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Learning Preferences and Motivation of Different Ability Students for Social-Competition or Self-Competition

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ABSTRACT

Competitive learning is attracting ever increasing amounts of attention in the field of digital game-based learning. Different mechanisms for the promotion of competitive learning have been proposed in previous studies, including social-competition and self-competition mechanisms, but few have addressed student preferences as to the choice between social-competition and self-competition, especially considering students' different levels of capabilities and their perception. Thus, this study investigates how students with different levels of capabilities choose and perceive learning models between social-competition and self-competition. The study was carried out using the mixed-model experimental design. Sample consisted of 54 elementary school students assigned into three ability-level groups with all groups experiencing both treatments of social- and self-competition digital game-based learning environments. The results indicate that low-ability students had lower test anxiety and greater preference for social-competition, whereas medium-ability and high-ability students showed higher test anxiety and a similar preference for social-competition and self-competition. Based on this result, competitive learning design framework should consider enjoyment aspect of social competition for low-ability students, and interactive and performance aspects for self- and social-competition for medium- and high-ability students.

Keywords

Games, Primary school, Interactive learning environments

Introduction

Competition is a powerful motivator for student behavior regularly applied in education research. Some studies have found competition to have positive effects on student learning (Cheng, Wu, Liao, & Chan, 2009; Yu & Liu, 2009; Yu, Han, & Chan, 2008; Ke, 2008a; 2008b). However, competition could also have negative effects on student confidence and learning development (Stapesl & Koomen, 2005; Mussweiler, 2003; Gilbert, Giesler, & Morris, 1995). This could be because competition involves social comparisons, where students are exposed to conflicting sets of comparative information and processes, including failures in the competition. In particular, most competitions are zero-sum activities, in which one student loses the competition while the other wins. If the loser attributes this failure to lack of ability, he/she might feel frustrated or helpless (Dweck, 2000; Weiner, 1986; 1985).

To prevent possible negative effects, previous studies have proposed some mechanisms. For example, an *anonymous mechanism* is used to diminish the negative impact resulting from a face-to-face competitive setting (Yu & Liu, 2009; Yu, Chang, Liu, & Chan, 2002) or a *surrogate mechanism* is used to foster learning effort through commanding virtual pets to compete against each other (Chen, Liao, Chien, & Chan, 2011; Chen et al., 2012). In addition to these social mechanisms, a self-competition mechanism is also proposed, where students compete against themselves rather than their learning peers. Since students within the self-competition setting are not subject to any level of social pressure, possible negative impacts on students might be diminished.

However, the current studies seem to lack a systematic examination of students' learning preferences and motivation for the choices between social-competition and self-competition. This issue is significant because it could serve as a foundation to guide the development of competitive learning models. In this vein, this study investigates students' choice preferences and motivation for social-competition and self-competition. In addition, since students' ability level often plays a significant role in competition, we also take students' ability level into account in this study. Specifically, we try to answer the research question: *What are the learning preferences and motivation of different ability students for social-competition or self-competition?* The rest of this paper is organized as follows. Section 2 presents related works about competitive learning. Section 3 describes an experiment, which investigates students' preferences for social-competition or self-competition. In Section 4 we discuss the results of the experiment, which are

further used to develop a design framework for competitive learning. Finally, some conclusions and the limitations of this study are offered in Section 5.

Related work

Competition is regarded as useful for student learning because it can reinforce the goal structure of learning activities (Davis & Rimm , 1985), which, in turn, enhances students' motivation and learning achievement (Ke, 2008a). Nevertheless, the use of competition can also have negative influences (Stapel & Koomen, 2005), such as the lack of a scheme for improvement (Chan et al., 1992) and a high degree of stress (Yu & Liu, 2009). This is because competition involves a comparison process, during which participants are compared with each other (Martens, 1976). Such comparisons can affect students' confidence, attitudes, and belief in success (Mussweiler, 2003). In addition, most competition occurs under specific conditions where some students lose while others win. In such competition the loser may feel hurt as a result. Thus, there is a need to take the negative effects of competition into account.

