Mobile Assisted Game-based Chinese Character Recognition

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Abstract: This paper reports on the effects of two different dynamic grouping strategies in a mobile-assisted Chinese character learning game. The game application assigns each student a component of a Chinese character through their smartphones and requires them to form groups that can assemble a legitimate Chinese character using the components held by the group members. Sixteen Primary 3 (3rd grade) students taking Chinese as a second language (L2) class involved in the study. Video-recordings of the game and the transcriptions of focus group interviews were qualitatively analyzed. The study aims to explore the patterns of social interactions during the game, especially on the varied impacts of the two different grouping rules (allowing versus not allowing each student to join more than one group at one time) on the students' game behaviors and their learning gains.
Keywords: Mobile-assisted Language Learning (MALL); game-based learning; Chinese character learning; Computer-supported Collaborative Learning (CSCL)

1. Introduction

Chinese has long been regarded as one the most challenging languages to learn. One major challenge to the non-native learners is the complexity of the logographic configuration of Chinese characters [15][23]. There are two categories of Chinese characters in terms of their physical structures. One is called an integral character which contains only one component, such as 囗, and the other one is named compound character, which includes at least two components [15]. Most Chinese characters are composite made up of multiple reusable components that fit into the square space. The spatial configurations of these compositions usually follow about 15 different patterns [7][28]. Taking 𠮛 as an example, there are many Chinese characters that fits the pattern, such as 吾, 尘, and so on. Some simple components can be combined to form more complex components or compound characters [7]. Psycholinguists have stressed the importance of the awareness of part-whole relations and component knowledge in the processing of language [17]. Previous studies have also concluded that it is hard to memorize the strokes in whole words [19]. Therefore, other studies favored the instructions on the structure and form of characters that require the students to pay attention to the association between character, form and meaning. Students are encouraged to add associations to the characters and their forms using their imagination and creative thinking [11].

In turn, we developed a game-based learning approach on collaborative Chinese character formation, namely, "Chinese-PP" (汉字，拼一拼). PP refers to 拼一拼 or "Pīn yì Pīn" in Chinese, which roughly means "trial assembling", and also colloquially means "striving for better (outcomes)". In playing the game, the students are assigned

smartphones in 1:1 (one-device-per-student) basis. The activity is conducted in multiple rounds. In each round, a set of Chinese character components is randomly assigned by the system server via 3G connections to individual students. The students have to recognize and compose legitimate compound characters by grouping with their peers who have different components. This paper focuses on analyzing the social interactions, collaborative behavioral patterns and competitive strategies that were emerged during several game playing sessions. In particular, we will discuss the different impacts of two different grouping rules (allowing or not allowing the players to join more than one group at each time) on the students' game behaviors and their learning time.

2. Related Literature

2.1. Chinese character learning

Many studies emphasized the importance of Chinese character recognition. For example, previous research indicated that the students' mastery of components and their vocabulary have direct impact on character learning. Other studies also noted that novel students should focus on learning character recognition which is more important than writing [1]. Shen and Ke (2007) stated that component information is involved in word recognition in the area of morphological processing of Chinese character [16]. For example, some scholars found that characters can be recognized by the activation of submorphemic (radical) information [18].

A Chinese character consists of three tiers: whole character, components and strokes. Moreover, the middle part, the components, is the core and the base for the formation of a Chinese character [20]. While Chinese characters are composed from a limited number of common components, previous scholars had successfully used computer technologies to help students to develop such structural awareness about Chinese character [10]. Teaching the structures of characters and simultaneously addressing the relationship between parts and wholes would generate positive effects on character learning [2][12].

2.2. Mobile Assisted Language Learning

Mobile learning makes diverse possibilities of innovative instructional method be carried out in the general classroom in more effective and efficient ways. Scholars noted that mobile-assisted language learning (MALL) provide students with rich, real-time, convenient, social contact, collaborative, contextual learning opportunities no matter inside and outside the classroom (Kukulska-Hulme,& Shield, 2008). The paradigm has also been applied to Chinese Language learning in recent years. A previous study explored the feasibility of using of a wireless handheld system (WHS) that supports the individual and co-operative reading activities in Chinese language classes, and found that WHS improved students' Chinese language and facilitated co-operative learning in the Chinese class [4]. Another study on Chinese vocabulary (idiom and conjunction) learning placed an emphasis on learner created contexts and contents, and found that the students' ongoing, open-ended, personal-to-social meaning making processes showed potential of transforming language learning into an authentic learning experience [22][24][26][27].

