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AN EXPERIMENTAL STUDY ON THE EFFECTS OF COOPERATION AND
COMPETITION IN THE GAME-BASED MOBILE LANGUAGE LEARNING

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Abstract

As gamification gains popularity, it is a trend to implement gamified social features in the mobile language learning field based on Social Interdependence Theory (SIT), because the social interaction can positively affect learners. However, a detailed examination of how gamified cooperation and competition affect language learning process and outcome remains an open subject.

The current study was conducted among university students in China (N=75), and those students were randomly assigned either gamified cooperation or gamified competition setting. All students were asked to complete a daily task: learning 20 English words for 14 days with an app named Baicizhan. The study used a quantitative methodology and the data, related to task completion, learning achievement, social relatedness and intrinsic motivation, were collected to compare the difference.

In current study, firstly it confirmed that the cooperation outperformed competition in terms of promoting social relatedness; secondly, it identified that competition outperformed cooperation in terms of learning achievement; thirdly, it revealed that there was no significant difference in terms of task completion and intrinsic motivation between two settings. In a short, our study demonstrates that constructive competition can be as effective as cooperation in terms of motivating learners to put efforts and invoking intrinsic motivation; moreover, constructive competition was even more effective than cooperation in promoting learning achievement. Therefore, the constructive competition should be encouraged and taken into consideration when applying the gamified social features to learning activities.

Keywords: gamification, cooperative learning, competitive learning, social interdependence theory, constructive competition

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1 Introduction

In recent years, with the emergency of wireless technology and mobile devices, there is a shift from Computer Assisted Language Learning (CALL) to Mobile Assisted Language Learning (MALL) (Sung, Chang, & Yang, 2015), because mobile devices are able to make language acquisition happen anywhere and anytime as well as individually and collaboratively (Chinnery, 2006). Besides, the language learning can be facilitated by customized learning and personalized feedback offered by mobile devices (C. M. Chen & Chung, 2008), which provides learners with opportunities to monitor and regulate their learning process effectively. This seamless and efficient experience promotes the popularity of mobile assisted language learning.

At the same time, gamification is widely applied to mobile learning as a way to improve learning performance and enhance motivation. Gamification refers to implement game elements in a non-game context to engage learners (Huotari & Hamari, 2012; Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015) and substantial research has demonstrated if structured properly, gamification can positively impact motivation, engagement and learning outcome (Hamari, Koivisto, & Sarsa, 2014; Nah, Zeng, Telaprolu, Ayyappa, & Eschenbrenner, 2014). As the social interaction has been indicated as a powerful tool to motivate users to perform tasks, the application of gamified social interaction thrives in many fields. Drawing on SIT, gamified interaction can be categorized as cooperation and competition (Morschheuser, Maedche, & Walter, 2017). Both of their impacts on players' performance and motivation are investigated in the fields of game and fitness (Y. Chen & Pu, 2014; Peng & Hsieh, 2012), however, a detailed examination of how gamified cooperation and competition affect language learning process and

outcome remains an open subject. Thus, a 14 day experimental study was conducted with a language learning app – Baicizhan, and our aim was to investigate the difference between gamified cooperative and competitive groups in terms of task completion, learning achievement, social relatedness and intrinsic motivation.

2 Theoretical Framework

2.1 SIT: cooperation and competition

Social Interdependence Theory (SIT) is a theory about interaction, which explains how the structures of goals affect the individual's interaction with group members and result in different outcomes (Deutsch, 1949a; D. W. Johnson & Johnson, 2009). SIT is originated from Gestalt psychology and Lewis's field theory, and Morton Deutsch conceptualized it in 1949 (D.W. Johnson & Johnson, 2005). Social interdependence exists when other group members' actions have impact on individual's goal achievement. There are two types of social interdependence: positive and negative. The positive interdependence (cooperation) occurs when individual achieves goals only when others' do; However, the negative independence (competition) occurs when individual achieves goals only when others don't (Peng & Hsieh, 2012). For example, if you are positively linked with others, then you win or lose together; while with a negative linkage, if others win, you lose, and if others lose, you win.

The premise of SIT is that the positive interdependence contributes to a process of promotive interaction, while the negative interdependence contributes to a process of oppositional interaction (D. Johnson & Johnson, 2018; ZUO, WEN, & WU, 2018). Promotive interaction is defined as individual acts actively to make contributions to promote each other's success as to obtain the joint goal, i.e., mutual support, exchange of resources, and frequent communication; However, oppositional interaction is defined as individual acts actively to make contributions to obstruct other's success as to obtain individual's goals, i.e., misleading others, less communicating and sharing, and competing to win, etc. (D. W. Johnson & Johnson, 2009; D. W. Johnson & Johnson, 2015). Therefore, positive interdependence promotes: 1).

substitutability (how one's action can substitute for the action of another person), 2). positive cathexis (spending positive mental energy in objects outside of oneself, such as friends, family and hobby), 3). inducibility (readiness to accept others' influence to satisfy what others want); whereas negative interdependence induces non-substitutability, negative cathexis and a resistance to being influenced by others (Deutsch, 1949a; D. W. Johnson & Johnson, 2009; David W. Johnson & Johnson, 2005). Those psychosocial processes are involved in resulting in different outcomes in the following aspects: a). efforts to achieve, b). positive interpersonal relationship, c). psychological health. Amount of studies have demonstrated that the positive interdependence (cooperation) outperforms the negative interdependence (competition) in promoting efforts in achievement, positive relationship and psychological health (Y. Chen & Pu, 2014; D.W. Johnson & Johnson, 2005; Peng & Hsieh, 2012). For example, studies have demonstrated that a correlational evidence that the academic achievement is associated with sharing resources and being cooperative (Ghaith, 2002; Wentzel, 1993). And over 40 cross-ethnic studies have been conducted to compare the effects on relationship among cooperation, competition and individual setting, and the results consistently demonstrate that the cooperation outperforms competition and individual work in promoting positive relationship among diverse and heterogeneous participant (Gehring, Deibel, Hamer, & Whittington, 2006; Gillies, 2016). Also studies has shown that cooperation and valuing cooperation leads to healthier psychology in comparison with competition and individual work (D. W. Johnson & Johnson, 2015).

Though considerable evidence have indicated that competition promotes less achievement and productivity compared with cooperation, some scholars argue that competition can also benefit group member when it is properly structured (Burguillo, 2010; Cantador & Bellogín, 2012;

Verhoeff, 1997). Evidence of that competition can be constructive includes that it can encourage participants to complete task effectively, enhancing their willingness to take on challenges, and persist the participation (Cantador & Bellogín, 2012; Ciampa, 2014; Fasli & Michalakopoulos, 2005). In the two fields of business and industry, it is found that if the group leader can control those factors, such as fair rule, perception of chance for everyone to win, and healthy relationship among group members, the constructiveness of competition can be increased (Tjosvold, Johnson, Johnson, & Sun, 2003, 2006).

Though empirical research has indicated that the overwhelmingly positive effects of cooperation, scholars notes that without careful monitoring and nurturing, the cooperation tends to break down easily due to those reasons (Deutsch, 1962; David W. Johnson & Johnson, 2005): firstly, in order to avoid to moving from cooperation to competition, active and continuous efforts are required to sustain effective cooperation; secondly, cooperation can fail easily, when affected by the key psychological process (i.e., sustainability, cathexis and inducibility). For example, the inducibility may give the pressure of agreeing with others quickly to create a superficial harmony, but it deprives of the members' opportunity to make unique and creative contributions; thirdly, the cooperation can be costly regarding the efforts to maintain. Those cost may prohibit the cooperation if the cooperation is not necessary (Sharan, 2010). Therefore, those factors may have negative effects on the productiveness and achievement of cooperation.

2.2 SIT and gamification

In 2002, the term of gamification was coined by Marczewski and has gained popularity since 2010 in the education field (Faiella & Ricciardi, 2015). Gamification refers to apply game design elements to non- game activities and its application is involved in various context, including

education (Robson et al., 2015). To understand the effects of gamification systematically, Huotari and Hamari (2012) conceptualize the gamification as a process to invoke a gameful experience and future behavioral outcomes by improving service with motivational affordances. According to this definition, gamification can be categorized as three parts: 1). the application of motivational affordance, 2). subsequent psychological outcomes, 3). further behavioral outcome. The conceptualization of gamification reveals some key elements of gamification: 1). stimuli provided are aimed to meet motivational needs and invoke psychological states, such as immersion to the game, 2). the chance to influence the future behavior, 3). the adoption is voluntary but the subjective perception affects the adoption (Huotari & Hamari, 2012; Morschheuser et al., 2017).

Draw on the SIT, features of gamification are categorized into four categories (Morschheuser et al., 2017) : 1) individualistic gamification features, which motivate individuals towards the expected behaviors by structuring non-interdependence goals among them (e.g. by setting independent goals); 2) cooperative gamification features, which motivate individuals towards the expected behaviors by structuring positively interdependent goals (e.g. by setting a shared goal requiring collaboration); 3) competitive gamification features, which motivate individuals towards the expected behaviors by structuring negatively interdependent goals (e.g. by setting a goal requiring competition); 4) cooperative-competitive gamification features, which motivate individuals towards the expected behaviors by structuring positively interdependent goals within a group while competitively interdependent goals among groups (e.g. by setting a goal requiring inner collaboration to compete with other groups.)

