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Author(s)	Ki, WW
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IT support for the learning of Chinese characters

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Introduction

This paper is going to report an initiative to enhancing children's Chinese characters learning through raising their structural awareness about the language with the support of a knowledge-based multimedia system.

There is a lot of literature highlighting the importance of structural understanding in general. In learning about a domain, one doesn't just go through an additive process of acquiring more and more pieces of information. More important is that the learner can develop a structured view of the domain. With the structural concepts, the person would be able to relate pieces of information into a meaningful whole. With this structured view, the learner would be able to switch attention flexibly to focus on different parts, or at different levels of details, addressing to the issue immediate at hand, without necessarily losing sight of the whole.

Language is a complex structure. It is an amazing capability of human beings to be able to develop and use such structures. However, an emerging body of psychological research has indicated that learners vary in their structural awareness of the language. The differences in terms of their sensitivity towards patterns of phonological, orthographic and morphological structures of the language do have important bearing on their language performance.

In the area of science and mathematics, a lot of work has been done in developing technologically supported microworlds for the learner to explore structural explanations behind natural and formal phenomena. However, there has been comparatively less work of this kind in the area of language learning.

Language is a system with structural regularities. However, in general, these structures are learnt in a way quite different from science and math. For most of the time we are learning it while we are using it. This difference might lead to a difference in the nature of the structural understanding we should be after, and a difference in the role of the technology.

There has in fact been a long on-going debate among language educators about structural awareness instructions. The opposition against such instruction can be summarized as follows: To do something and to step back reflecting about how one's doing it at the same time is difficult. Too much self-consciousness can inhibit the learner as a user of the language ; In order to discuss about structures, a higher-order language is needed, and that will be an additional burden for the language learner.

Without disregarding the above positions, the author however would like to argue that incidental and conscientious learning of the language need not be mutually exclusive. To think about the structure of a language while using it is possible. It can be just a matter of degree, scope and nature. It is an empirical question about how the degree, scope and nature of thinking about the language vary, in the developmental course of learning, as well as in responding to the momentary demand of the situation of at hand. And precisely this is the knowledge that most educators need to have in

designing language education experience for their students with due respect both to the situated as well as the systematic nature of language.

It is the belief of the author that the technology can play an important role in the development of awareness about the structure of language. With print and computer technologies, language can increasingly become an external object in itself, which is detached from the human bodies that perform the language interaction. Language put into a written form is more amendable to a more reflective mode of language usage. Language in a computer knowledge base would make the structural principles of the language more affordable to exploration. This is an area we wish to explore.

At the same time we are quite aware of that while we are using technology, technology also affect our way of thinking. While it amplifies certain aspects of our experiencing the world, it bounds to reduce others and put them off focus. The use of knowledge-based systems tends to make the objective appearance of knowledge most prominent and up front, and the situations and persons that make the piece of knowledge often recede to the background. In this project, therefore, we have to keep reminding ourselves the importance in seeing the function of the technology in really teaching and learning situations, and whether the use of technology might change the nature of language learning in a counter-positive way.

The experience of language can be many fold. Language can be part of you, enabling you to relate to people and the world, when your focus of attention is not on the language but on the people and the world. Language can also be part of the world, as a target of study to which you focus your attention. It can be something so closely bound to your moment by moment being in the world and interaction with people around you. But it is also some external cultural artifacts, including captured live language in the past, the language patterns that been commonly appropriated by the society, and also analytic theory/descriptions about the language. It appears to the author there are moments of each of these in the course of language learning, and the role of the technology in language learning should be carefully examined in respect to these different ways of experiencing language. In the learning of written words with technology, there are simultaneously operations on different levels: the concrete, the spoken, the written, and the program. There may be things that the technology can or should do and things not. The learning does not happen just with the square box. The functions of the technology must be considered with due respects to the other operations which is going to happen at a learning situation.

