

I. Introduction

In the last few decades, language learning strategy transfer has drawn much attention in research on second language learning. The results of these studies aid researchers in better understanding the theory of transfer of strategies from L1 to L2. Several studies have explored variables related to various aspects of learners' L1 backgrounds that might influence their L2 reading strategies (Briggs and Goryo 1988; Koda 1988, 1990; Chikamatsu 1996; Hall 1996; Mori 1998; Matsunaga 1999; Machida 2001). For example, many investigators have suggested that L2 learners who have a good command of their L1 reading tasks in general acquire good reading skills in L2 faster than those who are unskilled in L1 reading (Cummins, 1989, 1991; Troike, 1978).

Learners' L1 orthographic background has been considered one of the factors that determine their preference for different processing strategies—sound-based or visual-based -- in Japanese reading. Studies regarding strategy use in L2 word recognition have shown that when L1 is phonographic, such as English, learners prefer to use more sound-based strategies through sound to symbol correspondence rules, while learners from logographic backgrounds (e.g. Chinese) tend to rely more on visual-orthographic strategies (Koda 1988; Chikamatsu 1996; Kato, 2005). However, several researchers have reported results that are contradictory to the transfer processing theory regarding Japanese reading. For example, Ke (1998) studied the effects of learners' L1 backgrounds on recognition and production of Kanji words. Beginning level Chinese college students from seven different universities were recruited for this research. She found that learners' performance on recognition or production of Japanese Kanji words was not significantly influenced by their L1 background differences (heritage versus non-heritage). The results of self-report analysis also showed no statistically significant differences between learners' perception of strategy use and their L1 backgrounds.

Grainger's (1997) word identification study on strategy use of JFL¹ learners with various L1 backgrounds also revealed no statistically significant differences between learners' L1 backgrounds and the choice of processing strategies. Therefore, it seems that the evidence from previous studies about the effect of learner' L1 orthography on strategy use regarding Japanese reading is limited and not conclusive. Other factors such as proficiency level of learners, individual preferences and the characteristics of Japanese may also play important roles in the learners' strategy use in reading Japanese.

Nonetheless, it is often thought that learners of Japanese with L1 Chinese orthographic background have advantages in Japanese learning because of their extensive knowledge of Hanzi, and that no extra efforts need to be made for the recognition and writing of Kanji as their knowledge of Hanzi guarantees successful Kanji learning, regardless of how well they make use of it. This reflects a perception with regard to Japanese Kanji recognition and learning that the research on Chinese background learners is of less interest, and as a result, fewer studies have been conducted on the Kanji learning strategies of Chinese background learners in comparison with the strategies of alphabetical background learners. However, the relationship between Hanzi and Kanji is, as a matter of fact, not a one-on-one relationship; while they have many aspects in common, they differ in others such as phonological system, vocabulary, and semantics. For instance, most Kanji consists of two types of pronunciations: Kun-reading and On-reading. On-reading derives from the original Chinese pronunciation while Kun-reading is the pronunciation of the semantically corresponding native Japanese word. Unlike Kanji, most Hanzi are monosyllabic. Moreover, Kanji has more homonyms than Hanzi due to the sound changes that took place in the process of adjusting the pronunciation of Hanzi. Nevertheless, they have a common semantic core and the

¹ JFL refers to Japanese as a foreign language.

same etymological origin, which facilitates direct access to meaning through a visual-based strategy (Akamatsu, 1998). Therefore, it is naïve to say that Chinese background learners of Japanese have few problems in processing Kanji words. Rather, it would be fair to say that the problems they may encounter are different from those of alphabetic backgrounds due to the interference of their L1 Chinese.

Literature review

A comparison between Kanji and Hanzi

The term for Chinese characters or Hanzi here especially refers to the writing script currently used in Taiwan and Hong Kong (Traditional Chinese) rather than in the People's Republic of China (Simplified Chinese). From the perspectives of semantics and orthography, Hanzi and Kanji differ in the usage, meaning, and shape due to the simplifications of Kanji after the Second World War. Moreover, in contrast to the multiple character-to-pronunciation correspondences in Kanji, a Hanzi character normally has only one pronunciation. Furthermore, the contrasting tones in spoken Chinese which function like phonemes in alphabetic scripts are transformed into accentuations in Kanji. Hanzi also differ from Kanji in the amount of homonyms, which is mainly the result of sound changes that occurred when Japanese borrowed from Hanzi. Such sound changes have created more homonyms in Kanji than in Hanzi (Akamatsu, 1998).

In spite of these differences between Hanzi and Kanji, these two scripts, in general, have the same etymological origin as well as semantic core. This provides learners of either language background with easy access to the meanings of Hanzi or Kanji. In a study on two-character Kanji compound homographs between Japanese and Chinese, Hong (2005) analyzed 17,049 Kanji compounds based on the similarities between Chinese and Japanese orthography and meaning. She categorized these Kanji compounds into four types: (1) Same meaning: for example, 最初 'first' has the same meaning in both Chinese and Japanese. (2)

Overlapping meaning: for example, the meaning of 左右 ‘the left and right sides’ is shared by the two languages, while the meaning of ‘about’ only exists in Chinese. (3) Different meaning: for example, 汽車 ‘train’ in Chinese refers to an automobile. (4) Nothing: these are Kanji compounds peculiar to Japanese. For example, 合図 refers to the ‘signal’ in Japanese and has no corresponding Hanzi words. The number and proportion of these four types in all 17,049 Kanji compounds are: (1) 9,616/56.39% (2) 573/3.37% (3) 305/1.79% and (4) 6,555/38.45%. The number of Kanji compounds that are categorized as the same or overlapping with Hanzi words in meaning is 10,189, which is 59.76% in all analyzed Kanji compounds.

