decided to attempt to bridge the gap identified as one of the most difficult hurdles in Japanese language acquisition, namely, finding and learning kanji. This problem is acknowledged by many in the literature and well summarized by de Courcy and Birch (1993): "Learning kanji seems to be the major problem for students developing literacy in Japanese"

The solution I decided to pursue and test would not require prior knowledge of the Japanese Language System, such as counting calligraphic strokes or knowledge of radicals, but instead would be based on simple structural and graphical rules. An on-line software prototype was therefore developed and tested by 21 participants in an exhaustive series of meetings and tests.

### **Results and Main Points of Discussion**

The principal findings from this study show that Kanjiform provides a faster and more accurate search method to find kanji than the traditional paper dictionary. Participants also reported that

the method was easy to learn, enjoyable and makes finding kanji an easier task.

The memory tests were somewhat less conclusive with the first test not yielding a significant difference while the second test, a delayed recall measure, did produce a significant difference in favour of Kanjiform. These results perhaps points to some advantage at using a structural approach for increased long-term memory recall or deeper learning. As learning was incidental in this study, the focus being on the search and retrieval, more convincing results might be found with group of learners genuinely motivated and engaged in learning tasks related to Japanese language acquisition.

These findings seem to support my hypothesis that utilization of a search and retrieval method that is based on detailed description of the structure of kanji may lead to improved recall of the kanji under study.

### **Recommendations**

- ***Larger Sample***

It is always preferable to study a larger sample. I would have preferred to double the size of participants but this was made

difficult on an individual basis, by the sizeable time requirement of the study.

- ***Balanced Approach***

Working with volunteers, busy university students in this case, requires a balanced approach as to how much time and effort the study requires from them. Several meetings, hours of homework and study time were required for this study and I consider myself fortunate that none of the volunteers left before completing the entire process. This is probably because the level of involvement required by the study was made clear on the recruitment poster and at the outset of the study, but it also probably became a hindrance to finding more participants.

- ***Improved Testing Tools***

Although most of the materials had been piloted before the final testing, a few participants scored the maximum possible points for tests or completed a task well within the prescribed time. The particular students participating in this study were from quite competitive academic programs and were, perhaps not surprisingly, very motivated and accustomed to perform well during exams or tests. Testing tools that would allow for better upper-limit testing by either having a shorter time limit or more questions should be considered for further experiments.

- ***Other On-Line Search Tools***

The decision to test Kanjiform against a traditional paper dictionary was made mostly because of the desire to test against materials designed for, and currently in use by, beginners. Although there is beginner curriculum available on the Internet, most of the on-line kanji search tools are not developed with this group in mind. We did, however, compare Kanjiform and WWWJDIC to gather data about their respective interfaces.

Nonetheless, it would be important in the future to compare Kanjiform with other on-line beginner tools as they hopefully become more common.

- ***Curriculum Integration***

In this study, participants concentrated on the form and meaning of kanji. Since it is important to learn not only form and meaning but also kanji reading (pronunciation) at the same time, a more integrated approach to curriculum and new tools should be tested in the future.

**Contribution to knowledge**

A discipline advances with people making a contribution to the existing body of knowledge and reporting on their original research, thus making such information available to others.



As with all research, mine was built on, and combined with existing writings. In addition, it looked at the problem from a different perspective and went deliberately against traditional approaches. By taking a purely graphic and structural approach to this special case of database query, I was able to create a search tool that is easily accessible to beginner learners of Japanese. This, I believe is my humble contribution to the field.

### **Future Research and Development**

For future research, I intend to build on the work I have done over the past few years in creating viable tools for beginner learners. I would like to further integrate the constructivist strategies utilized in the search process with the study interface. I plan to investigate if the use of more direct input devices during the search would improve the learning outcome. Such a tool might consist of a digital canvas divided as a grid. A user would interact with the touch screen by selecting items from graphical menus of graphemes or stroke intersections. Dragging these building blocks in the appropriate quadrant of the grid would result in a direct query to the kanji database.

The study interface could further be improved by providing more interactivity. For example, in addition to showing an animation of brush strokes, the learner might also attempt to draw the

character with a stylus or by simply using the tip of a finger. These types of activity would help marry the more traditional Japanese teaching methods and today's technology. Educational games could also be created and give more context to the kanji under study.

Lastly, vocabulary created by combinations of two or more kanji should also be integrated in the database and the study interface as these kanji compounds become more important as a learner progresses.

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## APPENDICES

## **Appendix A: General Questionnaire**

## **General Questionnaire**

Structural Approaches and Strategies to Identify  
& Remember Japanese Kanji Characters.

André Plante, Educational Technology Dept.

### ***Purpose***

The purpose of this questionnaire is to get a general idea of your interest in learning a foreign language such as Japanese.

This questionnaire is divided into two sections, covering the following aspects:

1. Basic information
2. Foreign Language Survey

### ***Disclosure***

Your answers will be confidential, and will be used in aggregate form. Participation in this questionnaire is voluntary, and your name will not be associated with this questionnaire. If you have any questions about the questionnaire, or any of the questions in it, please do not hesitate to ask me in person or by e-mail at [andre.plante@sheridaninstitute.ca](mailto:andre.plante@sheridaninstitute.ca)



**Identification/Basic Information**

Gender: Female \_\_\_\_\_ Male \_\_\_\_\_

**Please circle the appropriate answer:**

I- My age group is:

a) 15-19	b) 20-24	c) 25-29	d) 30-34	e) 35+
----------	----------	----------	----------	--------

II- My mother tongue is \_\_\_\_\_:

(you may circle more than one answer, and provide details for languages followed by “: \_\_\_\_\_” i.e. “Cantonese”)

English	French	Chinese: _____	Spanish	Punjabi
Aboriginal: _____	Arabic	Polish	German	Portuguese
Farsi	Tagalog	Korean	Russian	Other(s): _____
<small>(Ordering based on: Statistics Canada, 1996-2001 Censuses)</small>				

III- I can carry on a conversation in \_\_\_\_\_:

(you may circle more than one answer, and provide details for languages followed by “: \_\_\_\_\_” i.e. “Cantonese”)

English	French	Chinese: _____	Spanish	Punjabi
Aboriginal: _____	Arabic	Polish	German	Portuguese
Farsi	Tagalog	Korean	Russian	Other(s): _____
<small>(Ordering based on: Statistics Canada, 1996-2001 Censuses)</small>				

**Foreign Language Survey**

1) Have you ever been curious about the meaning of Chinese and/or Japanese characters?