Cooperative goal structure may positively affect players' intrinsic motivation and task enjoyment as it provides opportunity to experience deep competence satisfaction as well as social relatedness when collaborating with people toward the shared goals (Rigby and Ryan, 2011; Ryan et al., 2006). Because challenges in cooperative games, which are designed to be overcome only by cooperation and mutual support, therefore, the challenges are impossible for individual to complete, but are able to be solved with teamwork; Overcoming those challenges may invoke a deep competence satisfaction for players (Rigby and Ryan, 2011; Ryan et al., 2006.). In addition to competence, players' needs for social relatedness can be satisfied in the cooperative setting, which provides the opportunity to experience the meaningful relationship with others by working together towards the shared goals. Social relatedness refers to the needs for belonging and the will to interact and connect with others (Hamari & Koivisto, 2015). Social relatedness has been identified as motivational gratification for players of online games with cooperative features (Rigby and Ryan, 2011; Scharkow et al., 2015; Yee, 2006).

Competitive goal structure also invokes intrinsic motivation, positive feeling and enjoyment as often shown in competition games (Liu et al., 2013; Ryan et al., 2006). Because players can also experience competence satisfaction by completing difficult and interesting challenges in the competition setting (Reeve and Deci, 1996; Jung et al., 2010; Zhang, 2008). Also the competition is able to provide players with enjoyment, because it can offer instant performance feedback for competence assessment (Tauer & Harackiewicz, 2004)

Studies on gamification have compared the effect of competition and cooperation and the results show that: 1) players with cooperative goal structure put more efforts compared with the ones with competitive goals structure (Marker & Staiano, 2015; Peng & Hsieh, 2012), 2) players with

cooperative goal structure feel more intimate towards group members and communicate more compared with the ones with competitive goals. (Y. Chen & Pu, 2014). Besides, empirical studies has indicated that the cooperative gamification positively impact participation and idea quality in the community context, while the competitive gamification has the opposite impact (Morschheuser et al., 2017). This is because the cooperative gamification is able to fulfill social needs, such as belongings, which may promote the participation and knowledge exchange, and this positive social experience in turn positively affect the quality of collective product (Hutter, Hautz, Füller, Mueller, & Matzler, 2011; Scheiner, 2015). However, the study conducted by Tauer and Harackiewicz (2004) has demonstrated that no difference is found in performance as well as intrinsic motivation between cooperative and competitive groups in a basketball shooting activity. Also other factors like unbalanced opponents (Liu, Li, & Santhanam, 2013) and personality traits (Ahtinen et al., 2009) of players may demotivate players rather than the competitive goal structure itself.

2.3 SIT and learning

Based on SIT, learning can be structured as either cooperative learning (positive interdependence) or competitive learning (negative interdependence). Cooperative learning refers to that students work together in a group to achieve joint academic goals, and in this context, one obtains own academic goals only if the rest of group members all obtain their academic goals as well; while competitive learning refers to that students compete against each other to be the best in the group and in this context one obtains own academic goals only when the rest of group members fail to obtain their academic goals (D. W. Johnson & Johnson, 2015) .

The empirical studies, which compared cooperative learning with competitive learning, have indicated that cooperative learning outperforms competitive learning in terms of efforts to achieve, learning achievement, social relatedness, and self-esteem (Gillies, 2016; Slavin, 2014). For instance, studies has demonstrated that compared with competitive groups, the cooperative groups are willing to spend more time on tasks, have higher task enjoyment, have greater long-term retention, higher-level of cognition and metacognition, greater transfer of knowledge (Gehring, Deibel, Hamer, & Whittington, 2006; Roseth, Slavin, 1989). An extensive research examined the 164 studies has shown that all the eight collaborative learning methods can significantly increase students' achievement compared with competitive learning (D. W. Johnson et al., 2000). Relative to competition, cooperation helps students develop more positive and supportive relationship with peers, and students exhibit better social skills (Gehring et al., 2006); The 33% of variation of student achievement accounts for positive peer relationship and even reach 40% only when including the moderate and high-quality studies (Roseth et al., 2008). Besides, empirical studies have indicated that the cooperative relationship result in higher self-esteem compared with the competitive relationship, because cooperative experience provides more stable perception of self-worth, while competitive experience provides conditional perception of self-worth depending on one's lose or win (D. W. Johnson & Johnson, 2009; Springer, Stanne, & Donovan, 1999).

However, compared with cooperation, the lower performance of competition, may not account for this mechanics itself, instead, those factors may lead to its destructiveness (Cantador & Bellogín, 2012a; D. W. Johnson & Johnson, 2009) : 1) Emphasis wining. Because if wining is too important, performance will be negatively affected by high level of anxiety, and most participants tend to perceive their performance as failure. Besides, wining increases

psychological burnout and losing increases competition-learned-helpless, which both negatively affect the psychological health, 2) No reasonable chance for everyone to win. It impairs motivation if the perceived likelihood of winning is low, because people tends to avoid challenge, minimize efforts to devote, and have less interest and enjoyment, 3) No clear rules for wining. If the rules for wining is ambiguous, participants have to spend their energy on worrying about what is fair and unfair, which negatively affects their performance. If those factors can be avoided, competition can be constructive and should be encouraged, as competition are also able to contribute to encouraging to take challenging tasks, developing relationship with other opponents, promoting task enjoyment, increasing self-confidence, and maintaining task completion (Fasli & Michalakopoulos, 2005; Lawrence, 2004; Verhoeff, 1997) .

Some scholars also argue that the students' evaluation of the success of cooperative learning may not be accurate, because students tend to give positive assessment towards group work as to gain a positive evaluation for themselves or try to avoid bully (Barton, 2005; Tsay & Brady, 2010). Besides, most previous research, conducted from the perspective of teachers, tends to result in bias, because teachers are not evolved in the cooperative learning and don't suffer from the disastrous cooperative experience frustrating students, therefore teachers tend to see more advantages of cooperative learning and evaluate it positively (Davis, 1984). However, as the research has indicated that the individual performance and group performance are negatively affected by group hate, which is defined as a fearful feeling of facing the group work (Sorensen, 1981). The overuse of cooperative learning may develop group hate when students have to always work with peers don't take responsibility of their own role, which negatively affect student's emotion, motivation and learning outcome (Glenn, 2009).

In summary, previous research examines how SIT affects the field of gamification and learning separately. However, the study on the gamified learning context is still open. As the combination of gamification and learning gains popularity, it is important to fill this gap, in order to provide more insights for educational practitioner.

3 Aim and Research questions

The aim of this research is to explore the differences between cooperative and competitive game-based mobile language learning in terms of learning processes and learning outcomes.

The specific research questions are as follows:

1. Is there any difference between cooperative and competitive game-based mobile language learning in terms of task completion?
2. Is there any difference between cooperative and competitive game-based mobile language learning in terms of learning achievement?
3. Is there any difference between cooperative and competitive game-based mobile language learning in terms of social relatedness?
4. Is there any difference between cooperative and competitive game-based mobile language learning in terms of intrinsic motivation?

This study reveals more insights on the impacts of cooperative and competitive game-based mechanism on learners' task sustainability, learning achievement, social relatedness and intrinsic motivation. Through this study, Ed-tech companies and educators hopefully are more aware of the different impacts of cooperative and competitive mechanism on learners, it will benefit their design for product or activities when adding gamified social features to motivate learners to achieve their learning goals.

4 Methodology

4.1 Participants

A Total of 75 Chinese students (Female N= 59 (78.7%), Male N=16 (21.3%)) participated in this study. The mean age of participants was calculated as 20.55 (Min = 18; Max:26; SD = 2.03). Participants were recruited from different universities in China, ranging from Freshman (n = 17), Sophomore (n = 24), Senior (n = 10), Junior (n =10), 1st year in master's (n = 6), 2nd year in master's (n = 6) to 3rd year of master (n= 2). The participants were assigned randomly to one of six groups in which they completed the learning task either in gamified cooperation or in gamified competition setting (see Table 1 for further details on descriptive statistics about the participants and groups.)