In this paper, the author shall report an attempt to use technology to enhance young children's understanding about the structural principles of Chinese characters. First, the author shall discuss how the software is designed, in relation to our understanding of the structures of Chinese characters. Secondly, the author will share some of their ideas generated from classroom experimentation, namely about how one might integrate the different views of language, and the different types of computer and non-computer based activities in classrooms.

The structure of Chinese characters

Commonly used Chinese characters amount to several thousands. It is boring, even if not hard, for students to memorize each of them by rote. However, the number of character components, which are needed to build up the thousands of characters, has been estimated to be only under a few hundreds for most purposes (張, 1982) (國, 1997). Chinese characters actually share a large amount of components in common. To a certain extent, components in Chinese characters are the most basic units in Chinese characters as comparable to the alphabet in English spelling, so to speak.

Chinese characters are also interpreted as a combination of components rather than a collection of unrelated strokes. For example, to write the character 明, a person will complete the writing of the component 日 prior to the writing of any strokes in 月. This indicates that the character 明 is regarded as a combination of two components, 日 and 月. Moreover, the writing sequence of the strokes of 日 as a component in the character 明 is also identical to that of 日 as a valid character on its own. It is thus reasonable to regard components as reusable building blocks of Chinese characters.

In agreement with this, a developmental experiment (曹, 1965, 1965) has shown a significant improvement on the ability of elementary school students to master Chinese characters during the period between the first and second grade. It is believed, at the time the students have picked out the regularity among various characters and generalized from the characters an understanding of how different characters are related with each other. The ability to recognize character components is essential in the learning of Chinese characters.

Not only should students be able to recognize the components in a character, but the students should also notice the useful information carried by the components to the character. Look at the common component 女 of the characters 媽, 姊, 妹, 姨 and 婆. The character 女 per se means girl or woman. The meanings of the characters are all related to female: 媽(mother), 姊(elder sister), 妹(younger sister), 姨(aunt) and 婆(grandma). This kind of components which conveys meaning to the character is called the *morphological component* 形符 (or 形旁).

Similarly, *phonological components* 聲符 (or 聲旁), which are often located on the right hand side of a character, denote sound in the characters. Sharing the component 青, all of the characters 青(cing1), 清(cing1), 蜻(cing1), 請(cing2), 情(cing4), 晴(cing4) and 睛(zing1) are spoken similarly.

Actually 85% of modern Chinese characters falls in the category of *picto-phonetic composition* 形聲字 that is a combination of exactly one morphological and one phonological components. As such, many new characters can be taught in such a way that helps students to relate the characters to some other characters familiar to them probably with components in common. Moreover, components can also be used as a cue for guessing the meaning of unknown characters. Even though the students may encounter unfamiliar characters in reading, the context together with a familiar component should often suffice for students to vaguely understand the meaning, thus enabling them to continue their readings without interruption. (張, 1987)

Software Design

The basic hypothesis of the project is that, because there are many structural regularities in the composition of Chinese characters and words, the learning of Chinese characters and words would be more effective if the learners were made

aware of the principles underlying their composition. Based on the above characteristics of Chinese characters, several CALL programs have been designed and developed as teaching materials for teachers to use in classrooms. They include Rhymes, Interactive Exercises on Character Origin, Stroke Sequence, Character Component and Morphological Component, and Chinese Character Knowledge Base. Each of them will be described in detail in the following sections.

1 Rhymes 童歌字趣

Rhymes are characterized by their ease of memory. Children often enjoy singing and intoning them. This software is a compilation of 25 pieces of rhymes with vivid animation and lovable voice over of the children.