- a. Yes
- b. No

2) How many Chinese/Japanese characters can you read?

- a. None
- b. 1-10
- c. 11-100
- d. 101-300
- e. 301-1000
- f. 1001 and more

- 3) Do you enjoy learning new languages?
- a. Yes
  - b. No

If you answered "Yes" to the previous Question, please answer the next 3 questions.  
If you answered "No" you are done! Thank you!

- 4) What motivates you to learn new languages?  
*(you may circle more than one answer)*
- a. I like to travel and speak with the locals in their own language.
  - b. I like to read books / watch movies in the original language
  - c. I like to chat on-line with people from around the world
  - d. I want to work abroad
  - e. Other: \_\_\_\_\_ (please specify)

- 5) What language(s) are you currently learning or are you considering?  
*(you may circle more than one answer)*
- a. Chinese
  - b. French
  - c. Japanese
  - d. Spanish
  - e. Other: \_\_\_\_\_ (please specify)

- 6) What kind of tools do you like to use when studying a foreign language?  
*(you may circle more than one answer)*
- a. Textbook
  - b. Paper dictionary
  - c. On-line dictionary
  - d. Paper Flashcards
  - e. Foreign language magazines
  - f. CD/DVD
  - g. Foreign language websites
  - h. Other: \_\_\_\_\_ (please specify)

**Any comments?**

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Thank You!

## **Appendix B: Interface Components Questionnaire**

## **Interface Components Questionnaire**

Structural Approaches and Strategies to Identify  
& Remember Japanese Kanji Characters.

André Plante, Educational Technology Dept.  
Concordia University

### ***Purpose***

The purpose of this questionnaire is to get your feedback about the concepts behind an experimental interface for an on-line tool currently being designed.

This questionnaire is divided into three sections, covering the following aspects:

1. Basic information
2. Interface Design
3. Interface Concepts Evaluation

### ***Disclosure***

Your answers will be confidential, and will be used in aggregate form. Participation in this questionnaire is voluntary, and your name will not be associated with this questionnaire. If you have any questions about the questionnaire, or any of the questions in it, please do not hesitate to ask me in person or by e-mail at [andre.plante@sheridaninstitute.ca](mailto:andre.plante@sheridaninstitute.ca)

**Identification/Basic Information**

Please circle the appropriate answer:

I- My gender is:

a) Female	b) Male
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II- My age group is:

f) 15-19	g) 20-24	h) 25-29	i) 30-34	j) 35+
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III- My mother tongue is:

(you may circle more than one answer, and provide details for languages followed by “: \_\_\_\_\_” i.e. “Cantonese”)

English	French	Chinese: _____	Spanish	Punjabi
Aboriginal: _____	Arabic	Polish	German	Portuguese
Farsi	Tagalog	Korean	Russian	Other(s): _____
<small>(Ordering based on: Statistics Canada, 1996-2001 Censuses)</small>				

IV- I can carry on a conversation in:

(you may circle more than one answer, and provide details for languages followed by “: \_\_\_\_\_” i.e. “Cantonese”)

English	French	Chinese: _____	Spanish	Punjabi
Aboriginal: _____	Arabic	Polish	German	Portuguese
Farsi	Tagalog	Korean	Russian	Other(s): _____
<small>(Ordering based on: Statistics Canada, 1996-2001 Censuses)</small>				

V- How many Chinese/Japanese characters can you read?

a) None	b) 1-10	c) 11-100	d) 101-300	e) 301-1000	f) >1001
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**Interface Design Survey**

1. While looking for the spelling or the meaning of a word, which of the following tools do you prefer to use? (Circle only ONE answer)

- a. Paper/traditional dictionary
- b. On-line dictionary
- c. Electronic dictionary (small devices sold for travelers, ESL learners, etc)
- d. Search engine (such as Google)
- e. Other: \_\_\_\_\_ (please specify)

2. What makes you want to use a particular online tool over and over? (such as Google, a currency calculator, etc.) Rank the items in the list below from 1 to 5 (1 being the most important factor)

- \_\_\_ “Cool” looking
- \_\_\_ Easy to use
- \_\_\_ Everyone I know is using it
- \_\_\_ Provides good answers
- \_\_\_ Fast

### Interface Concepts

In the next 5 questions you will be asked to match Japanese Characters (Kanji) with simple descriptive statements.

3. Please circle the character(s) that contains at least one **horizontal** line:

a) 出	b) 体	c) 川	d) 京	e) 少
------	------	------	------	------

4. Please circle the character(s) that contains at least one **vertical** line:

a) 冬	b) 六	c) 夕	d) 人	e) 早
------	------	------	------	------

5. Looking at each kanji character carefully, how many square or rectangular box(es) can you count? Have a look at example a) and write your answers below each of the other kanji.

a) 早 2	b) 思	c) 計	d) 買	e) 別
-----------	------	------	------	------

6. Now think of your kanji as a roadmap... can you see a "**CAPITAL T**" T-shaped intersections in any of the following characters? Circle the appropriate answer(s).

a) 正	b) 林	c) 人	d) 雨	e) 元
------	------	------	------	------

7. Kanji characters vary in graphic complexity. Compare the following characters with the scale showing a progression from 1 (simple) to 7 (complex). Have a look at example a) and b) and then circle the appropriate number for each of the other kanji.

	天	借	藥				
	1	2	3	4	5	6	7
a) 人	<input checked="" type="checkbox"/>	2	3	4	5	6	7
b) 顔	1	2	3	4	5	6	<input checked="" type="checkbox"/>
c) 前	1	2	3	4	5	6	7
d) 中	1	2	3	4	5	6	7
e) 出	1	2	3	4	5	6	7
f) 頭	1	2	3	4	5	6	7
g) 土	1	2	3	4	5	6	7

Any comments?

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Thank You!

## **Appendix C: Interface Questionnaire**



## **Interface Questionnaire**

Structural Approaches and Strategies to Identify  
& Remember Japanese Kanji Characters.

André Plante, Educational Technology Dept.

### ***Purpose***

The purpose of this questionnaire is to get your feedback about the interface of a few on-line specialized search-engines.