Table 1. Descriptive statistics about the participants

		Overall	Cooperative			Competitive		
		(n=75)	Coop1 (n=13)	Coop2 (n=13)	Coop3 (n=13)	Comp1 (n=11)	Comp2 (n=12)	Comp3 (n=13)
Age								
	Mean	20.55	19.92	19.62	20.92	20.91	20.67	21.31
	SD	2.03	1.61	1.45	2.18	2.26	2.01	2.40
Gender								
	Male (M)	16		2	5	3	1	5
	Female (F)	59	13	11	8	8	11	8
Grade								
	Freshman	17	2	4	2	2	4	3
	Sophomore	24	7	5	3	3	3	3
	Senior	10	2	3	1	1	1	2
	Junior	10	1	1	3	2	2	1

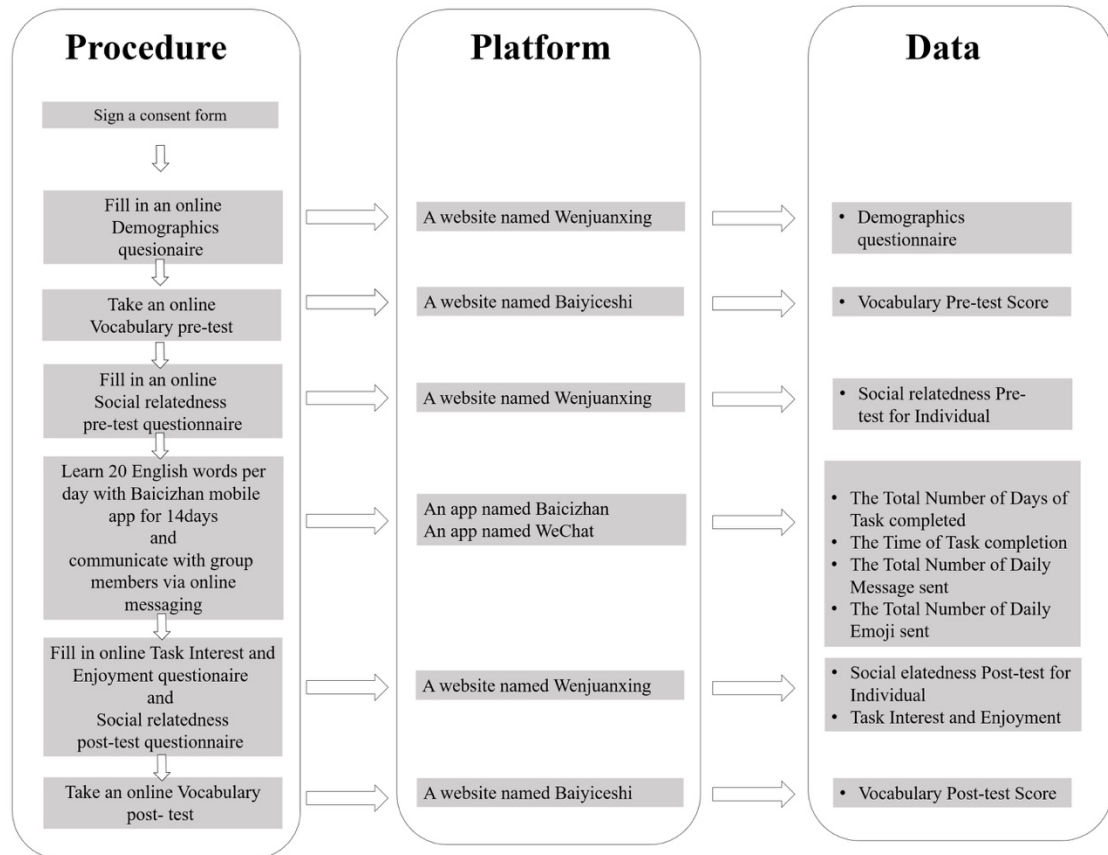
1st year in master's	6		3	1		2
2nd year in master's	6		1	1	2	2
3rd year in master's	2	1		1		

*Coop1= Cooperative group 1; Coop2= Cooperative group 2; Coop3= Cooperative group 3; Comp1= Competitive group 1; Comp2= Competitive group 2; Comp3= Competitive group 3

4.2 Procedure

The participants were recruited via a recruitment advertisement in an Ed-tech company's social media account with over three million followers. Its product named Baicizhan is the most popular English vocabulary -learning app in China (Yijing, 2018). There were no guidelines for arranging the group size. Thus, we decided that around 10 participants in each group would be sufficient to create a competitive or cooperative environment. Data collection took place from March to April in 2018 and the participants were required to follow those seven steps to participate in this study: 1) sign a consent form, 2) fill in an online Demographics questionnaire, 3) take an online Vocabulary pre-test, 4) fill in an online Group-relatedness pre-test questionnaire, 5) learn 20 English words per day with Baicizhan mobile app for 14 days and communicate with group members via online messaging, 6) fill in online Task interest and enjoyment (TIE) questionnaire as well as Social relatedness post-test questionnaire, 7) take an online Vocabulary post-test. In the end, all participants entered a draw to win four gift card and each was worth 45 euros. Participants were free to quit the study at any moment, and even they quitted the study, they could enter the final draw. Participants completed the daily tasks voluntarily and the completion rate didn't affect their draw. Thus, it is possible to assume that participants had no other motive than voluntary and intentional participation in the study (see

Figure 1 for further details on the overview of procedure and corresponding online environments used for data collection).



(Figure 1. Overview of procedure, platform and data types)

The data collection procedure was explained via an online messaging app - WeChat. The web links for data collection were distributed via WeChat, including Demographics questionnaire, Vocabulary pre- and post-tests, Social relatedness pre- and post-tests questionnaires and Task interest and enjoyment questionnaire. To avoid cheating in the Vocabulary pre- and post-tests, participants were asked to turn on their camera on computers during the tests, because through camera, the intelligent Baiyiceshi website are able to recognize and document the suspicious

behavior of cheating, such as opening a book, leaving the computer and searching answers online. Both of the Vocabulary pre-and post-tests were not able to retake in the website and participants received the test results as soon as they completed the test. After the experiment ended, log files of participants were provided to the researcher, with an approval of Baicizhan.

4.3 Data collection instruments

4.3.1 Demographics questionnaire

The online Demographics questionnaire asked participants about their age, gender, education status, university, WeChat ID and Baicizhan ID.

4.3.2 Vocabulary test

Participants took both Vocabulary Pre- and Post-tests on an online website named Baiyiceshi. Both vocabulary pre- and post-tests included the same 280 words and Vocabulary pre- and post-tests were presented in a multiple choice format. That is, for each word, the participants were asked to select the correct Chinese meaning out of 5 possible answers (see Figure 2. The environment of Baiyiceshi website). The words were selected from the vocabulary list of CET 6 (College English Test 6, a national English test for undergraduate and postgraduates in China). The procedure was: 1) Participants took the Vocabulary Pre-test with 280 words, 2) those words were studied by participants in the mobile language learning app Baicizhan during the 14 days, 3). Participants completed the Vocabulary Post-test with the same 280 words. Prior to the statistical tests, firstly, the reliability of Vocabulary pre-test and Vocabulary post-test were checked, the findings revealed Vocabulary pre-test (280 items, $\alpha = 0.989$) and Vocabulary post-

test (280 items, $\alpha = 0.987$). Secondly, the distribution of the variables across the sample were checked.

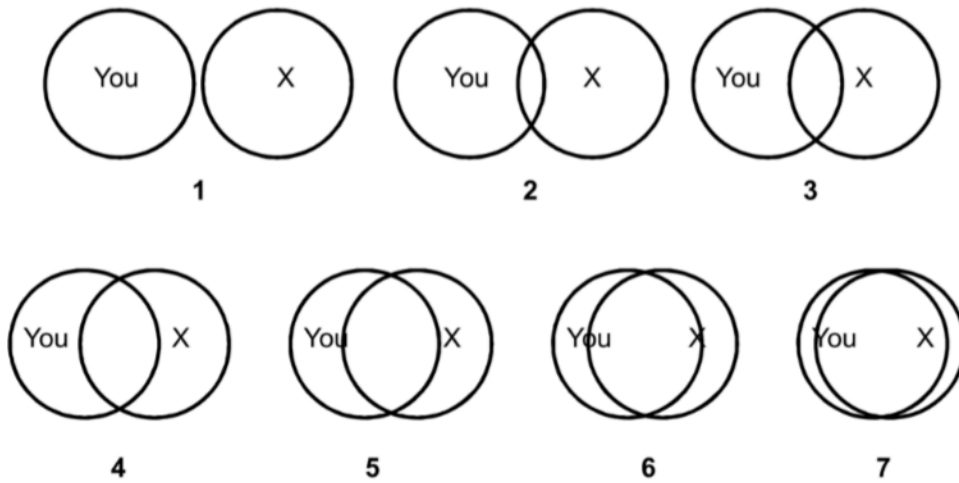


(Figure 2. The environment of Baiyiceshi website)

4.3.3 Social-relatedness questionnaire

The 'Inclusion of the Other in the Self' (IOS) scale (Aron, Aron, & Smollan, 1992) was used to measure the social-relatedness among the participants in the current study. Previous studies have shown that IOS is a reliable instrument to measure the perceived subjective closeness of the relationships between individuals (Ga'chter, Starmer, & Tufano, 2015). IOS includes a single item that asks participants: "Which of these pairs of circles best describes your relationship with participant X?" Answer to the question (i) varied on a 7-point scale (1= "unrelated to participant X", 7 = "very related to participant X"). Participants are asked to assess their closeness with participant X by selecting one out of seven pairs of increasing overlapping circles (see Figure 3. The Inclusion of Other in the Self (IOS) Scale), in this figure, you refers to the participant and X refers to the group member. If the participant feels unrelated to X, one would naturally choose

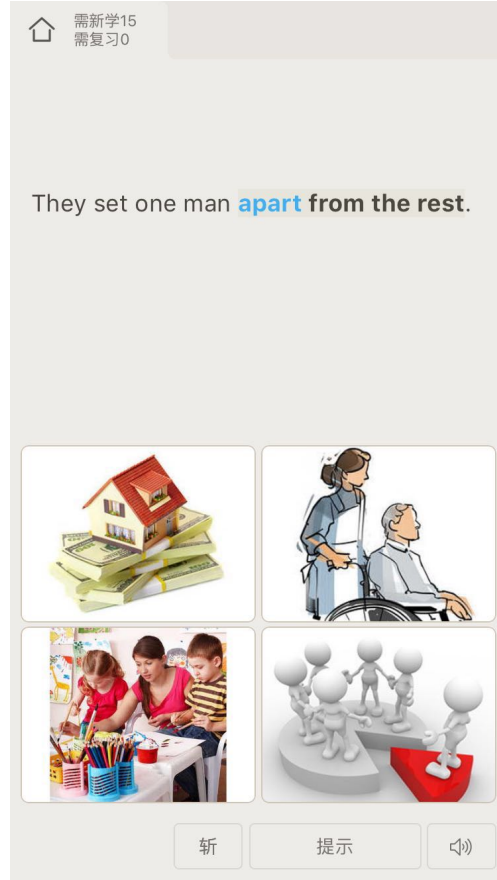
the first pair of disjoint circles, and if one feels very related to X, the seventh pair would be the best choice. The questionnaire was applied to both Social relatedness pre- and post-tests.