To this end, a number of competitive mechanisms have been investigated, as illustrated in Table 1. The first three emphasize the individual model, whereas the latter three focus on the social model. Regarding the individual model, the common goal of these mechanisms is to help students be more aware of learning status and further take actions to improve through different approaches, such as the improving space (Chan & Lai, 1995), learning companion (Chan & Lai, 1995), and avatar (Chen, Chien, & Chan, 2011). These mechanisms are underpinned by the theory of self-regulated learning (Schunk, & Zimmerman, 1998): offering students suitable information to foster their strategy planning, progress monitoring, and outcome evaluation. In other words, the students' self-generated thoughts, feeling, strategies, and behaviors might contribute to a better learning cycle, in which the students could play an active and dominant role in their learning.

Regarding the social model, the design focus has shifted from self-regulated learning to social interaction underpinned by the hypothesis of zone of proximal development (Vygotsky, 1978), a distance between what students can achieve by themselves and what they can achieve when provided with appropriate support through social interactions with peers. Thus, different social mechanisms are incorporated with competition to support student learning. For example, the Teams Games Tournaments (TGT) allows students to work together as a learning group to compete against other groups (Slavin, 1990; Ke, 2008a; Ke, 2008b). Other related mechanisms include the anonymous mechanism (Yu et al., 2008) and surrogate mechanism (Chen, Chow, Biswas, & Chan, 2012). The two mechanisms help students alleviate possible negative effects by hiding identities and virtual surrogates, respectively.

Table 1. Some mechanisms for competitive learning

	Mechanisms	*Description*
Individual models	Improving space (Chan & Lai, 1995)	Encourages students to prepare themselves better before the competition takes place so that they have more chances to win.
	Learning companion (Chan & Lai, 1995)	Offers computer-simulated agents to help students improve their learning performance and win the competition.
	Avatar mechanism (Chen et al., 2011)	Provides students with avatars to represent their learning performance in different units so that they can compete with themselves.
Social models	Anonymous mechanism (Yu et al., 2008)	Hides students' identities as a protective mechanism for preventing negative effects when they lose in the competition.
	Group mechanism (Ke, 2008a; 2008b)	Shares the risk and responsibility between group members to prevent negative effects when students lose in the competition.
	Surrogate mechanism (Chen et al., 2012)	Offers virtual pets as mediators in competition for the shaping of positive attribution and belief in effort.

Furthermore, competition has a great impact on students' performance, confidence, or even attitudes. It has been revealed that students' academic performance has a negative relationship with their test anxiety (Chapell et al., 2005), which might result from a higher-pressure setting. In other words, students with higher pressure or anxiety might lead to lower performance. By contrast, some studies demonstrated that the relationship between anxiety and performance is an inverted U-shaped curve (Yerkes & Dodson, 1908), implying that appropriate arousal of anxiety could contribute to students' learning. Thus, when competitive mechanisms are applied to educational settings,

different students might perceive competition as different levels of pressure, which might further influence their preferences and choices.

In such a vein, a significant research question arises while reviewing those related studies: What are students' preferences and motivation when using these competition-based models? This research question is significant because students' choices and preferences to use learning systems is a prerequisite for effective learning outcomes. Nevertheless, this question has seldom been addressed in past studies, especially within computer-supported competitive models. If we could have a better understanding of different students' choice preferences and motivation for the two models, it would be helpful to design suitable competitive models that take individual differences into account. Thus, this study focuses on addressing students' preferences and motivation for individual or social competition-based models.

Methodology

To address the research question, a mixed-model experimental design was conducted in this study. More specifically, there are two independent variables: the levels of ability and competition models. Each student with different levels of ability (i.e., between-subject variable) experienced the two competition models (i.e., within-subject variable) and gave feedback to their choices. In particular, the *avatar mechanism* and *surrogate mechanism* serve as two examples of self-competition and social-competition models, respectively.