Hong’s finding of extensive correspondences in orthography and meaning between Hanzi and Kanji offers an explanation of how Chinese learners of Japanese prefer to use the visual-based strategy in the processing of Kanji. On the other hand, as indicated by Kato (2005), unless the sounds of Chinese and Japanese words are identical or very similar, which allows learners to make phonetic association, phonological recoding strategy is generally less preferred as the phonological correspondence between Kanji and Hanzi is not as close as the correspondence in orthography and meaning.

The phonological correspondences between Hanzi and Kanji

Several investigators have indicated that there are phonological correspondences between Kanji (On-reading) and Hanzi in many aspects such as long vowels and consonants correspondences (Cheng, 1996; Wang, 1998; Cheng, 2000; Wang, 2003; Wang, 2004; Cheng, 2004), Cheng (1996, 2000, 2004). Therefore, learning Japanese through Sino-Japanese phonological correspondences still has pedagogical potential as long as JFL learners are instructed how to make proper phonetic associations based on the rules of the phonological correspondences. As reported by Kato (2005), when JFL Chinese learners are to

read Kanji words, their knowledge of Hanzi such as meaning and pronunciation will be retrieved consciously or unconsciously to assist the processing of Kanji. Therefore, the process of learning the readings of Japanese Kanji is also likely to be influenced by the phonology of Hanzi.

In light of Hanzi and Kanji correspondences, Cheng (1996, 2000, and 2004) conducted a series of studies to investigate the relationships between Hanzi and Kanji regarding vowels, entering tones², and contracted sounds. The results of his studies suggested that there are regular and systematic correspondences between modern Hanzi reading and Kanji On-reading. Similar phonological correspondences studies such as those of Wang (1998) and Wang (2004) are also relevant to the current study. Moreover, the results of these studies demonstrate the potential of the application of phonological correspondence to Kanji learning. More specifically, it seems clear that L1 Chinese learners of Japanese are likely to take advantage of the phonological correspondences in inferring the readings of unfamiliar Kanji words. Kanji words that originate from Hanzi and pronounced in the On-reading give L1 Chinese learners of Japanese a sense of familiarity, which allows them to memorize the Kanji much easier through both visual representations (shapes) as well as the approximation of the sounds based on their Chinese counterparts. For example, 安全 refers to safety in both Japanese and Chinese, and its pronunciation is /anzen/ in Japanese and /antɕ^hyen / in Chinese presenting phonological similarity in both languages. In this case, it is very easy for Chinese learners to memorize 安全 based on their L1 knowledge. Simply stated, phonological similarities serve as an auxiliary tool for L1 Chinese learners to learn Kanji through sound-spelling correspondences.

² Entering tone is one of the four tones in ancient Chinese. Compared to other tones, its sound is relatively short and sharp. It is still kept in some of the dialects of southern Chinese (e.g. Hakka and Min), while it disappeared from modern Mandarin Chinese.

The role of L1 background in Kanji learning

In addition to the studies on the phonological correspondences between Chinese Hanzi and Japanese Kanji, the effectiveness of learning strategies in Kanji learning has also been studied by a number of investigators. For example, Mori (2002) conducted a study to examine the ability of English-speaking learners of Japanese to infer the meanings of unfamiliar Kanji compounds as well as their perception of the effectiveness of the approaches they preferred. Their ability was measured under three conditions: Kanji compounds in isolation, contextual information only, and both. The result showed that the combined effects of the two sources (contextual clues and Kanji compounds) seemed to be better than one single source alone; however, nearly half of the participants were not able to integrate the two sources to interpret novel Kanji words. Rather they tended to overly rely on either Kanji compounds or contextual clues. Moreover, this finding correlated with their perception of the effectiveness of the approaches. That is, the choice of learning strategies as well as learning output was significantly influenced by learners' perception. Therefore, Mori attributed the use and the effect of multiple sources of information to individual differences. Her study, however, is based on the analyses of English-speaking learners. It did not include any analyses of learners' use of knowledge from their first language. It is therefore possible that learners with L1 orthographic backgrounds other than English - such as Chinese - would use different strategies from those used by English-speaking learners, particularly the strategies for inferring the meaning of unfamiliar Kanji compounds utilizing their L1 Chinese knowledge.

Moreover, the studies on the effect of L1 orthographic differences on Kanji recognition and learning also drew the attention of several researchers (Mori, 1998; Gamage, 2003; Kato, 2005). However, these studies appear to contradict one another; some claim that L1 logographic background learners prefer visual based

strategies, other studies show phonologically oriented strategies. For example, Mori (1998) investigated how learners' L1 orthographic backgrounds influence their use of the strategies in L2. Learners of Japanese with alphabetic and logographic backgrounds were recruited to participate in a Kanji test with pseudo-characters. The results of her study showed that L1 orthographic backgrounds did make a difference in the strategy use for L2 learning. That is, alphabetic background learners preferred to use a phonological strategy to process L2 while character background learners preferred the use of a visual based strategy for memorizing the unfamiliar Kanji even though the characters were not phonologically accessible.

Kato (2005) conducted a study of learning strategies employed by L1 Chinese learners in the memorization and guessing of Kanji words. Positive L1-L2 transfer was found both in the aspects of meaning and sounds. That is, participants used either phonetic or shape association to facilitate their memorization of Kanji, even if they were not formally instructed how to use these strategies. Apparently the integration of meaning and phonetic association is an effective way to learn Kanji, and these participants seemed to rely more on the semantic aspect than on the phonetic aspect of lexical information in the processing of Kanji. It seems that visual based association provides a faster and intuitive connection to the meaning of new Kanji words while phonetic association is more complicated and less apparent to make a sound-to-shape connection.