Figure 1 the use of rhymes with attractive graphics

Students also learn Chinese characters from the rhymes (何, 1995). Each piece of rhyme includes one cluster of characters, which all possess a component in common (四, 1994). An example is

山 青 水清天氣晴，	
青 蛙 有對大眼 睛 ，	Green hill, clear water and sunny sky
吃飽蚊蟲心 情 好，	Little green frog with a pair of big eyes
請來蜜蜂與蜻 蜓 ，	Full of insect, feeling good
你們跳舞我拍和，	Inviting the bees and the dragonflies to come along
呱呱，呱呱，呱呱呱。	Singing, dancing and playing in harmony
	Croak-croak, croak-croak, croak-croak-croak

Little Green Frog with Big Eyes

青蛙有對大眼睛

Figure 2 Learning Chinese characters in a cluster, with a component in common

The cluster of characters we emphasis is **青**, **清**, **晴**, **睛**, **蜻**, **請** and **情** as shown above in bold. As mentioned earlier, all of these characters contain the component **青** and are spoken like each other. But with the deletion or addition of different components, the so formed characters differ in meaning. For example, adding a 日(sun) gives**晴**, which means “sunny”. Replacing it with a 虫(insect), the character becomes**蜻** like in **蜻蜓**(dragonfly).

The reason to put these characters together as a cluster is to help students to recognize the difference among the characters. Since the students have picked up the vocabulary verbally in their daily lives, homophonic errors are common. Since there is almost no difference in speech, the students often mistakenly use an incorrect character that sounds alike. Hence, teachers should help the students to understand in what situations each of the characters is used. Putting the characters in a cluster enables students to compare and contrast the characters with one another.

2 Interactive Exercises 互動練習

2.1 Character Origin 文字由來

Chinese characters are not arbitrarily assigned symbol. Early Chinese characters are mostly hieroglyphic or pictographic. Many of these characters have become components in modern characters. Pictures of the ancient forms of characters can possibly help students to memorize the written form of the present day. This exercise challenges the students to correctly match characters to their pictorial origins.

Animation depicting the transformation of the characters from pictures to the written form is first shown to the students. For example, in following figure, a picture of the sun has changed into an earlier form \odot of a character. However the animation will suddenly be stopped before completion. The students then have to choose one of the characters on the panel that corresponds to the picture. If the selection is correct, in this case 日(sun), the evolution will continue until the end.



Figure 3 Matching a Chinese character with its pictorial origin

In comparison with still illustrations in books, the animation not only attracts the students' attention to the screen but also makes the dynamic process of how the characters evolve more visually explicit and understandable.

2.2 Stroke Sequence 筆順

Unlike drawing pictures, the writing of Chinese characters is governed by some commonly agreed rules - from the left to the right, for example. It applies not only in the way of writing a single stroke but also in the sequence of writing the components (Law, 1998). In the character 明, the writing of 日 precedes that of 月 as previously mentioned. The Stroke Sequence Exercise illustrates this concept of sequencing in writing.

The character to be written is first shown in gray. Clicking the correct end of the first stroke will cause the stroke to be written, in this case the upper end of the vertical stroke on the left of 日 (See the figure below). The writing then proceeds as 丨, 丩, 日, 日, 日, 明, 明 and 明. If the wrong end or the wrong stroke is being selected, the stroke will still be drawn but then be immediately cleared, giving feedback to the student that he has successfully clicked a stroke but unfortunately on the wrong one.



Figure 4 Writing a Chinese character with strokes in sequence

Sometimes the student may even select a stroke in the wrong component 月 instead of 日. In so doing, the component 月 on the screen will be dimmed, leaving only the component 日 remain visible. This draws the attention of the student back to the component that he ought to finish with before proceeding. In this way students are forced to write the components one by one and in the right sequence.

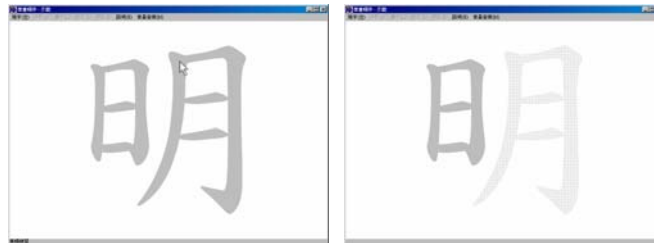


Figure 5 Writing a Chinese character with components in sequence

Upon completion, the whole character will be rewritten again so as to reinforce the correct writing order. If all strokes are selected correctly, the chop of an animal will be stamped on the character as a reward to the student.