Participants

In total 54 elementary school students (aged an average of 11 years) in Taiwan participated in the experiment. To further understand whether students' learning ability would influence their preferences, these students were further categorized into three different levels of ability based on their examination scores in school in the subject of language learning, ranging is from 0 to 100. Specifically, the method of categorization into the three levels (i.e., low, medium, or high ability) contains two steps: (1) the total number of students is divided by three groups, 54/3=18 (2) If the scores of the students with two different levels are the same, these students are re-assigned to an upper group. Finally, the numbers of students in the three groups are 16, 17, and 21, respectively. The details are described in Table 2.

Table 2. Students in each ability level

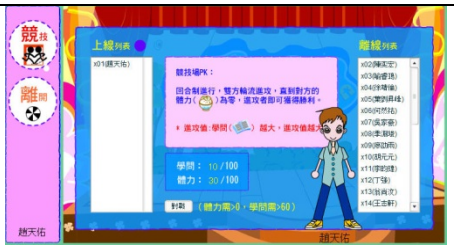
Student ability	*Number of students*
Level L (low-ability)	16
Level M (medium-ability)	17
Level H (high-ability)	21

Instruments

Two system instruments

Two learning systems were used in the experiment, in which the subject domain (Chinese idioms) was the same in both versions. The major difference between the two systems lies in the opponents that students compete against. Specifically, as illustrated in Table 3, students who used the self-competition system learn Chinese idioms (Table 3b) and their learning status is shown through avatars (Table 3a). These avatars represent the learning outcomes for different units as the avatars compete against each other (Table 3c). Similarly, the learning status of students who used the social-competition version to learn Chinese idioms (Table 3p) is also shown in their avatars (Table 3q). However, a student can choose one of the other students as an opponent (Table 3r) so that his or her avatar can compete against that of the other student (Table 3s).

Table 3. Comparison between self-competition and social-competition systems

	Self-competition	*Social-competition*
Virtual character		
	(a) An avatar is used to represent the student' current learning status	(p) An avatar is used to represent the students' current learning status
Learning material		
	(b) Chinese idiom learning activities	(q) Chinese idiom learning activities
Competitive model		
	(c) The avatar competes against student's own avatar for previous units	(r) The student chooses one of the other students as an opponennt
		
		(s) The avatar competes against another student's avatar

Motivated Strategies for Learning Questionnaire (MSLQ)

A motivational questionnaire adapted from the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1991) with a 7-point Likert choices was used to collect students' motivational feedback with choices ranging from "not at all true for me" (point=1) to "very true for me" (point=7). This information provides explanation on the students' choice preferences. The motivational scale of the MSLQ contains three aspects: *value*, *expectancy*, and *affective*. Regarding the value component, there were 4 items for *intrinsic goal*, 4 items for *extrinsic goal*, and 6 items for the *task value* aspect; regarding the expectancy component, there were 4 items for *control of belief*, and 8 items for the *self-efficacy* aspect; regarding the affective component, there were 5 items for the aspect of *test anxiety*. According to the work of Pintrich and his colleagues (1991), this questionnaire had a relatively high reliability (Cronbach's alpha were .74, .62, .90, .68, .93, and .80 for the six aspects, respectively).

Preference Questionnaire (PQ)

To collect students' preferences as to which competitive system they preferred and the reasons why they made this choice, a perception questionnaire (developed by the first author of this paper) was used. The questionnaire contained two items: "*Which system version did you prefer to use?*" (i.e., students are asked to choose one between self-competition and social-competition systems) and "*For what reason did you prefer to use it?*" (i.e., students are asked to write down theirs reasons for this open-ended question).

