A Cognition-Based Game Platform and its Authoring Environment for Learning Chinese Characters

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Abstract. We present integrated services for playing and building games for learning Chinese characters. This work is unique on two aspects: (1) students play games that are designed based on psycholinguistic principles and (2) teachers compile the games with software tools that are supported by sublexical information in Chinese. Players of the games experience and learn the grapheme-morpheme relationships underlying the writings and pronunciations of Chinese characters. Both visual and audio stimuli are employed to enhance the learning effects in the games. The software tools, utilizing structural knowledge about Chinese characters, offer instrumental information to facilitate the compilation of games. Preliminary studies with 116 participating students, in an elementary school in Taipei, showed that students who were given a one-month period to play the games improved their response time in naming tasks for reading Chinese characters. In addition, evaluation of the authoring tools by 20 native speakers of Chinese indicated that using the tools significantly improved the efficiency of preparing the games and the quality of the resulting games.

Keywords: grapheme-phoneme conversion, phonological components, serious games, language-dependent authoring tools, visually similar Chinese characters.

Phono-semantic characters (PSCs, henceforth) constitute more than 60% of Chinese characters in everyday lives. The writing of a PSC carries phonological and semantic information with its phonological and semantic parts, respectively. For instance, "讀"(du2), "瀆"(du2), "犢"(du2), "牘"(du2) share the same phonological components (PCs, henceforth), and contain different semantic parts. The PC, "賣" (mai4) on the right sides, provide hints about the pronunciations of these characters, and the influence of "賣" is consistent. A PC may and may not be a stand-alone character. The characters "檢"(jian3), "撿"(jian3), and "儉"(jian3) share their PCs on their right sides, but that PC is not a standalone Chinese character. A PC, when it is a stand-alone character, may and may not be pronounced the same as those characters that contain the PC. In the above examples, the pronunciations of "賣" and "讀" are different. In contrast, "匋"(tou2) is a stand-alone character, and has the same pronunciation as "淘", "陶", and "啕". Despite these subtleties, learning the systematic influences of the PCs on their carrying characters significantly reduces the burden to remember the pronunciations of individual characters separately [1].

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With the assistance of our software tools, teachers can compile games in the form that is illustrated on this page. Players see the *target PC* shown on the top of the screen, "里" (li3) in this game, and characters, "狸" (li2) in this snapshot, will randomly pop up from any of the six holes. Players will hear the pronunciations of the characters (the sound is played automatically to strengthen the connection between the pronunciation and writing of the character), and they have to judge within a time limit whether or not the character contains the target PC. If yes, as shown in this snapshot, the player has to hit the monster with a mouse clip (or touch it on a flat panel computer). If no, the player does not have to do anything. A sequence of 10 characters will be presented to the players in a single game. Credits of players will be increased or decreased upon correct or incorrect hits (or touches), respectively. If the players collect sufficient credits, s/he will be allowed to play advanced games in which s/he learns how the characters are used in normal Chinese text.

116 students in an elementary school in Taipei participated in an evaluation of the games. Pretests and posttests were administered with (1) the Chinese Character Recognition Test (CCRT) and (2) the Rapid Automatized Naming Task (RAN). In CCRT, participants needed to write the pronunciations in Jhuyin, which is a phonetic system used in Taiwan, for 200 Chinese characters. The number of correctly written Jhuyins for the characters was recorded. In RAN, participants read 20 Chinese characters as fast as they could, and their speeds and accuracies were recorded. Experimental results show that performance of the students, in the experimental group, improved significantly in RAN speed (p-values <0.02) but remained almost the same in RAN and CCRT accuracies.

The content of a game includes characters that do and do not contain the target PC. To have a way to control the challenge levels of the games, we require characters that do not contain the target PC to exhibit varying attractiveness. Attractive distracters make the game more challenging than those obviously unattractive ones. A character that contains components that look like the target PC is such an attractive distracter. Consider the game illustrated on the previous page. The character "理"(li3) is a correct character to click, while the character "玾" (jia3) is not. We consider "玾" a challenging distracter because it looks like "理".

Listing sufficient characters that contain the target PC demands very impressive memory about the writings of thousands of Chinese characters. It turns out that providing lists of attractive distracters are even more challenging. Experimental results showed that even native speakers of Chinese cannot perform well in these tasks.

When authoring a game, the teacher chooses the correct characters for the game, than s/he has to provide the attracters. Applying the techniques that we reported in [2], we were able to assist teachers in both tasks. Consider the target PC "里" again. Our authoring tools can provide teachers the list "鋰裡浬娌埋哩俚里理狸鯉鐘童貍喱量" to use in the game as correct characters. Note that these characters belong to different radicals and have different pronunciations. Consequently, there is no easy way to find them all with just a dictionary, and our software tools are crucial. Moreover, we can recommend characters that look like the correct characters, e.g., "鈿鉀鍾" for "鋰", "裸袖嘿" for "裡", "湮湩渭" for "浬", "狎猥狠狙" for "狸" , and "黑墨" for "里".

We evaluated the authoring tools with 20 native speakers, each authoring games for a list of 5 target PCs. The group that used our tools was able to finish the jobs two times (on average) faster than those who did not, and the quality of the resulting games were 50% better at the same time (p-values < 0.01).

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References

1. Lee, C.-Y., et al.: Consistency, regularity, and frequency effects in naming Chinese characters. Language and Linguistics 6(1), 75–107 (2005)
2. Liu, C.-L., et al.: Visually and phonologically similar characters in incorrect Chinese words: Analyses, identification, and applications. ACM TALIP 10(2), 10:1–10:39 (2011)