This questionnaire is divided into three sections, covering the following aspects:

1. Basic information
2. Interface Design
3. Comparison

### ***Disclosure***

Your answers will be confidential, and will be used in aggregate form. Participation in this questionnaire is voluntary, and your name will not be associated with this questionnaire. If you have any questions about the questionnaire, or any of the questions in it, please do not hesitate to ask me in person or by e-mail at [andre.plante@sheridaninstitute.ca](mailto:andre.plante@sheridaninstitute.ca)

**Identification/Basic Information**

Gender: Female \_\_\_\_ Male \_\_\_\_

**Please circle the appropriate answer:**

I- My age group is:

k) 15-19	l) 20-24	m) 25-29	n) 30-34	o) 35+
----------	----------	----------	----------	--------

II- My mother tongue is:

(you may circle more than one answer, and provide details for languages followed by “: \_\_\_\_\_” i.e. “Cantonese”)

English	French	Chinese: _____	Spanish	Punjabi
Aboriginal: _____	Arabic	Polish	German	Portuguese
Farsi	Tagalog	Korean	Russian	Other(s): _____
<small>(Ordering based on: Statistics Canada, 1996-2001 Censuses)</small>				

III- I can carry on a conversation in:

(you may circle more than one answer, and provide details for languages followed by “: \_\_\_\_\_” i.e. “Cantonese”)

English	French	Chinese: _____	Spanish	Punjabi
Aboriginal: _____	Arabic	Polish	German	Portuguese
Farsi	Tagalog	Korean	Russian	Other(s): _____
<small>(Ordering based on: Statistics Canada, 1996-2001 Censuses)</small>				

IV- How many Chinese/Japanese characters can you read?

- a) None
- b) 1-10
- c) 11-100
- d) 101-300
- e) 301-1000
- f) 1001 and more

**Interface Design Survey**

7. While looking for the spelling or the meaning of a word, which of the following tools do you prefer to use? (Circle only ONE answer)

- a. Paper/traditional dictionary
- b. On-line dictionary
- c. Electronic dictionary (small devices sold for travelers, ESL learners, etc)
- d. Search engine (such as Google)
- e. Other: \_\_\_\_\_ (please specify)

8. What makes you want to use a particular online tool over and over? (such as Google, a currency calculator, etc.) Please rank the items in the list below from 1 to 5 (1 being the most important factor)

- "Cool" looking
- Easy to use
- Everyone I know is using it
- Provides good answers
- Fast

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### Comparison

Using SAFARI on your Apple Computer, please open a web browser to **Kanjiform.com** at <http://www.kanjiform.com> and another web browser to the **Multi-Radical Kanji Selection screen** by clicking on the link at the top of the Kanjiform.com window or typing the following: <http://www.csse.monash.edu.au/~jwb/cgi-bin/wwwjdic.cgi?1R>

9. Which of the two sites looks more inviting to you at first glance?
- a) Multi-Radical Kanji
  - b) KanjiForm.com

Why? (please write clearly)

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10. Look at the two sites for a minute or so, which one seems better suited for a beginner?
- a) Multi-Radical Kanji
  - b) KanjiForm.com

11. Which of the two uses simpler language?
- a) Multi-Radical Kanji
  - b) KanjiForm.com

Using both KanjiForm.com and Multi-Radical Kanji, try to find the following Japanese Kanji Character:



Then, answer the questions in the columns below:

<b>KanjiForm.com</b>	<b>Multi-Radical Kanji</b>
<p>K6- Did you find the kanji using KanjiForm.com?</p> <p>a) Yes b) No</p>	<p>M6 - Did you find the kanji using Multi-Radical Kanji?</p> <p>a) Yes b) No</p>
<p>K7- What was the experience like?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>M7- What was the experience like?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>K8- Any suggestion on how to improve the interface?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>M8- Any suggestion on how to improve the interface?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>

**Any other comments?**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Thank You!

## Appendix D: Poster

# **22 Research Volunteers Needed!**

**Would you like to learn a few Japanese Characters?**

**Would you like to help design an on-line search engine?**

You would be required to evaluate how the new experimental approach compares to traditional learning strategies used today in Japanese classes by attending two short group sessions answering questionnaires and participating in 2 short interviews.

Your participation in the study would require about 12 hours spread over a couple of weeks.

**Week 1**

- 1/2 hour initial meeting
- ~2 hours at home looking up Kanji using Tool 1
- ~3 hours at home studying the meaning of some characters
- ~1 hour evaluation questionnaire

**Week 2**

- 1/2 hour meeting
- ~2 hours at home looking up Kanji using Tool 2
- ~3 hours at home studying the meaning of some characters
- ~1 hour evaluation questionnaire

**You could win:**

- **1 iPod Nano 2GB or**
- **1 of 2 iPod shuffle 512MB or**
- **1 of 2 50\$ prize in iTune, HMV Gift Certificates or cash**
- **1 of 19 25\$ prize in iTune, HMV Gift Certificates or cash**



日本語

Please e-mail ASAP André Plante at [andre.plante@sheridaninstitute.ca](mailto:andre.plante@sheridaninstitute.ca) with the information requested below:

- 7) Your name: \_\_\_\_\_
- 8) Your gender: Male \_\_\_\_\_ Female \_\_\_\_\_
- 9) Your age: \_\_\_\_\_
- 10) Your e-Mail: \_\_\_\_\_
- 11) How many Chinese/Japanese characters can you read?

a. None	b. 1-10	c. 11-100	d. 101-300	e. 301-1000	f. 1001 and more
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Selected Participants will be contacted by e-mail.

## **Appendix E: Meeting Protocols**

### **Protocol Meeting 1**

1. Thank you for participating in the study
2. Summarize the design of the study
3. Find Code for participant, (check mark in spreadsheet)
4. Give the participant his/her package
5. Have the participant sign the consent form
6. Show the following question:
  - a. On a scale from 1 to 5 (5 being "very good")
  - b. How would you rate your computer skills?
  - c. 1. Very Weak    2. Weak    3. Average    4. Good    5. Very Good
  - d. (Record answer on spreadsheet)
7. Go through the package and explain the two main documents
8. Demonstrate the tool
9. Answer Questions
10. Book next meeting

### **Protocol Meeting 2**

1. Greet
2. Get Study Materials back from participant
3. Explain Agenda for this meeting
4. Administer test/questionnaire on Search skills (15min)
5. Take back questionnaire from participant
6. Administer test/questionnaire on memory (15min)
7. Take back questionnaire from participant
8. Give new study materials to participant
9. Demonstrate the tool
10. Answer Questions
11. Book next meeting



### **Protocol Meeting 3**

1. Greet
2. Get Study Materials back from participant
3. Explain Agenda for this meeting
4. Administer test/questionnaire on Search skills (15min)
5. Take back questionnaire from participant
6. Administer test/questionnaire on memory (15min)
7. Take back questionnaire from participant
8. Administer User Survey questionnaire (15min)
9. Take back questionnaire from participant
10. Thank participant for involvement
11. Book next meeting