Note that this exercise does not train the motor skill of the students to write strokes. As we believe, being able to use the mouse to write strokes on the screen does not imply that the student can write properly with a pencil on paper. Instead the aim of the exercise is to develop the concept of stroke order rather than the practice of writing.

Another thing we stress on the design is simplicity, which especially appeals to teachers unfamiliar with computers. Simple mouse click is used rather than such complex operation as dragging the mouse along the path of a stroke. Our belief is, the student is to learn the concept of stroke sequence rather than the control of mouse.

2.3 Character Component 部件砌字

In this exercise, students are required to recall the written form of a character when given the sound and the meaning of the character. To specify the written form, the students have to think out the components forming the character in the correct order. The purpose of the exercise is simply to remind students that Chinese characters are made up of components.

The exercise starts with the speech sound of a character (in Cantonese, which is the dialect widely used in Hong Kong), followed by a word that contains the character - “情、心情” (cing4, sam1cing4), for example. Since homophone is common in Chinese, the purpose of using the word is to state precisely which character is being referred to. With the picture of the character in mind, the students then click the components on the panel, which are then combined to form the character, just like the game Boggle.



Figure 6 Composing the character 情 from components

The components should be selected in the same sequence as writing the character. In the example above, the students should click the components exactly in the order of 小 and then 青.

When the students are unable to find out the correct component, after a failure of several trials, the whole character will flash, giving a hint to the students. This indirectly guides the students towards the correct component. Without such hint, the students would be likely to give up in frustration. Until the whole character has been completed, the cat at the bottom will run across the screen and finally catch the mice. The students can then move on to the next character.

The characters to be composed can be organized into groups. In the previous example, the group of characters in question is 情, 清, 晴 and 請. These characters have been broken down into components listed in the option panel. Throughout the same group, the components on the option panel will then remain unchanged so that the students need not be overloaded by reading the components each time for a new character.

2.4 Morphological Component 找尋形符

Recap that morphological component is the component that suggests meaning in a character. From the component, students can often deduce what an unknown character means, which is especially useful in reading. This exercise brings up the students' awareness of what kind of characters is likely to have a particular morphological component.

After hearing the sound of a character, the student has to determine which one of the morphological components the character should possess. In the figure below, the student is choosing the morphological component for the character 妹 (younger sister) from the options of 人(human) and 女(female). If correct, 女 in this case, the bear climbs up the tree and gets the honey. Then the next character is spoken and so on.

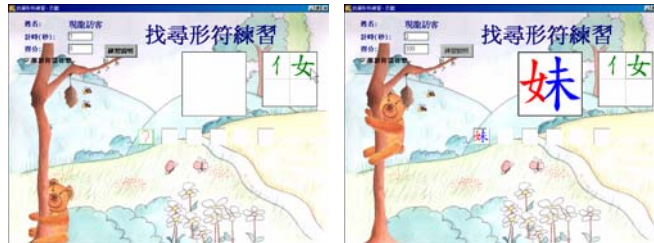


Figure 7 Identifying morphological component

The exercise ends up partitioning off the characters into two sets. One set contains 妹(younger sister), 姊(elder sister), 媽(mother) and 她(she) while the other set contains 伯(uncle), 你(you), 他(he) and 們(we or they). It becomes obvious that the characters denoting human in general possess the morphological component 人 and the characters denoting female possess the component 女. By comparing these characters, the students can easily identify the similarity in the meaning of these characters with the same morphological component.

In addition, teachers can also prepare their own exercises with the authoring tools provided. Using the tool, teachers are free to choose the combination of characters out of a total of 500 characters, tailor-made for their curriculum. (The authoring tools are also available to Character Origin, Stroke Sequence and Character Component.) The figure below shows the selection of characters 妹(younger sister), 姊(elder sister), 媽(mother) and 她(she), which contain the morphological component 女(woman). When finish, an exercise with the desired characters will be automatically generated, like the one mentioned previously.