On the other hand, Gamage (2003) used a questionnaire to investigate the perception of Kanji learning strategies among L1 alphabetic and L1 logographic background beginning level learners of Japanese in Australia. He found that repeated writing was the most used strategy in learning Kanji. That is, participants tended to rely more on rote learning via repeated writing to memorize new Kanji words while contextual clues and association with alphabets were rarely used in the

memorization of the shape and pronunciation of new Kanji. With regard to the strategy difference between alphabetic and character background learners, he indicated that alphabetic background learners seemed to prefer to use visual based strategies (e.g. picture-to-Kanji association) while character background learners claimed to rely more on phonologically oriented strategies (i.e. similar pronunciation grouping of Kanji). This result, though inconsistent with Mori's and Kato's conclusion, also showed that there is a difference in the preference of strategy use for Kanji learning between different L1 background learners of Japanese. Following these studies, one can assume that L1 to L2 transfer appears to be common in the processing of Kanji learning regardless of learners' L1 orthographic experiences, and L1 orthographic backgrounds did play an important role in the selection of processing strategies for Kanji recognition and learning. However, researchers of previous studies neither explained how to transform the Sino-Japanese phonological correspondences into an effective strategy for L1 Chinese background learners of Japanese, nor did they examine if this strategy could be taught to facilitate Kanji learning.

Purpose of research

The studies that have been conducted thus far provide insights into the application of language learning strategy research of Kanji learning and recognition. While much research has been devoted to analyzing the relationship between Hanzi and Kanji, none of the researchers have proved the pedagogical potential of their results. Also, a number of studies that attempted to examine the role of strategy use in Kanji learning primarily depended on the views of learners from an alphabetic background rather than on the perspectives of learners from a logographic background. In addition, with respect to strategy use, it has been established that L1 Chinese learners normally rely on a visual-based strategy as their major or only means to access the semantic core and shape of Kanji words when processing printed Japanese texts based on their prior knowledge of Hanzi.

If no sufficient information or clues were provided by Kanji, they may encounter difficulty in comprehending Japanese texts, due to their inability to resort to an alternative strategy, such as phonological recoding, for the processing of Japanese texts. Although many researchers have reported that there are phonological correspondences between On-reading of Kanji and Hanzi words, to date, no researchers have ever tried to investigate how this might influence Kanji learning as well as the reading behavior of JFL Chinese learners. Neither have they ever attempted to examine whether the instruction of the Sino-Japanese phonological correspondences work to L1 Chinese learners' advantage and affect the processing and recognition of Kanji words.

Furthermore, while several studies regarding the transfer of L1 phonological awareness to L2 have indicated that the cross language transfer might not be the absolute determiner for the performance of real word reading and spelling tasks, it is not clear whether it yields a similar result in the case of JFL L1 Chinese-backgrounds' learning of Kanji through a phonological correspondence strategy. In light of these concerns, this study will propose an instructional method that utilizes the phonological correspondences between Kanji On-reading and Hanzi, with an aim to provide a phonological based instructional method to L1 Chinese learners in Kanji learning. As well, two specially designed tests with various contextual manipulations--sentences that consist of mostly-Kana or Kanji-Kana mixed contexts in combination with Kanji reading or Kanji script hints --will be compiled to investigate how L1 Chinese learners' reading behavior changes under different conditions. This design may lead to a better understanding of the L1 Chinese learners' use of visual based strategies and phonological based strategies in different contexts. Moreover, to investigate the influence of the phonological based instructional method on L1 Chinese learners, two groups of participants will be recruited for the study; one will use the proposed instructional method while the other will not. The difference in performance between the two

groups in the pre-test and post-test will be compared and participants' perception of the proposed instructional method will be used as a reference for the effectiveness of the instructional method as well. As a number of researchers have noted, visual based strategy rather than phonological based strategy, plays a dominant role in Chinese learners' Kanji processing. It is hoped that this study will also answer the question of whether the proposed instructional method makes a difference in learners' preference of strategy for Kanji processing.

To put it briefly, three subordinate objectives of the proposed study are as follows: (1) to examine how learners process Kanji-related questions in various contextual manipulations.(2) to measure the effectiveness of the proposed instructional method through the examination of how phonological information of Hanzi is used in the association of Kanji; and (3) to identify if learners employ different strategies in recognizing and inferring Kanji words after the intervention of the proposed method. The study of this Kanji learning related issue addresses a number of questions that must be answered before one can conclude whether or not phonological based instructional methods and strategies are beneficial to L1 Chinese learners' learning of Kanji. To this end, five research questions and hypotheses are proposed in this study.

Research questions

Research Question 1:

After receiving the proposed instructional method, will the experimental group perform better than the control group in the post-test?

Research Question 2:

After receiving the proposed instructional method, will the experimental group perform differently from the control group in a Kanji-Kana mixed context reading task if the question items are in the Kanji format in the post test?

Research Question 3:

After receiving the proposed instructional method, will the experimental group

perform differently from the control group in a Kanji-Kana mixed context reading task if the question items are in the Kana format in the post test?

Research Question 4:

After receiving the proposed instructional method, will the experimental group perform differently from the control group in a mostly-Kana context reading task if the question items are in the Kanji format in the post test?

Research Question 5:

After receiving the proposed instructional method, will the experimental group perform differently from the control group in a mostly-Kana context reading task if the question items are in the Kana format in the post test?

Method

Research design

This quasi-experimental study primarily involved a survey, comprised of three questionnaires concerning perception of Japanese learning, Kanji learning and recognition, strategy use in Kanji learning and personal background information. Moreover, in order to probe more deeply the relationships between Chinese learners' Kanji learning and their strategy use as well as the effectiveness of the proposed web-based instructional system, pre-tests and post-tests were conducted with the participants as well. The experimental sequence of the study took approximately two hours per week spread over five weeks, including pretesting learners before they received their instruction and posttesting learners immediately following instruction.