(Figure 3. The Inclusion of Other in the Self (IOS) Scale)

4.3.4 Baicizhan app

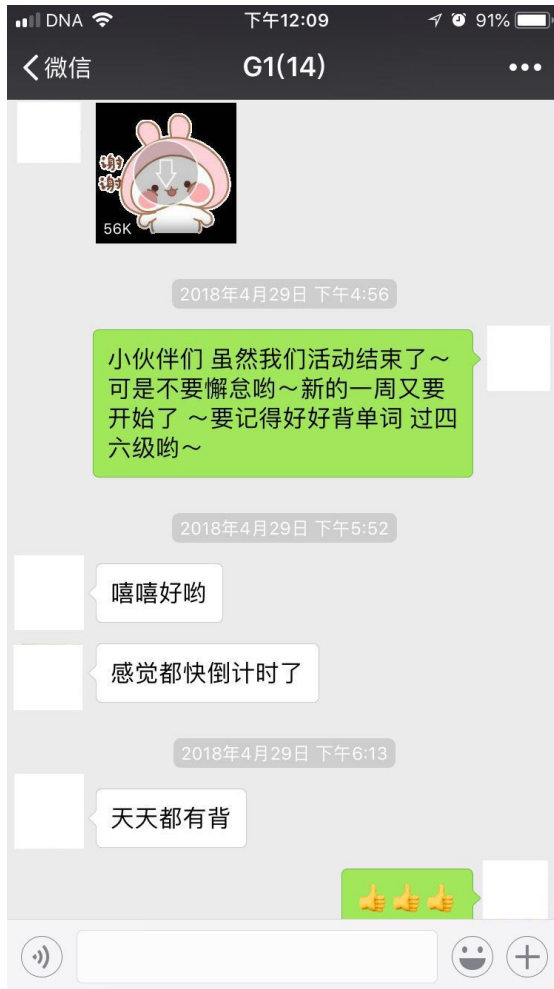
Baicizhan is a mobile app for English vocabulary learning owned by a Chinese Ed-tech company, and this app is available both on Android and IOS system. After setting the daily goal to learn 20 words of CET 6 list in Baicizhan, each participant was assigned 20 words automatically every day. Each word learning section begins with a multiple choice. The participant is asked to choose the photo that one thinks best matches the sentences, and the answer is provided along with the word's definition in Chinese (see Figure 4. Word learning section in Baicizhan for further details). Later it provides different types of multiple choice, i.e., choose words' definition, to help learners to review the word. The leaderboard provides participants with the details of task completion, such as the total amount of task completed, task completion time and group ranks in one's group.



(Figure 4. Word learning section in Baicizhan)

4.3.5 WeChat environment

WeChat is a Chinese freeware and cross-platform messaging app. Participants communicated with group members in WeChat by sending text message, emoji, and pictures, etc. (see Figure 5. WeChat environment for further details). We collected the data of two variables from WeChat: Daily text sent and Daily emoji sent.



(Figure 5. WeChat environment)

4.3.6 Log data

The log data collected from each participant includes the total number of days of task completed, and time of task completion. The time of task completion means when the participant has finished his or her daily task, i.e., 8 a.m. or 9:10 p.m.

4.3.7 Task interest and enjoyment

Task Interest and Enjoyment (TIE) is a subscale of the Intrinsic Motivation Inventory (IMI) (Deci, 2009) and it was used to measure the TIE in the current study. The scale was taken from

a validated Chinese version of IMI. TIE included 7 items (see Figure 6. Subscale of TIE for more details) to measure participants' perceived enjoyment towards the learning activity, namely learning 20 words with Baicizhan per day in different experimental conditions. Answers to the TIE varied from 1= "not at all" to 7 = "very true". In the current study the internal consistency (Cronbach's Alpha (α)) of TIE was calculated as 0.842.

For each of the following statements, please indicate how true it is for you, using the following scale:

1	2	3	4	5	6	7
not at all			Somewhat true			Very true

Interest/Enjoyment

I enjoyed doing this activity very much

(Figure 6. Subscale of TIE)

4.3.8 Experimental design

The current study was comprised of two experimental conditions: gamified cooperation and gamified competition. The rules for participants in three cooperative subgroups were as follow:

- 1) When one group member completes the daily task, namely learn 20 words in Baicizhan, the group will gain 20 points for that day,
- 2) If all of the group members complete the daily task, the daily group points will be doubled,
- 3) The total points of 14 days will be counted when participants finish the experiment. The more points the group gains, the better title the group will earn. For example, if the cooperative group gains more than 20 points, they will win a title named the most amazing group in China, while if it gains more than 200 points, they will win a title named the most amazing group in Asia. (see appendix 5. Titles for cooperative groups when they gain different points for more details). The title was listed and sent to the participants beforehand. For example, there are 10 students in a group, the group will be awarded 20 points

when one completes the daily task. If nine out of them finish their daily tasks today, then the group points is $20 \times 9 = 180$ points, but if all of them finish their daily tasks, the daily group points is $20 \times 10 \times 2 = 400$ points.

The rules for participants in three competitive subgroups were as follows: 1) If one completes a daily task - learn 20 words in Baicizhan, one will win 20 points for oneself, 2) In the end, the one with the highest total points will be the champion in that subgroup, 3) If the total scores of participants are equal, the one who finished the tasks earlier will win. For example, if there are 3 students in a group, A = finished 10 daily tasks and always finished them at 8. am, B = finished 10 daily tasks and always finished them at 9 a.m., and C = finished 9 daily tasks and always finished them at 8 a.m. The final rank is $A > B > C$. In this research, the ranking was informed within the subgroups every day.

4.4 Data Analysis

The data in the current study was collected through various online platforms. Thus, all the data stored in different platforms was first transferred into a single Microsoft Excel sheet. Then IBM SPSS 25 software was used to run the statistical analysis on the data set. Both the Social relatedness pre- and post-test for individual were calculated by adding together the other group members' perceived relatedness scores towards the individual. To calculate the gain of social relatedness and learning achievement, both the scores of Social relatedness post-test and the Vocabulary post-test were subtracted from their pre-tests. Daily task completion time for each participant was calculated through the average of the daily task completion time in 14 days. Daily messages sent was calculated by adding up the number of text sent in the group by each participant in 14 days. Daily emoji sent were calculated by adding up the number of emoji sent

in the group by each participant in 14 days. The findings revealed that Vocabulary pre-test score (Skewness: -0.823; Kurtosis:0.025), Social relatedness pre-test score (Skewness: 0.404; Kurtosis: -0.209), Average daily task completion time (Skewness: -0.134; Kurtosis: -0.323); Average TIE (Skewness: -0.021; Kurtosis: -0.728) displayed normal distribution. On the other hand, Vocabulary post-test score (Skewness: -2.966; Kurtosis:13.287), Social relatedness pre-test score (Skewness: 2.045; Kurtosis: 4.450), Total number of days of task completed (Skewness: -2.828; Kurtosis: 7.184), Average daily text sent (Skewness: 2.739; Kurtosis: 8.073), Average Daily emoji sent (Skewness: 3.061; Kurtosis: 11.132) didn't display normal distribution. The screening of the Vocabulary post-test score revealed a single outlier case. After excluding the single outlier case, Vocabulary post-test score showed normal distribution (Skewness: -1.317; Kurtosis: 1.516). The variable of Social relatedness pre-test was not processed for normal distribution, because the scale showed that most of the participants were strangers, therefore it was reasonable the most of the Social relatedness pre-test score were distributed around 1 (Min: 1.00; Max:1.60; Mean:1.05; SD:0.15).As for Total number of days of task completed, even after transformation, this variable didn't show any normal distribution, and this may be caused by that almost 60% participants completed daily task every day. Thus, we have conducted non-parametric test on this variable. After square root transformation, the variables of both Average Daily text sent (Skewness: 1.276; Kurtosis: 1.341) and Average Daily emoji sent (Skewness: 1.130; Kurtosis: 1.472) displayed normal distribution.

5 Results

The table below (see Table 2. Descriptive statistics of variables in each subgroups) shows the details of variables related in each subgroup.