Figure 8 Generating courseware on the fly

3 Chinese Character Knowledge Base 漢字知識庫

Properties of five hundred Chinese characters are determined and stored in this database; including the structures 結構, stroke sequences 筆順, radicals 部首, pronunciations 讀音, liushu's 六書, morphological 形符 and phonological

components 聲符 of the characters. These characters are further linked up together to form a network by their common properties. For example, with the same speech sound, homophones are connected together such that students can go from one to all of the others. Similarly for other properties, the characters are related in different dimensions. Exploring this network, students are expected to develop a mental “toolkit” from these properties of Chinese characters, which is helpful to them in learning other characters proficiently in the future.

As shown below, selecting 門 as a component will produce a list of characters: 門, 們, 閃, 問, 悶, 開, 閒 and 闊. All of them contain 門 as a part of the characters. The students can further specify the character to be a picto-phonetic composition. Only the five characters 們, 問, 悶, 開 and 闊 will then remain in the list. In addition to this, the students can further require the component 門 to serve as a morphological component in the characters. The list will be reduced to 開 and 闊, which are all related to 門(door) in meaning as in 開(open) and 闊(wide). The function of the component 門 can also be changed into being phonological. The list will then become 們, 問 and 悶, which are both spoken like 門(mun4) as the sounds of 們(mun4), 問(man6) and 悶(mun6) respectively..

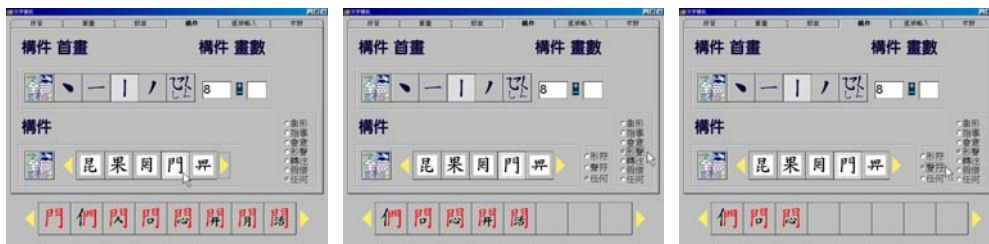


Figure 9 Selecting characters by different criteria

Clicking one of the characters in the list, say 問, will bring the students to another window that details all the particulars of the character 問. On the window it is indicated that the components 口 and 門 are the morphological and phonological components respectively. Clicking the component 口, the students can return to the first window with the pre-set selection of 口 as the morphological component, producing another list of characters 問(ask), 啼(cry), 喊(shout), 喝(drink) and others, most of them are actions with the mouth(口). Moving back and forth, the students can explore a list of related characters, for example, from 門 to 問 to 嗎 to 媽 to 妹 and so on so forth.



Figure 10 Exploring a list of related characters

Classroom experimentation

The software has been tried out on a limited scale in the classrooms of three primary schools (about 4 teaching sessions per school) and the associated classroom teaching strategies were also investigated. Most participating teachers did not have previous experience in teaching with computers, and the schools were only just beginning to have their computers. In the experimentation, all the software and materials were given to the teachers for their free disposal. They could choose any part they like to try and designed their own lesson plans. By so doing, we could understand more about ways of thinking of the language teachers. Positive feedback was received and some models of teaching have been identified (Ki et al 1999).

From some of the most well received lessons, we gained better ideas about how content and activities can be structured to bring about motivating and creative usage of the language, and at the same time draw learners' attention to the structural regularities and variations in the language.

Let's illustrate it with one lesson. The following poem was used. The poem reads: 山青水清天氣晴，青蛙有對大眼睛，吃飽蚊蟲心情好，請來蜜蜂與蜻蜓，你們跳舞我拍和，呱呱，呱呱，呱呱呱。(Green hill, clear water and sunny sky / Little green frog with a pair of big eyes / Full of insect, feeling good / Inviting the bees and the dragonflies to come along / Singing, dancing and playing in harmony / Croak-croak, croak-croak, croak-croak-croak) The lesson proceeded as follows:

The first part of the lesson was mostly on learning the text in its context. The teacher gave a set to the topic (asking students about whether they had seen frogs and what they knew about frogs.) Then the teacher presented the multimedia poem. The students listened and enjoyed the story. The whole poem was read aloud by a child's voice in the multimedia software, together with some animation about the story. The teacher then asked pupils to close their eyes and imagine the scene and the sound.