Participants

To evaluate the effectiveness of the proposed instructional method on Kanji learning, a pretest, a posttest, and a questionnaire was administered to experimental and control groups consisting of 30 L1 Chinese students. In all, one intermediate Japanese class participated in the study. These volunteers whose L1 learning began

with Zhuyin Fuhao (a quasi-alphabetic script) were recruited from an intermediate Japanese class at a large university in northern Taiwan. They were selected from a similar socioeconomic background. All of the participants have had at least one semester of Japanese learning experience, but none of them are Japanese majors. They receive four hours of in-class Japanese instruction every week. The total accumulated learning hours was about 100 hours at the time of the study. The participants were assigned to the experimental or control group on a systematic sampling basis as follows: students with odd ID numbers were assigned to the control group while students with even ID numbers were assigned to the experimental group. There are around 15 participants in each group, with their ages ranging from 19 to 25.

Instruments

Homework

A Kanji compound word list consisting of 153 Japanese Language Proficiency Test Kanji compounds³ was compiled into two formats as a part of the proposed instructional method and was used as homework for both groups. The first copy of the Kanji compound word list was randomly arranged without showing any explicit phonological correspondence relationship between Kanji and Hanzi while the second copy was organized in groups with explicit phonological correspondence rules embedded in the first line of each group. The two formats of homework were delivered via e-mail to all participants after the pre-test. To avoid the learning effect from already learned Kanji words, none of the Kanji compounds in the list were used as the target testing words in the post-test. The control group was assigned to read the randomly arranged word list and was asked to use a hard-copy dictionary to look up the pronunciation and meaning of the Kanji compound words while the experimental group was assigned to read the well-organized word list and was required to consult a web-based phonological

³ Most of the Kanji compound words are of Level 1 and Level 2 JLPT; only 8 are categorized as

correspondence learning system to finish their homework.

Phonological correspondence rules in homework

As intermediate level learners of Japanese do not have sufficient exposure to Japanese, they are not likely to memorize a whole set of phonological correspondence rules between Kanji and Hanzi in six weeks. Therefore, considering the time constraints and learners' burden, only the phonological correspondences that will be tested in the post-test are extracted from the database. As a result, a Kanji compound word list that will be distributed to the experimental group is developed based on forty phonological correspondence rules. There are typically two to four Kanji compound word examples for each rule, showing the phonological correspondences relationship between individual Kanji and Hanzi. This allows learners to quickly establish the phonetic associations according to the rules and Kanji word examples in the list. Once these learners have mastered the limited set of phonological correspondence rules, one can assume that they are able to some extent to infer the possible readings or the written form of unknown Kanji words based on the learned phonetic associations.

Table 1 shows a sample of phonological correspondence rules, Kanji compound word examples, and the target testing words in the study. These correspondence rules are based on the highest accumulated frequency in the phonological correspondences database to present phonological relationships between Hanzi and Kanji. All rules in this table show bi-directional associations, which means learners can use these rules as a reference to infer possible readings or written forms of Kanji words. As the correspondences in the Kanji compound word list are simplified and narrowed down to show a one-on-one relationship, learners in the experimental group are encouraged to consult the web-based instructional system to get a better understanding of detailed correspondence relationship.

Table 1 A sample set of phonological correspondence rules, Kanji compound word examples, and the target testing words

Correspondence Rules	Reliability Index ⁴	Example Kanji Compound Words		Target Testing Words	
虫ㄣ<=>しん	2	方針	ほうしん	真珠	しんじゅ
		地震	じしん		
		診断	しんだん		
		針路	しんろ		
虫メ尤<=>そう	3	包装	ほうそう	別荘	べっそう
		舗装	ほそう		
		壮大	そうだい		
虫尤<=>ちょう	4	通帳	つうちょう	副社長	ふくしゃちょう
		拡張	かくちょう		
		主張	しゅちょう		

A web-based instructional system

In this study, data based on Wang's (2004) research on Sino-Japanese vowel correspondences as well as a phonological correspondence database consisting of 3518 Kanji compounds in all levels of JLPT (Japanese language proficiency test) are specially compiled for the learning of phonological correspondence rules. The data above have been integrated into a web-based instructional system as part of the instructional method.

The system is actually a combination of three separate learning modules: (1) Hanzi-to-Kanji phonological correspondence, (2) Pronunciation combination searching module, and (3) Practice module. Participants in the experimental group are required to use the web-based system to collect data for the assigned homework. The first module is the Hanzi-to-Kanji phonological correspondence module (see

⁴ The Reliability Index (RI) represents the number of the phonological correspondences between Kanji and Hanzi. The higher the RI is, the lower the reliability is. For example, a rule with the RI equals to 2 means that there are two kinds of phonological correspondences between Kanji and Hanzi. Rules with higher reliability are compiled and chosen at first in the present study. In case the RI is high for a rule, then the most frequently used phonological correspondence will be used.

Figure 1), which contains three subordinate items: (1) Hanzi consonant, (2) vowel, and (3) level components for searching selection. The second module is exclusively employed for searching the pronunciation combinations of specific Kanji words (see Figure 2). Three tables are listed to show the detailed phonological information of each single Kanji, example sentences, and phonological correspondence rules related to the Kanji words.