### **Protocol Meeting 4**

1. Greet
2. Explain Agenda for this meeting
3. Administer test/questionnaire on memory (15min)
4. Take back questionnaire from participant
5. Debrief
6. Thank participant for involvement

## **Appendix F: Kanji used in Kanjiform Treatment**

一	1	one, once, first	安	45	restful, feel at ease, cheap
万	3	ten thousand, myriad	少	47	few, little, small
上	5	top, up, upper part, rise, go up, climb up	川	49	river, stream, brook
中	7	center, centre, middle, inside	年	51	year
二	9	two, second	後	53	back, behind, rear, afterwards, after
人	11	person, people, man, human being	新	55	new, novel, fresh
休	13	rest, take a day off, relax	時	57	time, hour, o'clock
何	15	what, how many	月	59	month, moon, Monday
入	17	enter, put in, come in	本	61	book, root, origin, main, this
六	19	six, sixth	東	63	east, eastern
出	21	go out, put out	母	65	mother, cause, motive, mama
前	23	before, in front, former	氣	67	spirit, vapor, mind, soul, heart, mood, feelings
十	25	ten, tenth	火	69	fire, Tuesday
午	27	noon	生	71	life, birth, grow, raw, existence
南	29	south	白	73	white
口	31	mouth, opening, entrance	目	75	eye, item, aim, look, gaze
右	33	right	空	77	sky, air, emptiness
四	35	four, fourth	耳	79	ear
土	37	earth, soil, ground, Saturday	花	81	flower, blossom
多	39	many, much, numerous	西	83	west, western
天	41	sky, air, heavens, celestial sphere	言	85	say, speak, talk, words
子	43	child, offspring	語	87	word, language, speak, speech, term

買	89	buy, purchase	去	133	go away, leave
車	91	car, vehicle, wheel, carriage	合	135	combine, unite, fit, suit
道	93	way, path, road, way of moral conduct	味	137	taste, flavor
長	95	long, chief, head	員	139	member, official
雨	97	rain, rainfall	回	141	turn round, revolve, rotate, time
食	99	eat, food, meal	地	143	earth, land, ground, place
駅	101	station, railway station	場	145	place, hall, grounds
魚	103	fish	売	147	sell, deal in
世	105	world, age, generation	夕	149	evening, dusk
乘	107	ride, ride in, travel, get on, power	太	151	big, thick, great, large
京	109	capital, metropolis	妹	153	younger sister
代	111	substitute, generation, fee	始	155	begin, start, open
低	113	low, humble	室	157	room, house, apartment
体	115	body, object, form	寒	159	cold, chilly
使	117	use, employ, messenger	工	161	construction, work, artisan
借	119	borrow, get a loan	帰	163	return
元	121	origin, beginning, element	度	165	degree, time, extent
光	123	light, glow, shine, glitter, sparkle	引	167	pull, draw, haul, tug
冬	125	winter	弱	169	weak
別	127	seperate, another, branch off	待	171	wait, wait for, expect
勉	129	endeavor, make efforts	思	173	think, believe
区	131	ward, district, section, area, zone	悪	175	bad, evil, wicked

所	177	place	町	221	town, city, town section
教	179	teach, instruct, coach, religion	界	223	world, circle, bounds, boundary
料	181	materials, fee, charge, rate	発	225	start, emit, discharge, reveal, develop
旅	183	travel, journey, trip	真	227	true, real, actual, truth
早	185	early, quick, prompt, fast	知	229	know, knowledge, let know, inform
映	187	reflect, project, shine	研	231	hone, grind, polish, research, investigate
昼	189	daytime, noon, midday	秋	233	autumn, fall
暗	191	dark, gloomy, from memory	答	235	answer, reply, respond
有	193	have, own, possess, being	終	237	end, finish, terminate
朝	195	morning, dynasty, reign, rule	考	239	think, consider, study, investigate
林	197	forest, woods, grove	肉	241	meat, flesh
業	199	work, business, industry, occupation, trade	色	243	colors, colours, complexion, feature, lust
歌	201	song, sing	茶	245	tea, tea leaves, light brown
正	203	correct, right, righteous, just	薬	247	drug, medicine, pharmaceutical
死	205	die, death	計	249	plan, devise, compute, meter, gauge, total
池	207	pond, pool, reservoir	説	251	explain, theory
洋	209	ocean, sea, western, European	質	253	quality, grade, matter, material, query, question
海	211	sea, ocean	走	255	run, dash, run away, flee
牛	213	cow, ox, cattle, bull, beef	転	257	turn, rotate, turn into, change, move, transfer
特	215	special, peculiar	近	259	near, close, nearby, recent, modern
理	217	reason, principle, manage	通	261	pass by, pass through, commute, through
用	219	use, utilize, be effective, work, errand, task	運	263	transport, carry, move, fortune, luck, fate

都	265	metropolis of Tokyo
野	267	uncultivated field, field, range, area
門	269	gate, gateway, entrance, door
院	271	institution, hospital, clinic, academy, institute
青	273	blue, green, youthful, young
頭	275	head, chief, top
顔	277	face
飯	279	cooked rice, meal, food
首	281	head, neck, leader
鳥	283	bird, chicken, fowl

## **Appendix G: Kanji used in Traditional Treatment**

七	2	seven, seventh	小	46	small, minor, little, short
三	4	three, third	山	48	mountain
下	6	under, below, lower part, inferior, go down	左	50	left
九	8	nine, ninth	店	52	store, shop, place of business
五	10	five, fifth	手	54	hand, occupation, arm, means
今	12	now, present, this	日	56	day, sun, Sunday
会	14	meet, assembly, society	書	58	write, writing, book
先	16	ahead, before, previous, precede	木	60	tree, wood, timber, Thursday
八	18	eight, eighth	来	62	come, coming, arrive, come to
円	20	circle, round, yen	校	64	school, proofread, collate
分	22	divide, minute, part, understand	每	66	every, each
北	24	north	水	68	water, Wednesday
千	26	thousand	父	70	father, papa, daddy
半	28	half, semi-, hemi-, halfway	男	72	man, male
友	30	friend, companion, pal	百	74	hundred, numerous
古	32	old, ancient	社	76	company, firm, society, social, shrine
名	34	name, fame, famous	立	78	stand, stand up, establish, set up, erect
国	36	country, region, nation	聞	80	hear, hear of, learn of
外	38	outside, without, foreign	行	82	go, act, line, carry out, travel
大	40	large, big, great, important	見	84	see, look at, observe
女	42	woman, female, girl	話	86	talk, speak, tell, converse
学	44	study, learning, science	読	88	read