Procedures

To reduce the bias of treatment order, participants were divided into two groups, who used the different system versions in a different order, as shown in Figure 1. Each session lasted 40 minutes and was held once a week. The employed procedures are as follows: (1) before the experiment, participants were instructed how to use the systems. In addition, to increase the validity of their opinions, the participants were also told that they could freely use the system functions; (2) during the sessions, participants in the two groups used different systems. The Group A students first used the self-competition system for one session and then used the social-competition system for another session. In contrast, the Group B students first used the social-competition system and one week later switched to the self-competition system. (3) The MSLQ was immediately administrated at the end of each session to collect information on students' motivation. In other words, the Group A students were asked to complete the MSLQ twice: at the end of self-competition session and social-competition session, respectively. Similarly, the Group B students were also asked to complete the MSLQ twice. (4) At the end of all sessions, participants were further asked to fill out the PQ. In this way, participants' preferences for the two system versions were collected after they have experienced the use of both systems.

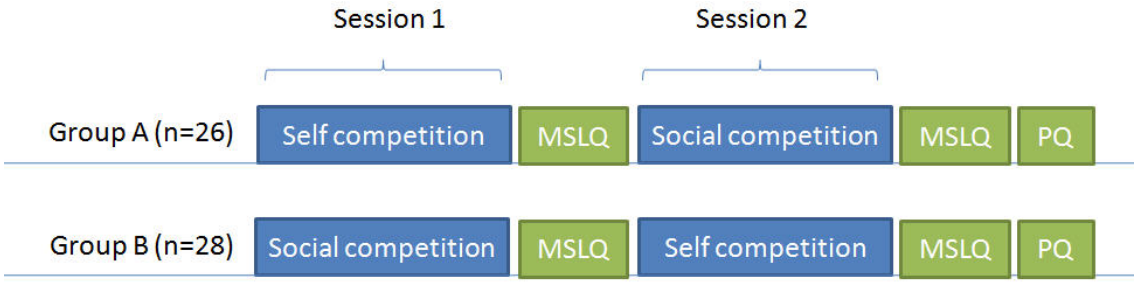


Figure 1. Within-subject experimental design

Data analysis

The data analysis comprises two parts. For the motivational scale, a repeated measures analysis of variances (ANOVA) was carried out, with two system versions (i.e., self-competition and social-competition) and three levels of ability (i.e., level L, M, and H) as independent variables and the motivational aspect as the dependent variable. All these analyses were conducted with the Statistical Package for the Social Science (SPSS Windows version 17).

For the preference questionnaire, Chi-square tests were conducted to validate the significant difference between students' preference between two groups, with the two system versions as independent variable and the number of students as dependent variable. In addition, content analysis was used to categorize students' reasons for preferring the chosen systems. Since no existing and suitable coding scheme for competition-based learning models could be found in the literature, this study uses a coding scheme based on the two previous studies: the reasons for loneliness and social use of the Internet (Morahan-Martin & Schumacher, 2003) and the sources of competence information (Horn, 2008; Horn & Amarose, 1998). This is because competition-based learning involves both technology use and theory of competence and motivation (Harter, 1978; 1981).

Specifically, the coding scheme is organized into three aspects: (1) the cognitive aspect on the level of the individual effort; (2) the social aspect related to the degree of interpersonal relationship; and (3) the affective aspect on the

game-related feelings. Table 4 illustrates the details of the coding scheme. Two graduate students were trained to use the scheme to independently code all responses to the preference questionnaire. A statement was deemed "codeable" if the two coders used the same coding scheme. If this was not the case, they discussed the choices until they came to an agreement. The Cohen's kappa of the coder inter reliability was .79, representing good agreement beyond chance (De Wever, Schellens,Valcke, & Van Keer, 2006).