Table 2. Descriptive statistics of variables in each subgroups

		Cooperative			Competitive		
		COO1	COO2	COO3	COMP1	COMP2	COMP3
Total number of days of task completed	Mean	13.77	13.38	13.23	10.64	11.33	12.69
	SD	0.60	0.96	0.83	4.39	4.68	3.30
Task completion time (h.m.s)	Mean	11.20.46	14.23.00	12.28.48	09.38.31	10.08.40	10.41.06
	SD	02.57.16	02.03.21	03.40.26	04.26.38	04.52.19	04.51.48
Social relatedness pre-test	Mean	1.07	1.00	1.07	1.11	1.06	1.00
	SD	0.17	0.00	0.17	0.24	0.16	0.21
Social relatedness post-test	Mean	1.72	2.02	1.45	1.23	1.38	1.33
	SD	0.24	0.28	0.23	0.34	0.20	0.21
Average daily text sent	Mean	1.56	1.71	0.21	0.32	0.14	0.51
	SD	2.25	1.45	0.31	0.53	0.30	0.72
Average number of daily emoji sent	Mean	0.49	0.46	0.15	0.13	0.16	0.19
	SD	0.44	0.85	0.18	0.20	0.16	0.22

Vocabulary pre-test score	Mean	80.34	68.09	76.42	78.52	64.94	58.43
	SD	16.96	18.86	14,19	20.43	25.62	25.09
Vocabulary post-test score	Mean	92.27	87.83	90.18	92.29	87.91	88.39
	SD	10.00	13.80	8.31	8.02	10.27	11.24
TIE score	Mean	5.13	5.51	5.14	5.40	5.32	4.68
	SD	0.78	0.73	1.10	1.19	1.05	0.99

5.1 Is there any difference between cooperative and competitive game-based mobile language learning in terms of task completion?

To answer this question, first the Total number of days of task completed between cooperative groups (Mean=13.46, SD=0.82) and competitive groups (Mean=11.61. SD=4.11) were compared with Mann Whitney U test. As the table 3 below showed that no significant difference ($Z = -1.521$, $p = 0.128$) was observed between cooperative (41.27) groups and competitive (34.46) in terms of total number of days of tasks completed for the 14 days.

Table 3. Result of Mann Whitney U Test to Compare the Total Number of Days of Task Completed for 14 days

Groups	N	Rank Average	<i>U</i>	<i>Z</i>	<i>P</i>
Cooperative	39	41.27	574.5	-1.521	0.128
Competitive	36	34.46			

Also an independent-samples t-test was conducted to compare Average daily task completion time between cooperative and competitive groups. There was a significant difference in the scores for cooperative groups ($M=45851.37$, $SD=11364.54$) and competitive groups ($M=36670.04$, $SD=16652.87$); $t_{(73)} = 2.808$, $p = 0.007$ (see table 4). These results suggest that the rule who finishes the tasks earlier will win have an effect on the daily task completion time among competitive groups. Specifically, the results in this study suggest that the competitive groups completed the daily task earlier than the cooperative groups due to the impact of the rule.

Table 4. Result of Independent Sample Test to compare the Daily Task Completion Time

Groups	N	Mean	SD	$t(df)$	P	η^2
Cooperative	39	12.44.11	03.09.25		0.007	0.097
Competitive	36	10.11.10	04.37.33	2.808(73)		

5.2 Is there any difference between cooperative and competitive game-based mobile language learning in terms of learning achievement?

To answer this question, the improvement from Vocabulary pre-test to Vocabulary post-test were compared between cooperative groups and competitive groups. The independent sample t-test, a parametric technique, was conducted for this comparison. As the table 5 showed that there was a significant difference in the learning achievement gain for cooperative groups ($M=15.42$, $SD=10.07$) and competitive groups ($M=22.18$, $SD=15.59$); $t(68) = -2.187$, $p = 0.040$. These results suggest that cooperative and competitive mechanism have different impact on learning achievement gain. More specifically, the results in this study suggests that the competitive mechanism enhanced the learning achievement more than cooperative mechanism did in this game-based mobile language learning.

Table 5: Result of Independent Sample Test to compare the learning achievement gain

Groups	N	Mean	SD	<i>t(df)</i>	<i>P</i>	η^2
Cooperative	38	15.42	10.07	2.187(68)	0.040	0.66
Competitive	32	22.18	15.59			

5.3 Is there any difference between cooperative and competitive game-based mobile language learning in terms of social relatedness between the group members?

To answer this question, an independent-samples t-test was conducted to compare the improvement of relatedness between cooperative groups and competitive from the beginning to the end. There was a significant difference in the scores for cooperative groups ($M=0.68$, $SD=0.35$) and competitive groups ($M=0.26$, $SD=0.20$) ; $t_{(73)}=6.364$, $p < 0.001$ (see table 6). These results suggest that cooperative mechanism led to more improvement in social relatedness than competitive mechanism, more specifically, the group members in cooperative groups felt closer to each other than the ones in competitive groups.

Table 6: Result of Independent Sample T-test to compare improvement of social relatedness

Groups	N	Mean	SD	<i>T(df)</i>	<i>P</i>	η^2
Cooperative	39	0.68	0.35	6.264(73)	<.001	0.357
Competitive	36	0.26	0.20			

In order to investigate whether the higher relatedness among cooperative groups is related to the increased interaction (i.e. sending text) among the cooperative group members, an independent-samples T-test was conducted to compare the Average daily text sent between cooperative groups and competitive. There was a significant difference in the scores between cooperative

groups ($M=0.83$, $SD=0.70$) and competitive groups ($M=0.41$, $SD=0.41$); $t_{(73)}=3.110$, $p = 0.002$ (see table 7). These results suggest that cooperative groups sent more text than the competitive, which means the increased interaction between group members leads to higher increase in social relatedness.

Table 7. Result of Independent Sample Test to compare average daily text sent

Groups	N	Mean	SD	$T(df)$	P	ηp^2
Cooperative	39	0.83	0.70	3.110(73)	0.002	0.101
Competitive	36	0.41	0.41			

Also, in order to investigate whether the higher social relatedness among the cooperative groups was a result of higher emotional exchanges (i.e. emoji) between group members, the Average daily emoji sent between cooperative groups and competitive groups were compared with an independent-samples T-test. There was no significant difference in the scores for cooperative groups ($M=0.45$, $SD=0.41$) and competitive groups ($M=0.32$, $SD=0.25$); $t_{(73)}=1.615$, $p = 0.111$ (see table 8). These results suggest that the higher social relatedness was not a result of emoji exchanges.

Table 8: Result of Independent Sample Test to compare Average daily emoji sent

Groups	N	Mean	SD	$T(df)$	P
Cooperative	39	0.45	0.41	1.615(73)	0.111
Competitive	36	0.32	0.25		

5.4 Is there any difference between cooperative and competitive game-based mobile language learning in terms of intrinsic motivation?

To answer this question, an independent-samples t-test was conducted to compare Average TIE scores between cooperative and competitive groups. There was no significant difference between the scores for cooperative groups ($M=5.26$, $SD=0.88$) and competitive groups ($M=5.09$, $SD=1.09$); $t_{(70)}=0.729$, $p = 0.469$ (see table 9). These results suggest there was no significant difference between cooperative and competitive groups in terms of TIE.

Table 9. Result of Independent Sample Test to Compare TIE

Groups	N	Mean	SD	<i>T(df)</i>	<i>P</i>
Cooperative	39	5.26	0.88	0.729(70)	0.469
Competitive	33	5.09	1.09		

6 Discussion

It becomes popular in recent years that applying cooperative and competitive game-based mechanisms to learning fields, however, an empirical investigation of their different impacts on learners is still open. The aim of this study is to fill this gap by exploring how those two mechanisms affect learning process and learning outcomes.

6.1 Comparison of gamified competition and gamified cooperation in terms of task completion

The current study found that no significant difference was observed between cooperative and competitive groups in terms of *total number of days of tasks completed* for the 14 days.

This finding is contrary to the previous studies which have supported the cooperation mechanism outperforms competition in terms of efforts to achieve (Y. Chen & Pu, 2014; Gillies, 2016; D. W. Johnson & Johnson, 2009). In those studies, scholars have posited that the positive social interdependence (cooperation) promotes substitutability, positive cathexis and inducibility and those factors positively affect participants' motivation to put efforts to group work (Deutsch, 1949a; D. W. Johnson & Johnson, 2005), however, those impacts were not confirmed in current study. The current study is in more favor of that the constructiveness of competition can increase when it is properly structured (Burguillo, 2010; Verhoeff, 1997).

In this study, the experimental design for competitive groups meets the criteria for constructive competition (Cantador & Bellogín, 2012a; Tjosvold et al., 2003, 2006): 1) No emphasis on winning, we emphasized a win-win rather than one-win by telling the participants that if they completed more tasks, it would motivate other group members to complete more tasks, and all would benefit this atmosphere, 2) Everyone has chance to win, in this study

every participant was capable of the daily task and no prerequisite skills were required, 3) The rule for winning is clear and fair, the rule was simple and clear in this study: the one, who completes tasks more and earlier, will rank higher and the app accounted for the data related to task completion. Participants didn't need to worry about the fairness. The result in this study is in line with the studies that competition is able to encourage participants to complete task effectively, enhancing their willingness to take on challenges, and persist the participation (Ciampa, 2014; Fasli & Michalakopoulos, 2005). Those studies are also supported by the result of task completions time in our experiment, which demonstrated that competitive groups completed the daily task earlier than the cooperative groups, due to the impact of the rule that the one who finishes daily tasks earlier will rank higher. Therefore, we conclude that when competitive mechanism is properly structured, it can be as effective as cooperation in sustaining the task completion.