2.3. Game-based Learning

The purpose of new interactive models in learning environment is to involve students in their learning tasks. Games are regarded as effective tools for enhancing learning [5][14]

because Game-based learning assists students to learn the material by overcoming challenges in games. Game-based learning has the characteristics of helping learners enthusiastic, focused, and engaged. As a result, the students can be interested in and enjoy the tasks they do [13]. The students do their best to achieve their goals by insisting on the end of playing game without forces [6]. The Chinese-PP approach in the study was designed on the foundation of the games and learning model which is illustrated in Figure 1 proposed by Garris et al. (2002). In the beginning of the game cycle, the judgments of users are based on free will, and their intentions representing engagement and enjoyment. User behaviors are triggered in exert intense effort and concentration. The feedback is critical to support performance and motivation [3][21]. Research suggested that the effects of feedback on performance are highly variable; especially well feedback can improve performance [8].
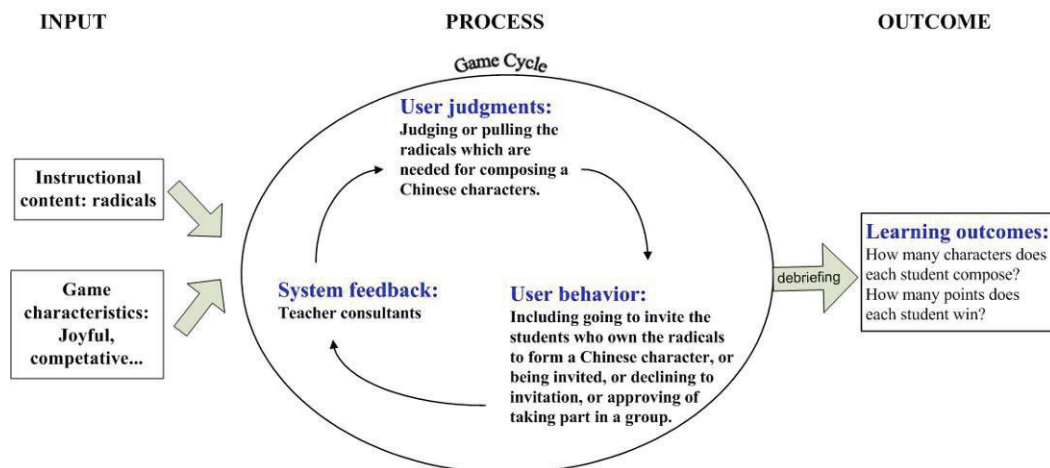

Figure 1. The Input-Process-Outcome Game Model used in ChinesePP (Garris et. al., 2002)

3. Method

3.1 Procedure

Sixteen P3 students who were learning Chinese as second language in Singapore in a primary school participated in the empirical study. Six one-hour Chinese-PP learning sessions were designed with the involvement of the researchers and teachers. Each learning session consisted of three sections, namely, warming up (about 15 minutes), game playing (about 30 minutes), and recalling (about 15 minutes). The learning sessions were enacted between May-September, 2011.

More specifically, in the warming up section, the teacher delivered brief instructions with Powerpoint files on specific knowledge of Chinese character structure, such as *pictophonetic character* (a character that composes of a component indicating the pronunciation and another representing the semantics, e.g., 晴 [means "sunny", pronounced as 'qíng'], with 日 ["sun"] representing the semantic meaning or 'picture' of the character, while 青 [similarly pronounced as 'qīng'] indicating the pronunciation), and enacted relevant paper-based group activities. The aim was to equip students with prerequisite knowledge for the subsequent (two to three rounds of) mobile-assisted game playing. After the game, the teacher facilitated a recalling activity where students were asked to relate the characters that they had composed during the game with the character

structure knowledge that they learned from the teacher (e.g., relating 晴 to 'pictophonetic character').

3.2. Design of game-based learning activities

Figure 2 shows the framework of the Chinese-PP game. At least two game-based factors and three learning theories are integrated in the system. The Chinese-PP game was designed by means of integrating mobile learning in the general classroom setting with the aim of promoting interactions and collaborations among learners. The game approach can be characterized as spontaneous, dynamic grouping game as no fixed student group is determined before each game round. Each student is equipped with a smartphone in which they can see what components they have and what components the other classmates are assigned. The students will identify their partners in order to collaboratively compose the components into a legitimate Chinese character. When one game advances to the next round, the existing groups are all disbanded and a new set of components are assigned to the students.
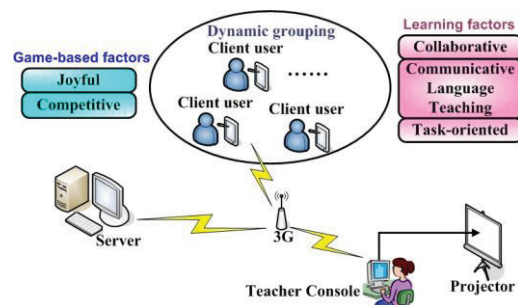