足	90	foot, leg, suffice, be enough	台	134	stand, platform, base
週	92	week, weekly	同	136	same, the same, equal
金	94	metal, gold, money, Friday	品	138	goods, quality, article, item
間	96	interval, between, space	問	140	question, ask, problem
電	98	electricity	圖	142	drawing, diagram, plan, figure
飲	100	drink, swallow, beverage	堂	144	hall, temple, shrine
高	102	high, tall, lofty	声	146	voice, sound
不	104	not, negation, bad, un-, dis-	夏	148	summer
主	106	main, master, principle, lead	夜	150	night, evening, nighttime
事	108	thing, matter, fact, affair	好	152	like, be fond of, favorable, good, fine
仕	110	serve, do	姊	154	older sister
以	112	starting point, by means of	字	156	character, letter, word
住	114	live, dwell, reside	家	158	house, home, residence, specialist
作	116	make, work, produce	屋	160	house, building, shop, roof
便	118	convenient, handy, post, mail, excrement, flight	市	162	city, town, market, fair
働	120	work, labor, serve	広	164	wide, spacious, broad, vast, extensive
兄	122	brother, older brother	建	166	build, construct, erect
写	124	copy, duplicate	弟	168	young brother
切	126	cut, chop, carve, slice	強	170	strong, strength, powerful
力	128	power, strength, effort, force	心	172	heart, mind, feeling, center
動	130	move, motion	急	174	hurry, urgent, sudden
医	132	medicine, medical, doctor	意	176	mind, meaning, heart, thought, desire

持	178	hold, have, grasp	画	222	picture, drawing, draw, paint, mark off, plan
文	180	letter, writing, literary	病	224	illness, sickness, disease, suffer from
方	182	direction, way, square, side	県	226	prefecture, territorial divisions
族	184	family, relatives, clan, tribe	着	228	arrive, dress, wear, stick, adhere
明	186	bright, clear	短	230	short, brief
春	188	spring	私	232	I, private, personal
暑	190	summer heat, hot	究	234	investigate, study, examine, delve into
曜	192	weekday, day of the week, -day	紙	236	paper
服	194	clothes, submit	習	238	learn, be taught, custom, habit
村	196	village, rural district	者	240	person
森	198	thick woods, forest	自	242	self, oneself, by itself, naturally
楽	200	pleasure, enjoy, music, comfortable	英	244	distinguished, outstanding, English, UK, British
止	202	stop, halt	菜	246	vegetables, green
步	204	walk, step, pace, progress	親	248	parent, relatives, intimate, familiar
民	206	people, race, populace	試	250	try, attempt, test, sample
注	208	pour, note, pay attention to	貸	252	lend, loan, rent, hire out
洗	210	wash, clean	赤	254	red, crimson, scarlet, Communist
漢	212	Chinese, fellow, Han Dynasty	起	256	rise, get up, raise up, lift, start, begin
物	214	thing, goods, object	輕	258	light
犬	216	dog, hound, puppy	送	260	send, ship, deliver, mail, transmit
産	218	give birth, produce	進	262	advance, proceed, advance in rank
田	220	rice field, paddy	遠	264	distant, far, remote

重	266	heavy, weight, pile up, duplicate, repeat
銀	268	silver
開	270	open, open up, commence, establish
集	272	collect, gather, assemble, recruit
音	274	sound, noise, speech sound, voice
題	276	title, caption, heading, topic, subject, problem
風	278	wind, breeze, manners, customs
館	280	large public building, hall
驗	282	test, try, attempt, examine, verify
黑	284	black

## **Appendix H: Sample of Search Practice Materials**

My Code: \_\_\_\_\_

Kodansha.dict

Find the kanji and fill in the appropriate information:

分	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
北	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
千	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
半	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
友	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
古	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
名	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
国	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
外	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
大	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____

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My Code: \_\_\_\_\_

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Find the kanji and fill in the appropriate information:

来	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
校	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
毎	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
水	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
父	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
男	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
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社	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
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My Code: \_\_\_\_\_

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Find the kanji and fill in the appropriate information:

高	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
不	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
主	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
事	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
仕	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
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作	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
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My Code: \_\_\_\_\_

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Find the kanji and fill in the appropriate information:

凶	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
堂	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
声	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
夏	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
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好	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
姉	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
字	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
家	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
屋	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____

HA.

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My Code: \_\_\_\_\_

Kodansha.dict

Find the kanji and fill in the appropriate information:

方	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
族	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
明	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
春	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
暑	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
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服	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
村	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
森	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
楽	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____

H.A.

Kodansha.dict

My Code: \_\_\_\_\_

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Find the kanji and fill in the appropriate information:

画	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
病	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
県	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
着	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
短	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
私	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
究	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
紙	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
習	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____
者	Page #: <input type="text"/>	This kanji was: <input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	I spent this amount of time: Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more	Any comments? _____ _____

H.A.

Kodansha.dict

My Code: \_\_\_\_\_

Kodansha.dict

Find the kanji and fill in the appropriate information:

進	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		
遠	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		
重	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		
銀	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		
開	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		
集	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		
音	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		
題	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		
風	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		
館	Page #:	This kanji was:	I spent this amount of time:	Any comments?
	<input type="checkbox"/> Easy to find <input type="checkbox"/> Moderately easy to find <input type="checkbox"/> Difficult to find <input type="checkbox"/> Impossible, I gave up	Indicate the time on the scale with X 0 0.5 1 min 2 min 3 min more		

H.A.

Kodansha.dict

## **Appendix I: Kanjiform Study Materials**

In this section you will study the following 20 kanji:

人	口	土	天	川	月	東	火	目	言
車	雨	魚	光	回	工	林	肉	門	鳥

Use kanjiform.com to find the characters and concentrate on memorizing them and their English meaning.