6.2 Comparison of gamified competition and gamified cooperation in terms of learning achievement

The results in current study showed that there was a significant difference between cooperative groups and competitive groups in terms of learning achievement. When comparing the improvement from Vocabulary pre-test to Vocabulary post-test, competitive groups were found to improve significantly higher than the cooperative groups. This finding is contrary to the previous study that cooperation outperforms competition in terms of learning achievement (D. W. Johnson & Johnson, 2009; Roseth et al., 2008; Slavin, 1996). This can be explained by those reasons: 1) Constructive competition enhances participants' motivation that help improve their learning achievement (Burguillo, 2010; Cagiltay, Ozelik, & Ozelik, 2015), 2) Competition is able to provide participant with sense of challenge and increase the

individual's desire to do well, either of which can promote participants' intrinsic motivation (Tauer & Harackiewicz, 2004), as a result, they would like to put more efforts. This can result in higher performance, especially for those who have competitive personality (Ahtinen et al., 2009), 3). The daily task in this experiment is high in means dependence, which can lead to an increased performance of competition. Because when the task is independent rather than interdependent, the participants cannot interfere each other's performance, this will mediate the negative effects of competition (Tauer & Harackiewicz, 2004). Therefore, we conclude that when competition is properly structured and are able to provide participants with perceived competence and task excitement, it can be even more effective than cooperation in promoting learning achievement. Also, we would like to highlight that the effects of cooperation and competition largely depends on the structure of a task, in a highly interdependent task context, cooperation outperforms competition in performance, however, in a highly dependent task context, both of the performance can be the same (Stanne, Johnson, & Johnson, 1999).

6.3 Comparison of gamified competition and gamified cooperation in terms of social relatedness

The current study found that the cooperative groups outperformed competitive groups in terms of improvement of social relatedness. This finding is in line with the previous study that group members with cooperative goal structure feel more intimacy towards each other and develop closer relationship compared with the ones with competitive goal structure (Y. Chen & Pu, 2014; D. W. Johnson & Johnson, 2009; Peng & Hsieh, 2012). The different interdependence among group members can explain the difference in the social relatedness. In cooperative groups (positive interdependence), individual achieves goals only when others' do, therefore,

group members are willing to make contributions to promoting each other's success as to obtain the joint goal, i.e., giving mutual support, exchanging of resources, and frequent communicating (Deutsch, 1949b; D. W. Johnson & Johnson, 2005). Those reciprocal behaviors lead to the increase in social relatedness. However, in competitive groups (negative interdependence), individual achieves goals only when others don't, therefore, group members tend to obstruct other's success as to obtain individual goal, i.e., misleading others, less communicating and sharing, and competing to win, etc. Those oppositional behaviors undermine the increase in social relatedness (Deutsch, 1949b; D. W. Johnson & Johnson, 2005). Further, the current study showed that the high increase in social relatedness was also reflected in the increased interaction among cooperative groups because the cooperative sent more text messages than the competitive ones. This finding supports the study of Yu and Pear (2014) that users sent significantly more messages in cooperation setting than competition. However, the impact of emotional exchange on social relatedness, such as sending emoji was not found in our study because this is no significant difference in the number of emoji sent between two groups. Overall, we conclude that cooperation leads to more interaction among the learners and facilitate higher social relatedness.

6.4 Comparison of gamified competition and gamified cooperation in terms of intrinsic motivation

The existing study does not support the previous empirical research that reports cooperation outperforms competition in terms of intrinsic motivation (D. W. Johnson et al., 2000; Slavin, 2014). On the contrary, the result in this study revealed that participants in both groups found the gamification equally interesting and enjoyable. Those can be explained by those reasons:

1) Cooperation is able to provide participants with opportunities to experience deep

competences satisfaction as well as social relatedness when collaborating with others toward shared goals. (Rigby and Ryan, 2011; Ryan et al., 2006). This experience has positive impacts on their intrinsic motivation, 2) As we stated before, in this study the gamified competition setting was constructively structured with the positive factors such as fair rule, perception of chance for everyone to win, and healthy relationship among group members. This provides the participants with more opportunities to experience competence satisfaction by completing difficult and interesting challenges in the competition setting (Reeve and Deci, 1996; Jung et al., 2010; Zhang, 2008). This experience can positively impact participants' intrinsic motivation. which is in line with the argument posited that competition can also benefit participants by encouraging them to take challenging tasks, developing relationship with other opponents, promoting task enjoyment, when it is properly structured (Cantador & Bellogín, 2012a; Liu et al., 2013; Tjosvold et al., 2003). Overall, we conclude that the constructive competition can have the same positive influence on participants' intrinsic motivation as cooperation did.

6.5 Limitations and future work

There are certain limitations in this study: 1) Because the scores for both Vocabulary pre- and post- tests were a bit high, thus, there was not much space for variance in learning achievement scores. In the future study, both the Vocabulary pre- and post- tests should be with more difficult words, therefore, the tests can capture the participants' improvement at a wider scale, 2) As this study lasted only 14 days, this short-term experiment may not comprehensively reflects how cooperation and competition affect learners from a long-term perspective, because the data may be biased by participants' novelty feeling towards those gamification feature, therefore, a longitudinal study should be conducted in the future, it will better investigate how the

cooperation and competition affect learning process and learning outcome differently and provide solid basis for application of gamified social features to the learning fields, 3) the daily task- learning 20 English word might have been easy to complete for participants, so the overall task completion are high between cooperative and competitive groups, however, if the complexity of tasks increase, the results may be affected. Therefore, a further investigation needs to conduct to compare the influence when two types of groups working on more complex learning tasks, 4) In this study, the relationship among participants is stranger, therefore, a future research could examine how the different relationships, i.e., friends, affects participants in cooperation and competition settings, as to gain a comprehensive understanding of this topic, 5) Our study was conducted with a small sample size, and future studies should have bigger sample sizes to explore those questions thoroughly, 6) The findings of our study is limited to the gamification design used in the study and altering the game process with different rules might yield different results.

7 Conclusion

The aim of this research is to explore the differences between cooperative and competitive game-based mobile language learning in terms of learning process and learning outcomes.

Overall, the findings of this study concerns about the differences in task completion, social relatedness, learning achievement and intrinsic motivation.

In summary, firstly the current study confirmed that the cooperative groups outperformed competitive groups in terms of improvement of social relatedness, which supports previous study that group members with cooperative goal structure feel more intimacy towards each other and develop closer relationship compared with the ones with competitive goal structure (Y. Chen & Pu, 2014; D. W. Johnson & Johnson, 2009; Peng & Hsieh, 2012). This finding was also strengthened by the result that cooperative groups sent more texts than competitive groups; Secondly, our findings are contradictory to those previous studies: 1) Task completion. Previous studies have supported the cooperation mechanism outperforms competition in terms of efforts to achieve (Y. Chen & Pu, 2014; Gillies, 2016; D. W. Johnson & Johnson, 2009). On the contrary, our study revealed that there was no significant difference found between cooperative groups and competitive groups. Our study demonstrates that constructive competition can be as good as cooperation in terms of motivating learners to achieve goals, 2) Learning achievement. The current study is contrary to the previous studies, which have demonstrated that cooperation outperforms competition in terms of learning achievement (D. W. Johnson & Johnson, 2009; Roseth et al., 2008; Slavin, 1996). Our study demonstrated that competitive groups improved more than cooperative groups. Therefore, the constructive competition can be more effective than cooperation in promoting learning achievement. Besides, we would like to highlight the

effects of cooperation and competition largely depends on the structure of a task, 3). Intrinsic motivation (TIE). Empirical research have reported that cooperation outperforms competition in terms of intrinsic motivation (D. W. Johnson et al., 2000; Slavin, 2014), while our study revealed that both competition and cooperation had the equally positive impact on participants' intrinsic motivation. For cooperation, it is the positive experience of social relatedness and deep competences satisfaction leads to the increase in intrinsic motivation (Rigby and Ryan, 2011; Ryan et al., 2006). For competition, it is the constructively structured mechanism, which provide participants with more opportunities to experience competence satisfaction, leads to the increase in intrinsic motivation (Reeve and Deci, 1996; Jung et al., 2010; Zhang, 2008).

In conclusion, our study fills the gap that how SIT (cooperation and competition) can be utilized to facilitate learning process and outcome in a gamified-mobile language learning context. Most importantly, our study identified constructive competition can be as effective as cooperation in terms of motivating learners to put efforts and invoking intrinsic motivation, and constructive competition can even promote higher learning achievement than cooperation. Those findings are in line with the studies have demonstrated that competition can also benefit participants by encouraging to take challenging tasks, developing relationship with other opponents, promoting task enjoyment, when it is properly structured (Burguillo, 2010; Cantador & Bellogín, 2012a; Liu et al., 2013; Tjosvold et al., 2003) Therefore, we would like to propose that constructive competition should be encouraged and taken into consideration when applying the gamified social features to learning activities, as to help learner sustain task completion and engage them. Furthermore, more studies should be conducted to investigate the differences between cooperation and competition in terms of longitude, complex task and relationship, as to gain a more comprehensive understanding of those two mechanism.