Figure 2. Framework of Chinese-PP in class

The setting and devices used in the study consists of a projector, the 3G wireless connection, a laptop with the Chinese-PP teacher console being installed, 16 smartphones installed with the client application of Chinese character recognition game. The facilitator (usually teacher) prepares several sets of Chinese components that are equal to the number of participating students in advance. When the game starts, the client application on the smartphone displays all the components for a student to select and configure (spatially) in order to form a Chinese character (see the left of Figure 3). Upon submission of her composed character to the server, the other students who "own" the components that the student has selected will receive the character on their "My Groups" window as a proposal for grouping. However, the proposed student cannot take for granted that her peers will join her group as the other students might have also formed their own characters or receive other proposals. This is the point where she will need to negotiate with the peers to join her group.

In addition, the system allows the teacher to tweak the game rule of whether to allow an individual student to form or join more than one group at a time (known as "single-group mode" and "multi-group mode" respectively). For example, a student who is assigned the component "五" ("five") submits a character "吾" (I). At the same time, another student may propose "伍" ("group") and invites the former to join them. During the single-group mode, she will have to choose one between the two options. Otherwise, she can join both groups if she thinks the two proposed characters are legitimate ones. During the learning sessions, the teacher complied to our advice by alternating between

the two modes across different game rounds in order to experiment their effects on the students' collaborative patterns and game behaviors.

The group which is organized by the students themselves based on their requirement. At the right of Figure 3, the teacher not only checks the characters which the students compose on the teacher console (projected on the screen), but also explains and gives just-in-time feedback to all the students. Moreover, the students can know the characters composed by other students and the scores they win (see below) in the teacher console.
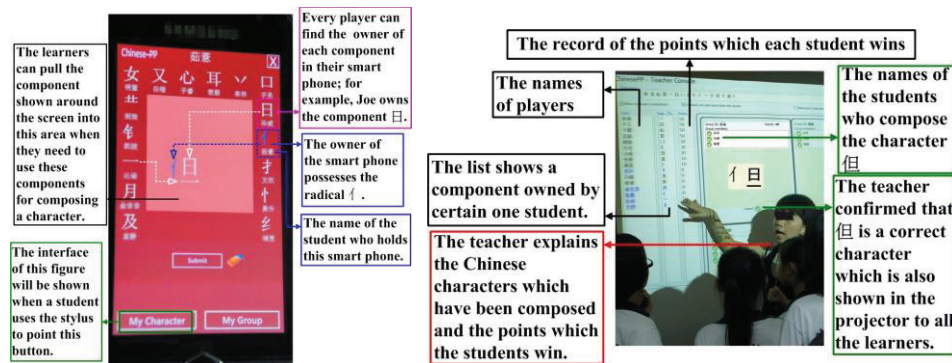

Figure 3. The user interface of the smart phone client (left), and the teacher console (right)

A scoring scheme is applied in the game in order to motivate the students to strive for greater game achievement. Students earn and accumulate scores by forming legitimate groups – 10 points for a 2-component character, 20 points for a 3-component character, 30 points for a 4-component character, and so on (same score to be awarded to each member of the group). This is to encourage the students to form bigger legitimate groups for identifying more complex characters. During the multi-group mode, a student who joins more than one group will earn accumulated scores from all the groups carrying the legitimate characters.

4. Results and Discussions

4.1. The social interactions in the game-based learning

The dynamic collaborative grouping strategy enabled by mobile information exchange and face-to-face interaction had successfully motivated learners' active desire in finding out what components can be put together to form a Chinese character in Chinese-PP. In terms of peer collaboration, competition, and tutoring, the higher-achievement (HA; in terms of their academic achievements in the Chinese Language course) students who have indomitable characteristics become the leaders and advisors of the group to guide other students in determining which are legitimate characters and which are not, or suggesting alternative characters by replacing one or more components. For example, in the study, a HA student Wendy (pseudonym) often took the initiative to advise other groups in their game playing. After two Chinese-PP learning sessions, her peers became more inclined to seek for her assistance. Albeit taking place in a general classroom, we rearranged the student chairs and desks to set aside an empty space and encouraged the students to walk around, form and re-form ad-hoc physical clusters to ardently discuss with different peers so as to explore alternative possibilities of characters, as shown in Figure 4. As for the lower-achievement (LA) students, we observed that they were not left alone during the game. This was because the more proactive students (who were not necessarily HA

students) would search for partners to compose their own groups. When other students needed the components which the LA students had, they would explain their proposed characters and invite the LA students to join their groups. As a result, the Chinese character knowledge of the HA could be transferred to their counterparts.