1- Circle the correct English meaning for 天:

- a. Mountain
- b. Sky
- c. Time
- d. Blue
- e. Winter

2- Circle the correct English meaning for 林:

- a. Forest
- b. Water
- c. East
- d. Red
- e. Money

3- Circle the correct English meaning for 門:

- a. Face
- b. Gate
- c. Morning
- d. Moon
- e. Snow

4- Circle the correct English meaning for 月:

- a. Car
- b. Meat
- c. Eye
- d. Moon
- e. Fish

5- Circle the correct English meaning for 肉:

- a. Gate
- b. Meat
- c. Head
- d. Sun
- e. Rice

6- Circle the Kanji that represents "moon" and by extension "month"

1. 人    2. 魚    3. 門    4. 月    5. 車

7- Circle the Kanji that represents "gate" and by extension "entrance"

1. 林    2. 門    3. 天    4. 魚    5. 人

8- Select the correct Kanji for each sentence by entering its number in the appropriate blank below:

1. 肉    2. 天    3. 月    4. 林    5. 門

- a. Her house was surrounded by a tall fence and a \_\_\_\_\_ (gate).
- b. Lions always eat \_\_\_ 1 \_\_\_ (meat).
- c. At night, we can see the \_\_\_\_\_ (moon) shining bright.
- d. Bears and wolves live in the \_\_\_\_\_ (forest).
- e. It's sunny today and the \_\_\_\_\_ (sky) is blue.

9- Select the correct Kanji for each blank space by entering its number in the appropriate blank below:

1. 川    2. 魚    3. 人    4. 車    5. 雨

Yesterday morning, I saw this \_\_\_\_\_ (person) driving a red \_\_\_\_\_ (car) by the \_\_\_ 1 \_\_\_ (river). She stopped and waived at a little girl holding a big \_\_\_\_\_ (fish). Hurry up! It looks like it will \_\_\_\_\_ (rain).

10- Connect with an arrow each kanji and its corresponding English meaning:

天		gate
月	----->	moon
林		car
魚		rain
雨		forest
車		person
肉		sky
人		river
川		fish
門		meat

11- Circle the correct English meaning for 目:

- a. Mountain
- b. Construction
- c. Eye
- d. Moon
- e. Winter

12- Circle the correct English meaning for 回:

- a. Square
- b. Turn round
- c. Eye
- d. Red
- e. Snow

13- Circle the correct English meaning for 鳥:

- a. Bird
- b. Fish
- c. Morning
- d. Moon
- e. Car

14- Circle the correct English meaning for 土:

- a. Car
- b. Meat
- c. Earth
- d. Moon
- e. Rice

15- Circle the correct English meaning for 東:

- a. Say
- b. Light
- c. Fire
- d. East
- e. River

16- Circle the Kanji that represents "turn round" and by extension "time"

1. 工    2. 光    3. 回    4. 口    5. 火

17- Circle the Kanji that represents "bird" and by extension "chicken"

1. 鳥    2. 土    3. 目    4. 言    5. 回

18- Select the correct Kanji for each sentence by entering its number in the appropriate blank below:

1. 東     2. 口     3. 言     4. 光     5. 火

- a. The museum was destroyed by the \_\_\_\_\_ (fire).
- b. The sun rises in the \_\_\_ 1 \_\_\_ (east).
- c. The dentist asked me to open my \_\_\_\_\_ (mouth) wide.
- d. Always \_\_\_\_\_ (say) "thank you" after someone gives you a gift.
- e. The sunset creates a beautiful \_\_\_\_\_ (light) on the ocean.

19- Select the correct Kanji for each blank space by entering its number in the appropriate blank below:

1. 回     2. 土     3. 工     4. 目     5. 鳥



Because of the road \_\_\_\_\_ (construction), a great pile of \_\_\_\_\_ (earth) was created. Many small \_\_\_\_\_ (birds) have started to \_\_\_\_\_ (turn round) the site. There were so many, I could not believe my \_\_\_\_\_ (eyes).

20- Connect with an arrow each kanji and its corresponding English meaning:

火	----->	fire
目		east
言		light
回		construction
光		eye
鳥		earth
口		bird
土		mouth
工		say
東		turn round

## Summary Page

Kanji	English Meaning	Looked at Picture	Looked at Animation
天	Sky, air, heavens	✓	✓
月			
林			
魚			
雨			
車			
肉			
人			
川			
門			
火			
目			
言			
回			
光			
鳥			
口			
土			
工			
東			

## Appendix J: Kanjiform Test 1

# Kanjiform.com Study Questionnaire

My code: \_\_\_\_\_

## PART 1

### Kanji Search Skills

(Within a monitored 15-minute period)

1- Using the online tool [www.kanjiform.com](http://www.kanjiform.com), please find (in no particular order) as many of the following kanji characters as possible and write in the space provided the Nelson number corresponding to each kanji:

Example: 

太 1172
--------

一	上	二	休	入
出	十	南	右	土
天	安	川	後	時
本	母	火	白	空
花	言	買	道	雨
駅	世	京	低	使
元	冬	勉	去	味
回	場	夕	妹	工

## Kanjiform.com Study Questionnaire

My code: \_\_\_\_\_

### PART 2 (15-minute Period)

Without the help of any tools, please answer the following questions:

1- Circle the correct English meaning for 門:

- a. Mountain
- b. Gate
- c. Time
- d. Blue
- e. Winter

2- Circle the correct English meaning for 林:

- a. Water
- b. East
- c. Red
- d. Forest
- e. Money

3- Circle the correct English meaning for 月:

- a. Car
- b. Meat
- c. Eye
- d. Moon
- e. Fish

4- Circle the correct English meaning for 魚:

- a. Gate
- b. Meat
- c. Fish
- d. Sun
- e. Rice

5- Select the correct Kanji for each blank space by entering its number in the appropriate blank below:

1. 川      2. 天      3. 車      4. 肉

Yesterday, I drove my mother's \_\_\_\_\_ (car) slowly by the \_\_\_\_\_ (river). It was sunny and the \_\_\_\_\_ (sky) was blue. On my way back, I stopped by the butcher shop and bought 2 kilograms of \_\_\_\_\_ (meat).