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Appendix 1

Social relatedness pre-test questionnaire (Here take a group of five participants as an example)

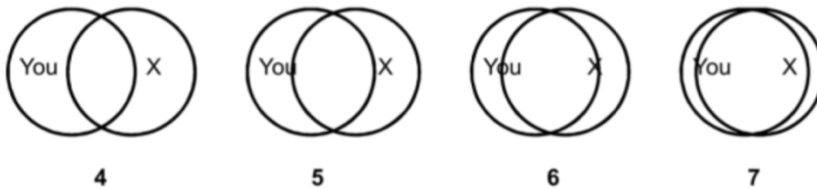
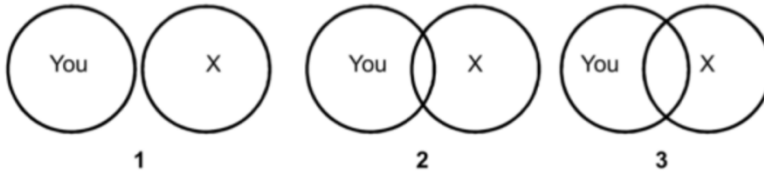
尊敬的参与者：

您好，下面这些是将会和你分到一组的同学，可以麻烦您对他们进行一个熟悉度评估吗？答案没有正确错误之分，您的答案将被保密且只用于试验用途。如果有不清楚的地方，请随时咨询我。

下面的图形中，哪个能最好的描述你和每一个小组成员的熟悉度？图中 X 代表的是被问的组员，即，你要把 X 当作这个组员来看待）。请勾选合适的数字来说明你们之间有多熟悉。

注意：如果你不认识 X，那么就选择两个圆没有任何关联的第一组。如果你们关系很熟，他或者她可能选择几乎重合的那一组圆——即第七组。如果这个人是你，选择第八个选项，这个人是我。

1. 下面哪一组圆最好的描述了你和组员 A 的熟悉程度？

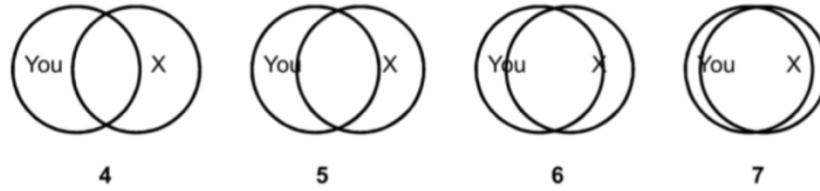
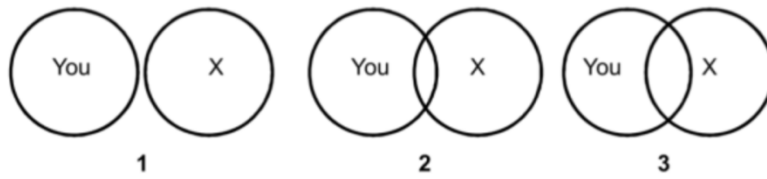


- 1 2 3 4
 5 6 7 8. 这个人是我

2. 你和组员 A 认识多久了？

- a. 我们素不相识
- b. 1 年内
- c. 1-3 年
- d. 超过 3 年

3. 下面哪一组圆最好的描述了你和组员 B 的熟悉程度?

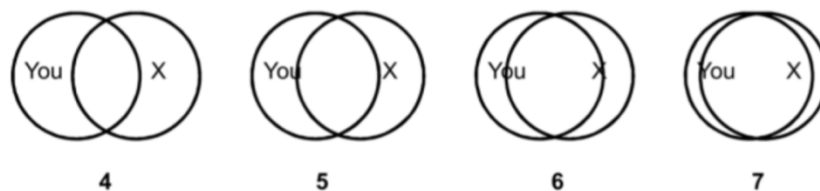
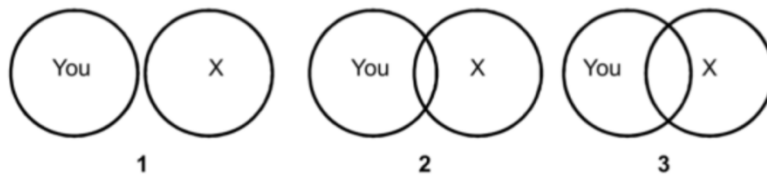


- 1 2 3 4
 5 6 7 8. 这个人是我

4. 你和组员 B 认识多久了?

- a. 我们素不相识
 b. 1 年内
 c. 1-3 年
 d. 超过 3 年

5. 下面哪一组圆最好的描述了你和组员 C 的熟悉程度?

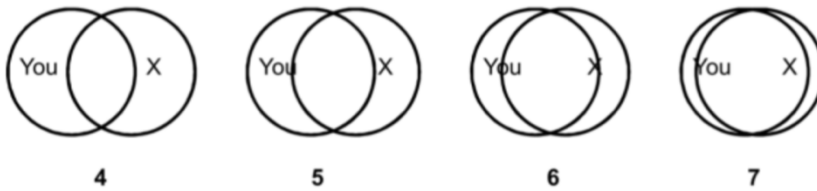
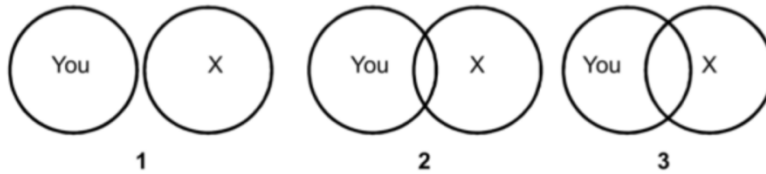


- 1 2 3 4
 5 6 7 8. 这个人是我

6. 你和组员 C 认识多久了？

- a. 我们素不相识
- b. 1 年内
- c. 1-3 年
- d. 超过 3 年

7. 下面哪一组圆最好的描述了你和组员 D 的熟悉程度？

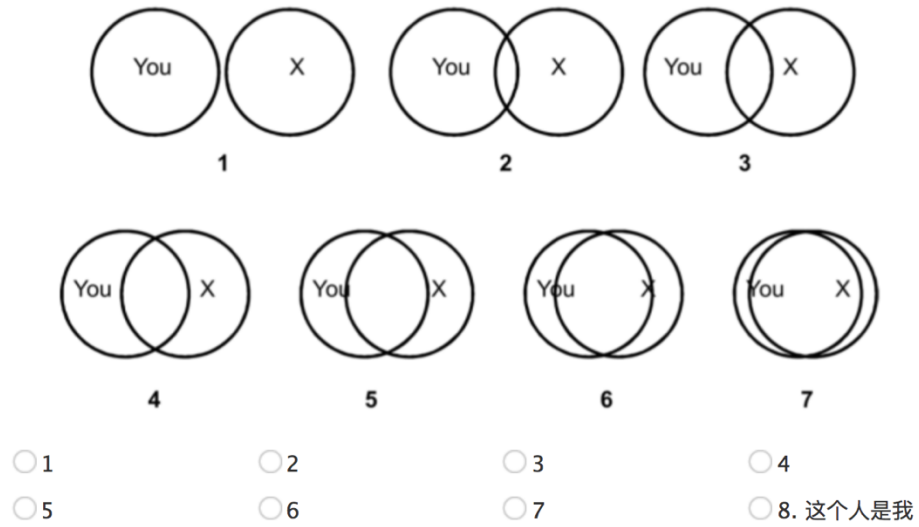


- 1 2 3 4
 5 6 7 8. 这个人是我

8. 你和组员 D 认识多久了？

- a. 我们素不相识
- b. 1 年内
- c. 1-3 年
- d. 超过 3 年

9. 下面哪一组圆最好的描述了你和组员 E 的熟悉程度？



10. 你和组员 D 认识多久了?
- 我们素不相识
 - 1 年内
 - 1-3 年
 - 超过 3 年

10. 你的名字是_____?

麻烦您再检查一下答案，确认后再提交，十分感谢您对我们实验的支持！

Appendix 2

The Vocabulary list for Vocabulary pre- and post-test (They are the same)

bounce	domestic	guarantee	mental	suicide
despise	magnet	sufficient	vacant	layman
impatient	urge	brand	specialist	propaganda
summit	chase	endure	sheer	extravagant
probability	diet	poisonous	engine	monarch
bulletin	prevailing	purchase	sturdy	voluntary
response	fastener	uproar	stark	suburb
butt	merciful	chorus	glossary	deduce
concession	procedure	reactor	specialty	brutal
reproach	spherical	solemn	provoke	realization
melancholy	yolk	offset	strain	bourgeois
conference	drain	passive	achievement	thrill
pave	cyber	annual	scarlet	cumulative
reconciliation	cocaine	fraud	complement	outrage
bang	tar	cane	inevitable	attendance
innovation	sensor	entitle	adjoin	junk
cite	clerk	decisive	indignant	haul
cannon	crime	adjustable	mast	religion
accustomed	flare	instrumental	fluctuate	detection
commitment	purity	tenant	initiate	reward

underwear	proof	spectacle	alternative	linear
bias	abundance	banquet	devise	compute
accommodation	gossip	advocate	peculiar	feasible
republican	composite	rivalry	pertinent	iceberg
shady	cathedral	hound	awkward	audit
counter	specific	pamphlet	brief	seminar
ornamental	sift	permanence	strife	prediction
clasp	persecute	underlying	standardize	angel
combination	alleviate	untie	diverse	vow
tract	bewilder	experimentally	perspective	synthesis
prospect	loom	pastime	manure	advent
probe	solidify	refuge	hybrid	decline
commute	shrink	denial	timely	consumption
prototype	approach	oyster	legitimate	conscious
fist	participant	scratch	spy	haughty
plea	recur	coarse	stun	growl
recipient	appeal	gradient	myth	charter
ozone	treaty	pinpoint	retort	gloomy
lane	scale	charity	prose	appliance
resignation	retain	stability	geometrical	notation
coherent	ban	bribe	physiological	naive
rank	masculine	immigrant	external	analytic(al)
disposal	float	grove	occupation	Thanksgiving

impurity	ruin	regenerative	extinguish	web
exert	successive	extraordinarily	marvel	extensive
cancel	rapidity	poetry	fracture	forum
multiply	batch	precedent	stylish	deceptive
outward	segment	condemn	reunion	tradesman
afflict	overwhelming	knob	negotiate	revolve
weird	aroma	proceeding	cereal	gloom
senseless	discourse	retail	slum	kit
plateau	considerate	acquisition	vaccinate	addition
regime	erupt	obsolete	shrub	ventilate
discard	remainder	analytic	underprivileged	crank
aesthetic	soluble	electronic	unpaid	continental
cycle	precipitate	stew	classic	muddy

5.