Figure 4. The students carry smart phone with them and go around to discuss with others

4.2. Different impacts of two grouping modes on the game playing and learning

In this section, we compare the effects of the two collaborative grouping modes, single-group mode and multi-group mode, to the students' game playing and interactional patterns in the game. According to our analysis on the video and server logs, during the single-group game rounds, most of the students usually spend more time to figure out the most complex characters that they could recall from the given components before making their submissions. Conversely, during the multi-group rounds, they would attempt to submit more alternatives of characters and were engaged in interactions with more peers to confirm the legitimacy of those characters. The game had also become more competitive as students who submitted multiple characters were more likely to gain higher scores. As the scores and their overall rankings were dynamically updated in the teacher's console and projected to the students to refer to, that became one of the motivating factors for them to remain active in playing the game.

Indeed, the students were keener on attempting to compose more complex characters. Take one example that we observed within the single-group mode, four students formed the character 熟(literally means "cooked" or "ripe") whose configuration 旦 is not taught in P3. In turn, each of the four members won 40 points respectively at the same time.

Conversely, during the multi-group mode, students tended to perform frequent group re-forming to explore more possibilities. In one instance, five students formed the 5-component character 警 ("warn") and received 40 points each. They then gradually decomposed the character by removing one component each time, and "transformed" it to 敬 ("salute", 30 points each), 苟 ("thoughtless", 20 points) and 句 ("sentence", 10 points each). In another case, two students who received the components 卄 and 日 respectively first formed the character 昔 ("previous", 10 points), and then teamed up with two other students separately to form 借 ("borrow", 20 points) and 惜 ("cherish", 20 points) respectively. In turn, both of them earned 50 points respectively. Apparently, the students had applied the knowledge of pictophonetic character to figure out multiple characters that their components can compose.

It is important to note that during the warming up sections of the past sessions, the teacher had only taught ten most basic spatial configurations for composing Chinese characters to the participating students. Nevertheless, Chinese characters with more complex spatial configurations that were previously untaught had been identified and submitted by the students during the activities. The above-stated example of 熟 with the spatial configuration 旦 is one of such student-identified characters. Our video and audio

analysis shows that it was the intensive peer tutoring and collaboration during the games that resulted in such unexpected knowledge gains.

4.3 Focus groups interview

We selected nine students with equal number of HA, middle-achievement and LA students, including Wendy, for a focus groups interview. Seven students informed us that they were usually taking the initiative to form characters and invite peers to join their group, while the other two were more being invited. All of the students expressed that they enjoyed the activities and would like to take part in more Chinese-PP sessions in the future. Seven students indicated their perception of having learned new characters during the game activities while, the other two students stated that they made guesses most of the time in playing the game. In particular, Wendy expressed that she had been willing to assist other students whenever requested by them, even though the characters that she suggested or affirmed did not make use of her own components. In this regard, the Chinese-PP approach has indeed resulted in the students' enjoyment, competitions and collaborations.

In addition, the students agreed that the teacher console could help them confirm whether their answers or guesses were correct or not. It became an important feedback mechanism in the game. Typically, in the first two minutes of each game round, most of the students studied their own smartphones as they could browse through all the components available for the game round and proceed to trial-compose their first characters. After the first character which is composed and submitted to the teacher console, some of the students started to notice what was displayed on the projected screen. As the learning sessions progressed, the time they needed to trial-compose their first characters became shorter. In the final (sixth) learning session, the students submitted their first character composed in less than one minute.

5. Conclusion and Future Recommendations

We have developed and studied Chinese-PP, a game-based MALL approach to address the Chinese as L2 learners' need of enhancing their understanding in the structures of Chinese characters. Two different grouping modes, namely, single-group mode and multi-group mode, were implemented in the activities. Through our empirical study, we discovered that the students were more deliberate in composing more complex characters in one shot during the single-group mode. Conversely, during the multi-group mode, the students were more inclined to draw the sentence structure knowledge that they picked up during the warming up sections in the present and past learning sessions to trial constructing multiple characters. Both modes of game playing have resulted in different game patterns and learning gains. In the future, we will further analyze the game process data in order to distill various cognitive processes of their game playing. We will then make an attempt to map the cognitive processes to the relevant theories of second language acquisitions and Chinese character learning. It is hoped that such an effort will lead to the discovery of more effective pedagogy and learning strategies for younger Chinese L2 students in understanding the structure of Chinese characters.

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