6- Connect with an arrow each kanji and its corresponding English meaning:

火	light
鳥	earth
言	fire
土	say
光	bird

7- Which of the following kanji means "mouth"? (circle the right answer)

a. 回	b. 区	c. 口	d. 右
------	------	------	------

8- Which of the following kanji means "person"? (circle the right answer)

a. 入	b. 人	c. 火	d. 太
------	------	------	------

9- Write down the correct English meaning for 雨 \_\_\_\_\_

10- Write down the correct English meaning for 東 \_\_\_\_\_

11- Write down the correct English meaning for 工 \_\_\_\_\_

12- Write down the correct English meaning for 目 \_\_\_\_\_

## **Appendix K: Kanjiform Test 2**

## Kanjiform.com Study Questionnaire 2

My code: \_\_\_\_\_

### PART 1 (15-minute Period)

Without the help of any tools, please answer the following questions:

1- Connect with an arrow each kanji and its corresponding English meaning:

光	bird
土	earth
言	say
鳥	fire
火	light

2- Circle the correct English meaning for 月:

- a. Meat
- b. Moon
- c. Car
- d. Eye
- e. Fish

3- Circle the correct English meaning for 魚:

- a. Rice
- b. Meat
- c. Fish
- d. Sun
- e. Gate

4- Circle the correct English meaning for 門:

- a. Gate
- b. Winter
- c. Time
- d. Mountain
- e. Blue

5- Circle the correct English meaning for 林:

- a. Money
- b. East
- c. Red
- d. Water
- e. Forest



6- Write down the correct English meaning for 雨 \_\_\_\_\_

7- Write down the correct English meaning for 工 \_\_\_\_\_

8- Write down the correct English meaning for 東 \_\_\_\_\_

9- Write down the correct English meaning for 目 \_\_\_\_\_

10- Which of the following kanji means “mouth”? (circle the right answer)

a. 右	b. 口	c. 区	d. 回	
------	------	------	------	--

11- Which of the following kanji means “person”? (circle the right answer)

a. 人	b. 入	c. 太	d. 火	
------	------	------	------	--

12- Select the correct Kanji for each blank space by entering its number in the appropriate blank below:

1. 天	2. 川	3. 肉	4. 車
------	------	------	------

Yesterday, I drove my mother's \_\_\_\_\_ (car) slowly by the \_\_\_\_\_ (river). It was sunny and the \_\_\_\_\_ (sky) was blue. On my way back, I stopped by the butcher shop and bought 2 kilograms of \_\_\_\_\_ (meat).

## Appendix L: User Survey

# User Opinion Survey

My code: \_\_\_\_\_

1. While using the on-line search method (kanjiform.com), which part(s), if any, of the interface did you find the most useful in pinpointing kanji characters? (Please CIRCLE the area on the picture below). Which part(s), if any, did you find the least useful? (Place a large X on the area)

The screenshot shows the kanjiform.com search engine interface. At the top, it says "kanjiform Experimental Kanji Search Engine" and "Practice: Try finding this kanji using the search engine below: 上". Below this is a search bar with "New Search" and "Exact" buttons. The main search area displays the kanji "右 中 目 町 悉" and "(冬新安...)" with a "Not Sure" button. Below the search results, there are several sections for user feedback:
 

- "Looking at your kanji carefully, how many squares or rectangles can you count?" with radio buttons for 0, 1, 2, 3, 4, 5 or More, and Not Sure.
- "Can you identify at least one..." with sections for vertical line, horizontal line, diagonal line, and diagonal line, each with a "Not Sure" button.
- "Now think of your kanji as a roadmap... can you see any of these 'road' intersections in your character?" with sections for 6-way, 5-way, 4-way, and 3-way intersections, each with a "Not Sure" button.
- "In terms of graphic complexity (number of brush strokes) where on the scale below would you place your kanji?" with a scale from 1 to 7 and a "Not Sure" button.

 At the bottom, there is a "Results ordered by:" section with "Most Common Kanji" and "New Search" buttons.

2. While using the traditional search method (the paper kanji dictionary), how often did you use the Stroke Count Index relative to the Radical Index?

- Exclusively used the Stroke Count Index
- Used the Stroke Count Index more often than the Radical Index
- Used both equally
- Used the Radical Index more often than the Stroke Count Index
- Exclusively used the Radical Index

next page →

**3. Reflecting on your experience with both the traditional and the online methods of finding and learning kanji, please rate the following statements by circling the appropriate word on the scale:**

a. The online search method (kanjiform.com) makes it easier to find a kanji than the traditional method (the traditional kanji dictionary).

strongly disagree	disagree	slightly disagree	slightly agree	agree	strongly agree

b. The online search method (kanjiform.com) is simple to learn for a beginner.

strongly disagree	disagree	slightly disagree	slightly agree	agree	strongly agree

c. The traditional search method (the paper kanji dictionary) makes it easier to find a kanji than the online search method (kanjiform.com).

strongly disagree	disagree	slightly disagree	slightly agree	agree	strongly agree

d. The traditional search method (the traditional kanji dictionary) is simple to learn for a beginner.

strongly disagree	disagree	slightly disagree	slightly agree	agree	strongly agree

e. I enjoyed using the online search method (kanjiform.com).

strongly disagree	disagree	slightly disagree	slightly agree	agree	strongly agree

f. I enjoyed using the traditional search method (the paper kanji dictionary).

strongly disagree	disagree	slightly disagree	slightly agree	agree	strongly agree

4. Do you have any other comments about the two methods studied, participating in this study or anything else?

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Thank You!

## **Appendix M: Order Effect Analysis**

## General Linear Model

Between-Subjects Factors		
		N
Initial Group (1 started with kf, 2 with kd)	1	10
	2	11

Descriptive Statistics				
	Initial Group (1 started with kf, 2 with kd)	Mean	Std. Deviation	N
KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	1	37.30	2.452	10
	2	34.27	4.245	11
	Total	35.71	3.757	21
KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	1	19.20	4.894	10
	2	15.27	2.867	11
	Total	17.14	4.351	21

Box's Test of Equality of Covariance Matrices	
Box's M	10.539
F	3.111
df1	3
df2	99783.919
Sig.	.025

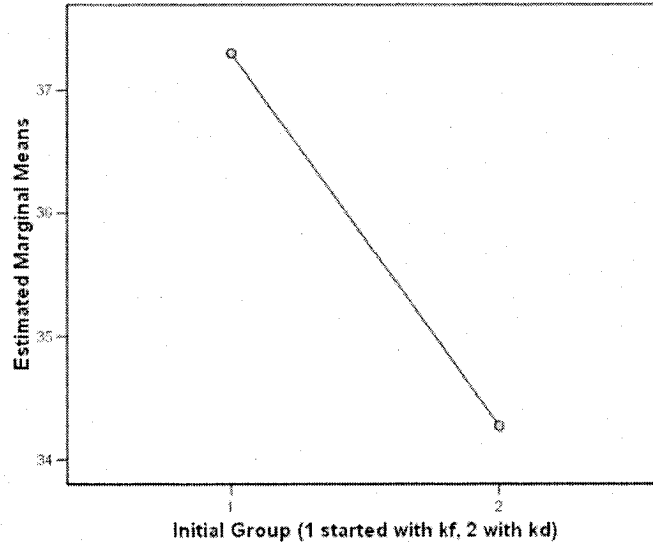
Multivariate Tests									
Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power
Intercept	Pillai's Trace	.992	1084.908	2.000	18.000	.000	.992	2169.815	1.000
	Wilks' Lambda	.008	1084.908	2.000	18.000	.000	.992	2169.815	1.000
	Hotelling's Trace	120.545	1084.908	2.000	18.000	.000	.992	2169.815	1.000
	Roy's Largest Root	120.545	1084.908	2.000	18.000	.000	.992	2169.815	1.000
group	Pillai's Trace	.284	3.572	2.000	18.000	.049	.284	7.144	.587
	Wilks' Lambda	.716	3.572	2.000	18.000	.049	.284	7.144	.587
	Hotelling's Trace	.397	3.572	2.000	18.000	.049	.284	7.144	.587
	Roy's Largest Root	.397	3.572	2.000	18.000	.049	.284	7.144	.587