Table 4. The coding scheme used in this study

Cognitive aspect	
a1: self-awareness	Enhances the ability or knowledge to understand students' learning status or performance better
a2: self-comparison	Emphasizes the comparative or competitive process, in which a student's status at different stages is examined
a3: effort-exerting	Highlights the learning effort that the student makes
a4: self-improvement	Focuses on improving learning status better than before, or surpasses past performance
Social aspect	
b1: self-protection	Focuses on the lack of confidence to interact with others
b2: knowing-others	Enhances the ability or knowledge to understand other students' learning status or performance better
b3: peer-comparison	Emphasizes the comparative or competitive process, in which the students' statuses are examined to determine who is better
b4: peer-interaction	Enhances interactivity through being (or playing) with peers/friends, rather than competition/comparison
Affective aspect	
c1: game-enjoyment	Highlights the feeling of fun and satisfaction resulting from the general features of a game or an activity
c2: social-enjoyment	Emphasizes the feeling of fun and satisfaction resulting from the interpersonal features or design of a game or an activity
c3: challenge	Focuses on the feeling of challenge in an activity
c4: easy-to-use	Focuses on the feeling of ease of system usability

Results and discussion

Motivational levels in using Digital Game-Based Learning

Table 5 illustrates the mean and SD of the scores on the motivational scale in terms of six aspects for all participants. The results of ANOVAs show that there was a statistically significant difference only for the aspect of *test anxiety*, whereas there were no significant differences for other aspects. Furthermore, regarding the aspect of *test anxiety*, the results showed that there was no significant difference for the effect of different systems ($F_{(1,51)} = .134$, $p = .715$), whereas there was a significant difference demonstrated for the effect of different ability levels ($F_{(2,51)} = 4.51$, $p < .05$), in which the interaction effect of the two variables was not significant ($F_{(2, 51)} = .488$, $p = .616$), implying that participants with different knowledge levels perceived different levels of test anxiety. The result of a further Tukey HSD post-comparison revealed that the scores for Level M and H were significantly larger than those for Level L ($p < .05$). This implies that participants with high- and medium-ability had higher test anxiety than those with low-ability, regardless of whether in the self-competition or social-competition category.

Table 5. The results of the motivational scale for all participants

	Self-competition			*Social-competition*		
	Level L	Level M	Level H	Level L	Level M	Level H
Value component						
Intrinsic goal	5.50(1.3)	5.91(1.0)	5.72(1.0)	5.34(1.2)	5.54(0.8)	5.86(0.8)
Extrinsic goal	5.14(1.4)	5.97(2.0)	5.59(0.9)	5.34(1.0)	5.75(0.9)	5.53(1.0)
Task value	5.40(1.3)	6.00(0.8)	5.77(0.9)	5.60(1.2)	6.01(0.7)	5.81(1.0)
Expectancy component						

Control of belief	5.18(1.1)	5.67(1.0)	5.50(0.8)	5.07(1.0)	5.57(0.8)	5.27(0.9)
Self-efficacy	5.37(1.2)	5.39(1.1)	5.44(1.1)	5.26(1.1)	5.47(1.0)	5.53(0.9)
Affective component						
Test anxiety	3.88(1.1)	4.90(0.7)	4.87(0.9)	4.15(1.3)	4.90(1.0)	4.78(1.1)

Preferences for self- and social-competition

Table 6 illustrates the number of students and their reasons for the selecting the chosen systems. For the low-ability (i.e., level L) students, the ratio of self-competition to social-competition was one to three. The results of the Chi-square test indicate that their preference was significantly different ($\chi^2 = 4.00$, $df = 1$, $p < .05$), implying that those students preferred social-competition. It should be noted that the major reason given for why students preferred either self-competition or social-competition was the same: they found the system more fun or exciting (N = 2 and N = 7, respectively). In other words, it was the *enjoyment* aspect of the competitive activities that dominated the low-ability students to choose these systems.

A possible interpretation for this was a "self-protective" viewpoint, in which these students utilized escape or avoidance behavior to reduce their stress and anxiety (Zeidner, 1998). In other words, the low-ability students might perceive the obvious interaction of the social-competition system to be more like a game, rather than a serious test. Thus, most students chose the social-competition system. If they perceived that what they were doing was a part of game-playing, rather than a serious assessment process, they would feel more relaxed, leading to lower test anxiety. This could also explain why low-ability students expressed lower test anxiety in the motivational scale.