Then the students proceed to a more detailed reading of the text. They read the multimedia poem by themselves in groups. They used the different controls to read the poem in different ways (by episode, by sentence etc) so as to know more about the words and phrases used in the poem. After that the teacher asked them to tell the story and their interpretation about some of the words and phrases.

In the third part of the lesson, the teacher focused on the structure of some of the Chinese characters according to a particular theme.

There were a number of possible themes the teacher can pick from the poem:

- Who are in the story, and which bi-character words correspond to the insect friends? 蜜蜂 (bee), 蜻蜓 (dragonfly):

Both of them contain the component 虫!

- Recall the pronunciation, Can you find out which characters rhyme in the first two sentences?
“山青水清天氣晴，小小青蛙大眼晴”。 The underlined characters rhyme; All of them carry the component 青. Why?
With this similarity detected, a variation also steps forth: What do the components 丿, 日 and 目 signify?
- What actions are there? They dance and beat.
The word dance (跳舞) carries the foot component (足); The word beat (拍和) carries the hand component (扌).

The teacher did not choose all. She just chose the amount she thought right. Along a theme she opened up a dimension of learning, inviting students to name other examples they knew along the theme, and to play games in composing characters from the relevant components.

Finally, the teacher invited the class to re-visit the poem, invent body movements to play/dance the poem at the same time as they read it. And the class concludes with an enthusiastic and enjoying playing and dancing of the poem.

Useful orientations in the lesson

What makes this lesson successful? How does this pedagogy differ from the current normal practice in Hong Kong literacy education?

Most Hong Kong primary Chinese textbooks follow the “divergent approach” in character learning. Articles are written with content related to the world experience of the children. Character instruction is organized according to articles. In each lesson, children are expected to learn to recognize and reproduce all new characters and words they come across in the text. Usually the new characters and words are all listed at the end of the text for the reference. In most cases, the set of characters and words are heterogeneous in terms of their structural composition or meaning. Little systemic nature of the language structure is highlighted.

The approach in the lesson also starts from meaningful text as in the “divergent approach”, but subsequently the lesson proceeds to concentrate only on certain characters and words of the text. Eventually it further focuses to a very small number of characters, but use them as a springboard to open up a theme in the structure of Chinese characters. Eventually, the students return to enjoy the context and meaning of the whole text. This is a cycle from ‘context’ to ‘structure’ and then back to ‘context’. Language learning and language awareness development are closely tied together.

The text content is so chosen that it is enjoyable in itself, and at the same time reveal some important structural features of the language. Subsequently when we developed other text, we do find that in fact in most cases relating a context to a particular language structure can be quite natural. For example, if it is a story about mother and child, then there will naturally be words like 愛心(love), 孝心(love to ancestor), 耐心(patient), 傷心(sad), 開心(happy), 憂心(worry), 關心(care), all sharing the same character morpheme 心 (heart, attitude), and if it is a story about a war between the cat and the mouse, then there are bound to be contrasting words with positive and negative connotations.

The approach is also different from “convergent approach” advocated by some educators in Mainland China. In the “convergent approach” they use text that is full of characters that share similar morphological or phonetic components, so as to make their students learn a large numbers of characters at the same time. However, to the author many of the texts are quite artificial. The author thinks actually, with the support of IT, once the learner notice that there are some interesting themes in the language structure, they can be encouraged to explore, and it is in fact not necessary to cram everything into the text.

In this lesson we also notice the integrative use of IT-based and non-IT based whole class reading and body activities. The latter are valuable things in the classroom, which we ought to feel sad if they are lost with the introduction of IT.