Levene's Test of Equality of Error Variances				
	F	df1	df2	Sig.
KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	4.790	1	19	.041
KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	6.089	1	19	.023

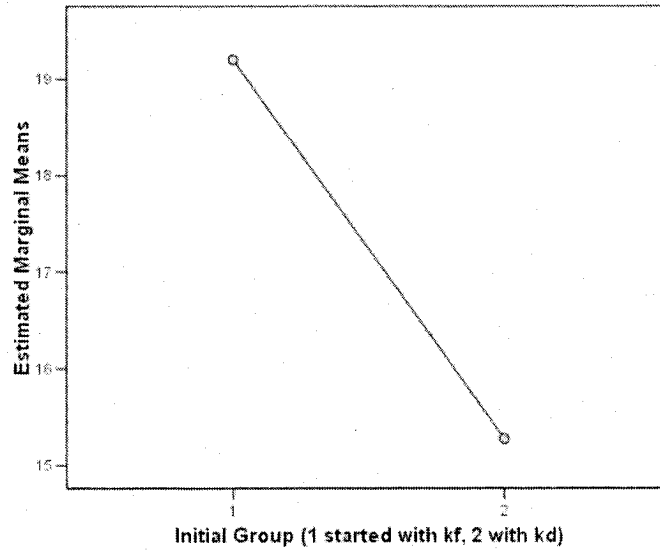
Tests of Between-Subjects Effects									
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power
Corrected Model	KF_Found	48.004	1	48.004	3.893	.063	.170	3.893	.465
	KD_Found	80.790	1	80.790	5.155	.035	.213	5.155	.577
Intercept	KF_Found	26832.956	1	26832.956	2176.123	.000	.991	2176.123	1.000
	KD_Found	6224.790	1	6224.790	397.173	.000	.954	397.173	1.000
group	KF_Found	48.004	1	48.004	3.893	.063	.170	3.893	.465
	KD_Found	80.790	1	80.790	5.155	.035	.213	5.155	.577
Error	KF_Found	234.282	19	12.331					
	KD_Found	297.782	19	15.673					
Total	KF_Found	27068.000	21						
	KD_Found:	6550.000	21						
Corrected Total	KF_Found:	282.286	20						
	KD_Found	378.571	20						

## Profile Plots

Estimated Marginal Means of KF\_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.



Estimated Marginal Means of KD\_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.





## NPar Tests

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	21	35.71	3.757	28	40
KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	21	17.14	4.351	9	27
KF_Memory: number of kanji remembered after 1 week practice, max 19/19	21	16.71	2.849	9	19
KD_Memory: number of kanji remembered after 1 week practice, max 19/19	21	15.38	3.827	3	19
Initial Group (1 started with kf, 2 with kd)	21	1.52	.512	1	2

## Mann-Whitney Test

Ranks				
	Initial Group (1 started with kf, 2 with kd)	N	Mean Rank	Sum of Ranks
KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	1	10	13.35	133.50
	2	11	8.86	97.50
	<b>Total</b>	21		
KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	1	10	13.25	132.50
	2	11	8.95	98.50
	<b>Total</b>	21		
KF_Memory: number of kanji remembered after 1 week practice, max 19/19	1	10	12.85	128.50
	2	11	9.32	102.50
	<b>Total</b>	21		
KD_Memory: number of kanji remembered after 1 week practice, max 19/19	1	10	11.85	118.50
	2	11	10.23	112.50
	<b>Total</b>	21		

Test Statistics				
	KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	KF_Memory: number of kanji remembered after 1 week practice, max 19/19	KD_Memory: number of kanji remembered after 1 week practice, max 19/19
Mann-Whitney U	31.500	32.500	36.500	46.500
Wilcoxon W	97.500	98.500	102.500	112.500
Z	-1.672	-1.600	-1.361	-.614
Asymp. Sig. (2-tailed)	.094	.110	.174	.539
Exact Sig. [2*(1-tailed Sig.)]	.099	.114	.197	.557

## Two-Sample Kolmogorov-Smirnov Test

Frequencies		
	Initial Group (1 started with kf, 2 with kd)	N
KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	1	10
	2	11
	Total	21
KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	1	10
	2	11
	Total	21
KF_Memory: number of kanji remembered after 1 week practice, max 19/19	1	10
	2	11
	Total	21
KD_Memory: number of kanji remembered after 1 week practice, max 19/19	1	10
	2	11
	Total	21

Test Statistics					
		KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	KF_Memory: number of kanji remembered after 1 week practice, max 19/19	KD_Memory: number of kanji remembered after 1 week practice, max 19/19
Most Extreme Differences	Absolute	.364	.500	.364	.182
	Positive	.364	.500	.364	.182
	Negative	.000	.000	.000	-.064
Kolmogorov-Smirnov Z		.832	1.144	.832	.416
Asymp. Sig. (2-tailed)		.493	.146	.493	.995

### NPar Tests

One-Sample Kolmogorov-Smirnov Test					
		KF_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	KF_Memory: number of kanji remembered after 1 week practice, max 19/19	KD_Found: How many kanji found out of the 40 random characters provided for testing within 15 mins in controlled environment.	KD_Memory: number of kanji remembered after 1 week practice, max 19/19
N		21	21	21	21
Normal Parameters	Mean	35.71	16.71	17.14	15.38
	Std. Deviation	3.757	2.849	4.351	3.827
Most Extreme Differences	Absolute	.158	.246	.175	.172
	Positive	.127	.211	.175	.172
	Negative	-.158	-.246	-.121	-.172
Kolmogorov-Smirnov Z		.723	1.125	.802	.789
Asymp. Sig. (2-tailed)		.673	.159	.541	.562