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請選擇查詢範圍

聲母：ㄅ ▼
 韻母：-ㄢ ▼
 級別：三四級 ▼
 查詢

漢字	假名	中文	注音	級別
來年	らいねん	明年	ㄌㄞˊ ㄢ	三四級
去年	きょねん	去年	ㄎㄩˊ ㄢ	三四級
残念	ざんねん	遺憾	ㄗㄢˊ ㄢ	三四級
万年筆	まんねんひつ	鋼筆	ㄇㄢˊ ㄢ ㄅ	三四級

發音對照

注音	假名
ㄌㄞˊ ㄢ	• ねん：出現頻率4次

Figure 1. A Hanzi-to-Kanji phonological correspondence module.

The last module consisting of a question component, a phonological correspondence hint component, and a table for inputting Hiragana words, is designed for the practice of the phonological correspondence rules (see Figure 3).

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資料
に一致する

▼

搜尋

「資料」に一致する検索結果1件

漢字	假名	中文	注音	級別
資料	しりょう	資料	ㄖ ㄘ ㄠ ㄣ ㄠ	二級

發音對照

漢字	發音
資	<ul style="list-style-type: none"> し ◦ ㄖ: 1
料	<ul style="list-style-type: none"> りょう ◦ ㄘ ㄠ ㄣ ㄠ: 1

發音規則

漢語發音	日語音讀
ㄖ	1. さ行音 2. ざ行音
ㄘ	1. ら行音
ㄠ	1. 長音

例句 (from Tanaka Corpus)

この理由により、著者に関する信憑性は、資料の信憑性に拠っているのである
彼は何の準備もしていないのではないかと、ちょっと心配しています。私は彼が資料を準備してプレゼンテーションをしたのを見たことがないものですから。
本が書けるだけの資料はまだ集まっていない。
どのような資料でも送っていただけると嬉しいです。
資料不足のため調査は中止された。

Figure 2. A reading combination searching module for specific Kanji words.

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請選擇出題範圍

聲母: <
 韻母: ㄣ ㄛ
 級別: 全部
選擇範圍

漢字	注音	日文發音	
全快	< ㄣ ㄛ ㄛ × ㄛ	<div style="border: 1px solid #ccc; padding: 2px; display: inline-block;">ぜんか</div> <div style="display: inline-block; background-color: #fff9c4; padding: 2px;">答題</div> <div style="display: inline-block; color: red; padding: 2px;">答錯了</div>	<div style="border: 1px solid #ccc; padding: 2px 10px;">下一題</div>

提示

注音	假名
< ㄣ ㄛ	<ul style="list-style-type: none"> ぜん: 16 けん: 14 かん: 2 せん: 2
ㄛ × ㄛ	<ul style="list-style-type: none"> かい: 6

あ	い	う	え	お	あ	い	う	え	お
か	き	く	け	こ	が	ぎ	ぐ	げ	ご
さ	し	す	せ	そ	ざ	じ	ず	ぜ	ぞ
た	ち	つ	て	と	だ	ぢ	づ	で	ど
な	に	ぬ	ね	の			っ		
は	ひ	ふ	へ	ほ	ば	び	ぶ	べ	ぼ
ま	み	む	め	も	ば	び	ぶ	べ	ぼ
や		ゆ		よ	や		ゆ		よ
ら	り	る	れ	ろ	わ		ん		を

Figure 3. A practice module with a Kana script input table and a phonological correspondence hint.

The standard operating procedure of querying the reading a specific Kanji is to select a combination of Zuyin fuhao reading (e.g. ㄋㄧㄢˊ, /nian/), then the system will retrieve a list of Kanji compounds that contain the designated reading (ㄋㄧㄢˊ, /nian/), its phonological correspondence (ねん, /nen/) in Japanese as well as its level in JLPT (see Figure 4). Moreover, the phonological correspondence will be shown in order of the matching frequency if more than one reading is matched (see Figure 5). The function of reading frequency offers information regarding how often a reading is used, which allows learners to memorize the readings more effectively. To put it briefly, these components are used primarily for searching and listing corresponding Kanji words as well as phonological correspondence rules, by showing a number of Kanji words that contain the specified combination of pronunciations.

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請選擇查詢範圍

聲母：ㄋ

韻母：ㄧㄢˊ

級別：全部

查詢

漢字	假名	中文	注音	級別
来年	らいねん	明年	ㄌㄧㄢˊ ㄋㄧㄢˊ	三四級
去年	きょねん	去年	ㄎㄩ ㄌㄧㄢˊ	三四級
残念	ざんねん	遺憾	ㄗㄢ ㄌㄧㄢˊ	三四級
万年筆	まんねんひつ	鋼筆	ㄇㄢ ㄌㄧㄢˊ ㄆㄧ	三四級
年代	ねんだい	年代	ㄋㄧㄢˊ ㄌㄧㄢˊ	二級
年度	ねんど	年度	ㄋㄧㄢˊ ㄌㄧㄢˊ	二級
年齢	ねんれい	年齢	ㄋㄧㄢˊ ㄌㄧㄢˊ	二級
年間	ねんかん	年間	ㄋㄧㄢˊ ㄌㄧㄢˊ	二級

Select a combination of Zhuyin fuhao reading, then the result of the query will be shown on the same page.

Figure 4. The first step for querying the reading of a specific Kanji.

發音對照	
注音	假名
ㄋㄣˊ	◆ ねん：出現頻率36次

The frequency of the reading. _____

Figure 5. The frequency of the reading of a specific Kanji.

Pre-test and post-test

In all, twenty three intermediate-level Kanji-Kana mixed sentences and twenty four intermediate-level mostly-Kana sentences that contain JLPT Level 2 target Kanji words, which the participants had never learned before, were chosen from a pool of level 2 JLPT ranging from 1990 to 2000 respectively. The criteria for the selection of the target testing Kanji compounds are based on the similarity of pronunciation, orthography, and meaning between Hanzi and Kanji. To examine the L1 Chinese learners' ability of Kanji inference, reading association as well as the extent to which they make use of the phonological correspondences rules, these sentences were compiled into the pre-test and post-test in various settings. As a result, both the pre-test and post-test consist of four types of sentences. Each type of sentence consists of ten question items. The following sentences demonstrate samples that will be used in the test⁵.