我认为这个背单词任务是令人厌烦的。

 1 2 3 4 5 6 7

根本不对

有一点对

非常对

6.

我认为这个背单词任务很有趣。

 1 2 3 4 5 6 7

根本不对

有一点对

非常对

7.

我会说做这个背单词任务，让人感觉愉悦。

 1 2 3 4 5 6 7

根本不对

有一点对

非常对

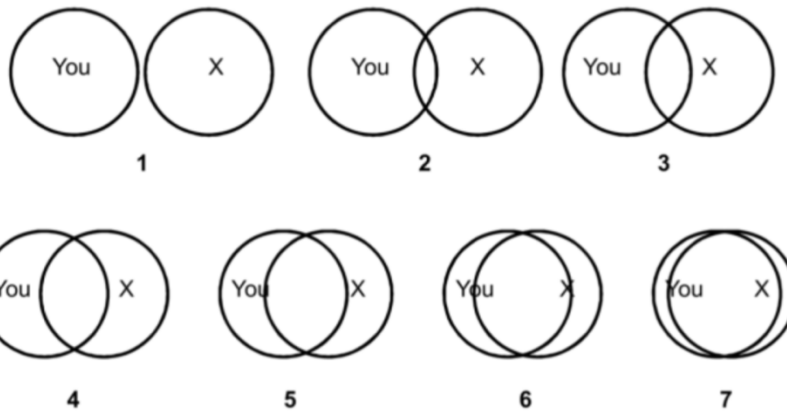
Appendix 4

Social relatedness post-test questionnaire (Here take a group of five participants as an example)

尊敬的参与者，请您对您和小组成员的熟悉度进行一个评估。下面的图形中，哪个能最好地描述你和每一个小组成员的熟悉度？图中 X 代表的是被问的组员，即，你要把 X 当作这个组员来看待）。请勾选合适的数字来说明你们之间有多熟悉。

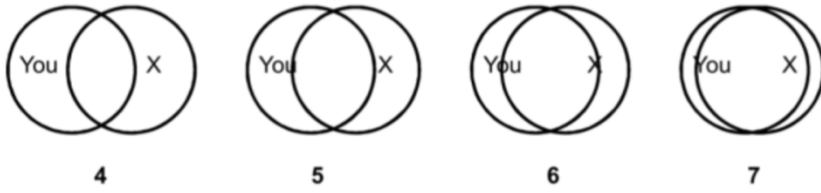
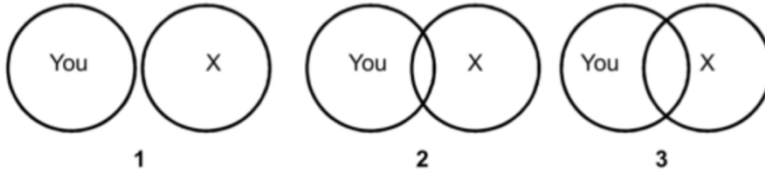
注意：如果你不认识 X，那么就选择两个圆没有任何关联的第 1 组。如果你们关系很熟，他或者她可能选择几乎重合的那一组圆——即第 7 组。如果那个小组成员是你，选择第 8 项“这个人是我”。

1. 下面哪一组圆最好的描述了你和组员 A 的熟悉程度？



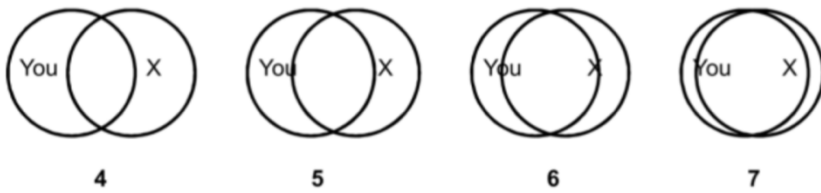
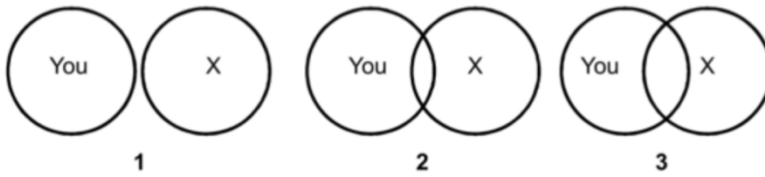
- 1 2 3 4
 5 6 7 8. 这个人是我

2. 下面哪一组圆最好的描述了你和组员 B 的熟悉程度？



- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8. 这个人是我

3. 下面哪一组圆最好的描述了你和组员 C 的熟悉程度？



- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8. 这个人是我

4. 下面哪一组圆最好的描述了你和组员 D 的熟悉程度？

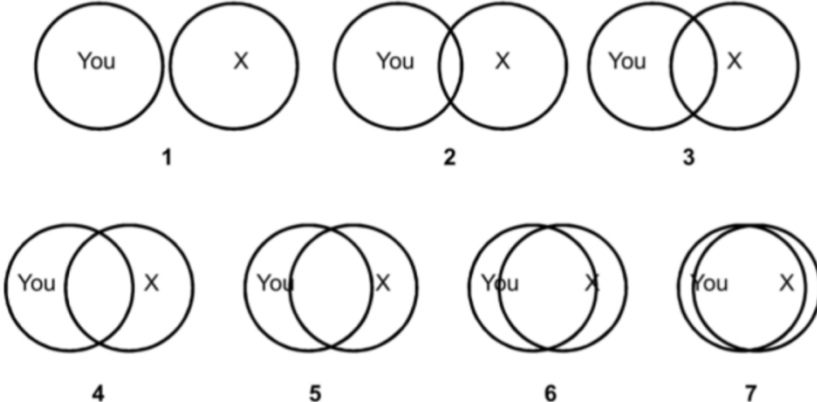


Diagram 1: Two separate circles labeled 'You' and 'X'.

Diagram 2: Two overlapping circles labeled 'You' and 'X'.

Diagram 3: Two overlapping circles labeled 'You' and 'X'.

Diagram 4: Two overlapping circles labeled 'You' and 'X'.

Diagram 5: Two overlapping circles labeled 'You' and 'X'.

Diagram 6: Two overlapping circles labeled 'You' and 'X'.

Diagram 7: Two overlapping circles labeled 'You' and 'X'.

○ 1 ○ 2 ○ 3 ○ 4
 ○ 5 ○ 6 ○ 7 ○ 8. 这个人是我

5. 下面哪一组圆最好的描述了你和组员 E 的熟悉程度?

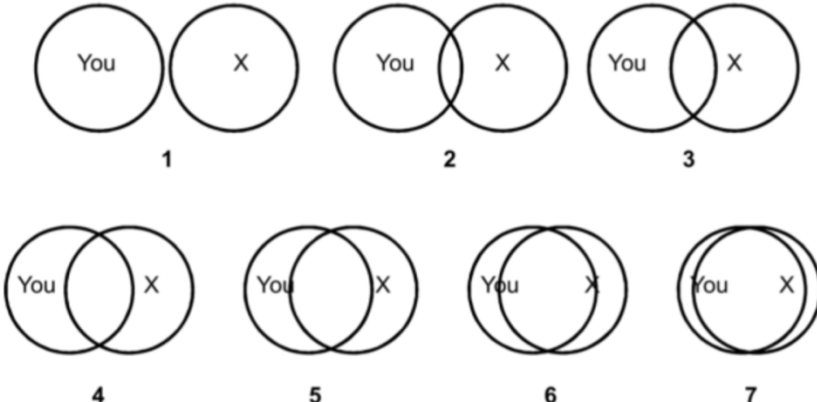


Diagram 1: Two separate circles labeled 'You' and 'X'.

Diagram 2: Two overlapping circles labeled 'You' and 'X'.

Diagram 3: Two overlapping circles labeled 'You' and 'X'.

Diagram 4: Two overlapping circles labeled 'You' and 'X'.

Diagram 5: Two overlapping circles labeled 'You' and 'X'.

Diagram 6: Two overlapping circles labeled 'You' and 'X'.

Diagram 7: Two overlapping circles labeled 'You' and 'X'.

○ 1 ○ 2 ○ 3 ○ 4
 ○ 5 ○ 6 ○ 7 ○ 8. 这个人是我

6. 你的名字是_____?

麻烦您再检查一下答案，确认后再提交，十分感谢您对我们实验的支持!

Appendix 5

Titles for cooperative groups when they gain different points.

1400 points = The most amazing group in the Universe

1399 – 1000 points = The most amazing group in the Galaxy

999 – 600 points = The most amazing group in the Solar system

599 -200 points = The most amazing group in the Earth

199 -20 points = The most amazing group in China