(1) Kanji-Kana mixed sentences with Kanji reading questions:

土産に真珠と陶器を勧められた。

(1) 真珠 1・じん 2・ちん 3・にん 4・しん

(2) 陶器 1・どう 2・ど 3・とう 4・と

(2) Kanji-Kana mixed sentences with Kanji recognition questions:

企業における外国人労働者のたいぐうについて、雑誌が特集をくんだ。

(1) たいぐう 1・対 2・態 3・待 4・隊

⁵ The Kanji and Hiragana characters that are underlined in the sentences are the target testing

(3) Mostly-Kana sentences with Kanji reading questions:

じしんの被害者にたいする、かれらのすみやかな 救援かつどうは、しょうさんにあたいます。

(1) 被害者 1・べい 2・き 3・ベ 4・ひ

(2) 救援 1・ぎゅう 2・きゅう 3・きゅ 4・きょう

(4) Mostly-Kana sentences with Kanji recognition questions:

せいかつのリズムがくるって、まんせいの すいみんぶそくになってしまった。

(1) まんせい 1・幡 2・万 3・慢 4・幡

(2) すいみん 1・遂 2・推 3・酔 4・睡

Question type (1) and type (3) are used to examine the learners' ability in Kanji reading association in the Kanji-Kana mixed and mostly-Kana contexts while question type(2) and type(4) are used to investigate the learners' ability in Kanji written form inference in the Kanji-Kana mixed and mostly-Kana contexts. By providing these four types of stimuli in the pre-test and post-test, the proposed study mainly aims to investigate the learners' performance differences in Kanji written form inference and pronunciation association between pre-test and post-test, and to examine the score changes between control group and experimental group after the proposed instructional method has been introduced, as well as score variations among four types of stimuli between pre-test and post-test.

Data collection procedure

In this study, all participants in the intermediate Japanese classes typically have four hours of instruction per week. Both the control group and the experimental group receive normal in-class instruction and specially designed

after-class homework which is delivered via e-mail after the pre-test. The control group was asked to look up the pronunciation and meaning of the Kanji compound words in the word list, while the experimental group was required to use a web-based instructional system to finish the same task. The purpose of the homework is to provide two treatments during the experimental session and it was used to familiarize the participants in the experimental group with the Sino-Japanese phonological correspondence rules. To ensure the progress of the experiment, both groups were required to print out and submit one unit of the assignment at the beginning of the next class during the experimental period. They were asked to complete the whole assignment over a period of five weeks. As this is an intermediate level Japanese class, most of the Kanji compounds in the homework didn't overlap with the ones the students learned in the class. The homework is regarded as an addition rather than a substitute to participants' Japanese learning. Their course grade may be influenced by the homework. However, to exclude the interference of instructional effect from the teacher, it was not analyzed with the results of the pre-test and post-test.

At the time of the experiment, most of the participants had already been learning Japanese for at least one semester, and each participant had learned at least 200 Level 3 and 4 Japanese Kanji words. All participants were required to sign a consent form before the experiment. The test instruments developed for the study consist of a pre-test and a post-test while the data collection instrument is a questionnaire after the post-test. The pre-test was administered to both groups prior to the beginning of the experimental curriculum, while the post-test was conducted at the end of the experimental curriculum. A survey was administered immediately after the post-test.

Data analysis

The quantitative analysis of the tests and questionnaires was conducted by using the SPSS statistical software package through the following statistical methods.

First descriptive statistics were calculated to summarize the participants' responses to the survey and the scores in the two tests. Next, to address the issue of performance difference between pre-test and post-test within the same group, paired sample *t* test analyses were conducted. The next part of the analyses used the independent samples *t* test procedure to test the statistical significance of the difference between the two group means and to compare the progress of the two groups in Kanji learning over the experimental period.

Results

Participants responded to the questionnaire items on a Likert scale of 1 to 5, indicating the degree to which they disagreed or agreed with statements concerning perception of Japanese learning, Kanji learning and recognition, strategy use in Kanji learning and personal background information. Parts of the results of the participants' responses to the strategy use in Kanji learning are summarized in Table 1. Generally speaking, the majority of these participants actually used their L1 knowledge and various skills to facilitate their Kanji learning. Ninety-six percent (96%) of the participants agreed or strongly agreed that Kanji was employed in segmentation when reading Japanese. Ninety-three percent (93%) used individual Kanji to infer the meaning of Kanji compounds. Seventy-three percent (73.4%) would use the reading to infer the meaning of Kanji. Ninety-three percent (93%) used read-aloud skills to memorize the reading and meaning of Kanji words. Ninety-seven percent (96.7%) of the participants used multiple methods such as contextual clues, individual Kanji as well as L1 knowledge to infer the reading and meaning of Kanji. Eighty-six percent (86%) used their L1 knowledge to analyze the meaning of Kanji homographs. Ninety-three percent (93.4%) used learned Kanji to infer the meaning of Kanji homographs. Sixty percent (60%) thought that they paid more attention to the meaning rather than to the reading of Kanji when reading Japanese. In addition, eighty-three percent (82.7%) considered that multiple reading of Kanji is the most prominent problem

they have in learning Kanji. The results seemed to suggest that

Kanji learning is the core in Japanese reading; their L1 knowledge is extensively used in the process of Kanji learning. Their visual-based preferences as well as difficulties in learning multiple readings are prominent in Kanji learning.

Table 2. Percentages of participants responses to the strategy use in Kanji learning (N=30)

Item	Strongly disagree/Disagree	Uncertain	Strongly agree/Agree
1	1(3%)	0(0%)	29(96%)
2	0(0%)	2(6.7%)	28(93%)
3	7(23%)	1(3%)	22(73.4%)
4	1(3%)	1(3%)	28(93%)
5	0(0%)	1(3%)	29(96.7%)
6	1(3%)	3(10%)	26(86%)
7	0(0%)	2(6.7%)	28(93.4%)
8	6(19.7%)	6(20%)	18(60%)

Student score variations between pre- and post-test

The results suggested group performance differences between pre-test and post-test with regard to the Kanji reading test. A paired-samples t-test was conducted to evaluate whether the web based Sino-Japanese phonological correspondence learning system was beneficial to the participants' development of Kanji reading ability. The results indicated that for the control group, the mean score of Kanji reading in the post-test ($M=18.36$, $SD=6.15$) was slightly higher than that in the pre-test ($M=17.36$, $SD=4.72$), $t(13) = -1.57$, $p=0.141$, while for the experimental group, the mean score of Kanji reading in the post-test ($M=25.88$, $SD=4.22$) was significantly higher than that in the pre-test ($M=14.81$, $SD=3.43$), $t(15) = -8.78$, $p=0.000$ (Table 2).

Table 3. Kanji reading: Comparison of Pretest and Posttest of Two Groups

	Experimental (N = 16)		Control (N = 14)	
	M	SD	M	SD
Pretest	14.8125	3.42965	17.3571	4.71670
Posttest	25.8750	4.22493	18.3571	6.14701
Gain	11.063	5.0394	1	2.3859
t-value	-8.781		-1.568	
p-value	0.000**		0.141	

* $p < 0.05$. ** $p < 0.01$.

Note: Gain = posttest - pretest.

A paired-samples t-test was conducted to investigate the scores variations across four different question types between pre-and post-test. For the first type of question: Kanji-Kana mixed sentences with Kanji reading questions, both groups gained higher scores and produced significant differences in the post-test, $t(15) = -15.248$, $p = .000$ and $t(13) = -4.660$, $p = .000$. (Table 3).

Table 4. Kanji-Kana mixed sentences with Kanji reading questions: Comparison of Pretest and Posttest of Two Groups

	Experimental (N = 16)		Control (N = 14)	
	M	SD	M	SD
Pretest	2.6250	.88506	3.8571	1.46009
Posttest	8.1875	1.37689	6.2857	2.46291
Gain	5.56250	1.45917	2.42857	1.94992
t-value	-15.248		-4.660	
p-value	0.000**		0.000**	

* $p < 0.05$. ** $p < 0.01$.

Note: Gain = posttest - pretest.

For the second type of question: Kanji-Kana mixed sentences with Kanji recognition questions, neither group gained higher scores in the post-test (Table 4). However, the decrease of the score in the experimental group was not statistically

significant ($t(15)=1.46$, $p=0.164$), while that of the control group was significant ($t(13)=4.28$, $p=0.001$).

Table 4. Kanji-Kana mixed sentences with Kanji recognition questions: Comparison of Pretest and Posttest of Two Groups

	Experimental (N = 16)		Control (N = 14)	
	M	SD	M	SD
Pretest	5.9375	1.76895	5.2143	1.71772
Posttest	5.1875	1.42449	3.2857	1.43734
Gain	-0.75000	2.04939	-1.92857	1.68543
t-value	1.464		4.281	
p-value	0.164		0.001**	

* $p < 0.05$. ** $p < 0.01$.

Note: Gain = posttest - pretest.

For the third type of question: Mostly-Kana sentences with Kanji reading questions, both groups gained higher scores in the post-test (Table 5). However, the increase of the score in the experimental group was statistically significant ($t(15)=-4.99$, $p=0.000$), while that of the control group was not significant ($t(13)=-2.96$, $p=0.011$).

Table 5. Mostly-Kana sentences with Kanji reading questions: Comparison of Pretest and Posttest of Two Groups

	Experimental (N = 16)		Control (N = 14)	
	M	SD	M	SD
Pretest	4.0625	1.52616	4.1429	1.51186
Posttest	6.9375	1.73085	5.7143	2.49395
Gain	2.87500	2.30579	1.57143	1.98898
t-value	-4.987		-2.956	
p-value	0.000**		0.011	

* $p < 0.05$. ** $p < 0.01$.

Note: Gain = posttest - pretest.

For the fourth type of question: Mostly-Kana sentences with Kanji recognition questions, only the experimental group gained higher scores in the post-test (Table 6). In addition, the increase of the score in the experimental group was statistically significant ($t(15)=-5.93$, $p=0.000$), while the decrease of the scores of the control group was not significant ($t(13)=1.02$, $p=0.328$).

Table 6. Mostly-Kana sentences with Kanji recognition questions: Comparison of Pretest and Posttest of Two Groups

	Experimental (N = 16)		Control (N = 14)	
	M	SD	M	SD
Pretest	2.1875	1.22304	3.7857	1.36880
Posttest	5.5625	1.86078	3.2143	1.71772
Gain	3.37500	2.27669	.57143	2.10180
t-value	-5.930		1.017	
p-value	0.000**		0.328	

* $p < 0.05$. ** $p < 0.01$.

Note: Gain = posttest - pretest.

Meanwhile, the results of the Independent-Samples t-test indicated that no significant difference was found in the pre-test ($t(28)=-1.71$, $p=.099$); after the intervention of the proposed instructional method, significant differences in scores were found in the post-test ($t(28)=3.95$, $p=.000$) between the two groups (Table 7). This finding indicated that both groups were homogeneous regarding Kanji proficiency, and performed differently after the intervention of the proposed instructional method.

Table 7. Independent Samples t test: Comparison of Pretest and Posttest of Two Groups

	Levene's Test for Equality of Variances		t-test for Equality of Means	
	F	Sig.	t	Sig. (2-tailed)

pretest	Equal variances assumed	1.841	0.186	-1.705	0.099
posttest	Equal variances assumed	2.105	0.158	3.946	0.000**

*p < 0.05. **p < 0.01.

Discussion and Conclusions

Conclusions

In this paper, we presented the results of Kanji learning between two groups and the effects of the proposed instructional method. Several research questions were addressed in this study, and the principal findings suggested that (1) the proposed instructional method was, indeed, effective in leading to higher testing scores in the experimental group. Thus, after receiving the proposed instructional method, the experimental group performed significantly better than the control group in the post-test; (2) the experimental group also outperformed the control group regarding the mean gains across all four types of questions. For instance, for the first type of questions: Kanji-Kana mixed sentences with Kanji reading questions, both groups scored significantly higher in the post-test. As to the mean gain, the experimental group (5.56) was significantly higher than that of the control group (2.43); (3) with regard to the second type of questions: Kanji-Kana mixed sentences with Kanji recognition questions, both groups performed worse in the post-test. However, the decreased score of the control group was statistically significant, while that of the experimental group was not. That is, even though this part of questions in the post-test might be more difficult, the experimental group managed to make use of the learned rules resulting in less decrease of scores. The control group was obviously greatly affected by the difficulty of the questions and thus produced a significant difference in the post-test; (4) when the third type of question: Mostly-Kana sentences with Kanji reading questions was presented, the experimental group obviously performed better than the control group when no Kanji based contextual clues were provided. (5) similar results were found when

the fourth type of question: Mostly-Kana sentences with Kanji recognition questions was presented to both groups. The experimental group outperformed the control group and produced significant differences in scores between pre-and post-test. That is, the experimental group was able to infer the orthography of Kanji by simply relying on the learned rules as well as on limited clues from contexts, which contained no Kanji.

In comparison with sentences with Kanji recognition tasks, it seems that the two groups had fewer difficulties in inferring the reading of Kanji based on the Kanji orthographic hints in the post-test. It appeared that the reliance on Kanji orthographic clues partially contributed to the results. Moreover, we suspect that making good use of the learned rules resulted in the experimental group's significant outperformance over the control group regarding the mean gains. It is obvious that relying solely on Kanji orthographic hints is insufficient in some cases, as the control group failed to achieve higher scores when no Kanji contextual clues were provided (i.e. type three and four questions). In contrast, owing to the help of the proposed instructional method, the experimental group was not affected and performed better than the control group regardless of the lack of Kanji-based contextual clues. On the other hand, as the answer items of the multi-choice questions were constructed with homophonic Kanji in the second and third type of questions, the completion of the task of recognizing Kanji requires not only the understanding of Kanji compounds but also the intended meaning of the context. Thus, it is not surprising that the mean gains of the control group were lower than those of Kanji reading in the post-test. When the contextual clues were insufficient for inference, the participants in the control group had nothing but primarily relied on a visual based strategy and intuitions to infer the proper orthography of Kanji. As a result, more errors occurred.

Also noteworthy are the lower scores of the two groups in the second type of questions. A possible explanation for the results is that these questions in the

post-test were more difficult than their counterparts in the pre-test. As a result, the control group even yielded decreased scores that were statistically significant. Nevertheless, the experimental group was only slightly affected with a non-significant lower mean score. In this regard, it is easy to see that the experimental group was still superior to the control group. Such a distinction was more prominent in the fourth type of questions, not only did the experimental group outperform the control group, but the results were also statistically significant.

In conclusion, it appeared that, regardless of the difficulty as well as of the type of questions, the experimental group demonstrated its superiority over the control group thanks to the proposed instructional method.

These findings are consistent with Kato's (2005) study that learners performed better in Kanji learning if they are able to use visual and phonological based strategies. In addition, the results of this study also confirm the cruciality of L1 Chinese knowledge in Kanji learning. Most important of all, it provides empirical evidence for the role of Sino-Japanese phonological correspondences in fostering optimal Kanji processing. That is, it appears that after receiving the proposed instructional method, learners are likely to employ the rules to correctly infer the Kanji readings or to recognize the orthography of Kanji under various situations. It is expected that once the phonetic associations between Kanji and Hanzi is established, they are capable of using both visual and phonological based strategies rather than simply relying on their L1 knowledge to process and learn Kanji. From this study, teachers of Japanese may gain insights into the role of Sino-Japanese phonological correspondences in Kanji processing and ways to integrate these insights into their teaching. Teachers should be more aware of the importance of systematic instruction of Kanji reading, which can be beneficial as students try to develop their Kanji knowledge.

There are several critical issues concerning the limitations of this study. The

research findings in this study may only fit the learners of L1 Chinese background rather than those of other L1 background. Whether or not the proposed instructional method produces the same effects on the learners of different proficiency and L1 background is an issue demanding further research. Another constraint is related to the difficulty level of the tests used in this study. The second type of question was obviously more difficult than the other three types of questions in the post-test. Though the results showed that the experimental group was still better than the control group regarding the mean gain variation between pre- and post-test, the inconsistent results with the other three make it less persuasive as to the effectiveness of the proposed instructional method with regard to the task of Kanji-Kana mixed sentences with Kanji recognition questions.

Future research could be conducted on learners of different language proficiency to see whether or not the instructional method based on Sino-Japanese phonological correspondences yields similar results. In addition, this study has tried to answer what strategies learners tend to use for processing written Kanji before and after the intervention of the proposed instructional method. It might be beneficial to examine further whether or not learners use similar strategies to process Kanji in listening.

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