Table 6. The results of student preferences and their reasons

Levels	*Preferred models*	*N*	*Reasons (N)*
Level L	Self-competition	4	c1 game-enjoyment (2) a2 self-comparison (2)
	Social-competition	12	c1 game-enjoyment (4) c2 social-enjoyment (3) b4 peer-interaction (2) b3 peer-comparison (1) c4 easy-to-use (1) a4 self-improvement (1)
Level M	Self-competition	6	a4 self-improvement (3) a2 self-comparison (1) a1 self-awareness (1) b1 self-protection (1)
	Social-competition	11	c1 game-enjoyment (3) c2 social-enjoyment (2) b4 peer-interaction (2) b3 peer-comparison (2) b2 knowing-others (1) c3 challenge (1)
Level H	Self-competition	10	a4 self-improvement (3) a2 self-comparison (3) a3 effort-exerting (3) a1 self-awareness (1)
	Social-competition	11	b3 peer-comparison (3) b2 knowing-others (3) b4 peer-interaction (2) c2 social-enjoyment (2) a1 self-awareness (1)

For the medium-ability (level M) students, the ratio of self-competition to social-competition was approximately one to two. The results of the Chi-square test indicated no significant difference in their preference ($\chi^2 = 1.47$, $df = 1$, p

> .05), suggesting similar preferences. Like the low-ability students, some preferred the social-competition system, but their reasons were different. The major reason for selecting self-competition was that this system could enhance self-improvement (N = 3), whereas the major reason for preferring social-competition was that it could support social interaction (i.e., game-enjoyment, N = 3; social-enjoyment, N = 2; peer-interaction, N = 2; peer-comparison, N = 2; knowing-others, N = 1). The result seemed to imply that the medium-ability students chose their systems based on the *interactive* aspect of the competitive activities—that is whether this competitive activity is individual or social?
One possible explanation was that the medium-ability students who chose the self-competition had higher self-discipline and self-efficacy (Bandura & Jourden, 1991). In other words, the students with higher ability have higher self-efficacy and the students believed that they could well manage learning and control behavior on their own. The self-competition system offered them more information to understand their learning status, so they preferred this version. On the other hand, the students who chose the social-competition could be social-directed learners, who regarded social interaction as the key element for a competitive activity. Previous studies indicate that the majority of people socialize in a game activity (Zichermann & Cunnigham, 2011; Bartle, 1996), which seems to be consistent with the results obtained in this study.

With the high-ability (i.e., level H) students, the ratio of self-competition to social-competition was almost the same. The result of the Chi-square test did not show a significant difference ($\chi^2 = .04$, $df = 1$, $p > .05$), implying that those students preferred both versions. The main reason for the choice of self-competition was that it could enhance self-improvement (N = 3) and self-comparison (N = 3), which are the same as for the medium-ability students described above. However, unlike the medium-ability students, the high-ability students paced more emphasis on effort-exerting (N = 3), suggesting that they seemed to be more self-disciplined. On the other hand, the main reason for the social-competition preference was still social interaction (i.e., peer-comparison, N = 3; knowing-others, N = 3; peer-interaction, N = 2; social-enjoyment, N = 2). Game-enjoyment, a significant reason given by the medium-ability students, was not found for the high-ability students. The implication is that game-playing is not as significant for them as for the low-ability and medium-ability students. Considering the aforementioned system preferences, it appears that the high-ability students tended to emphasize on the *performance* aspect of the competitive activities—that is whether this competitive activity is helpful to their learning performance or not.

A reasonable interpretation for these results is that the high-ability students seemed to regard competition as a serious activity, rather than a game-playing activity. Thus, students who highlighted self-improvement chose the self-competition system while others regarded an indirect (i.e., collecting public information about others) or direct form of interpersonal interaction (i.e., comparing or competing with others) as a significant part of a learning activity so they preferred the social-competition system. In other words, those students treated competition as an activity for evaluating their performance, which might explain why they had higher test anxiety.

Suggestion for design framework

Figure 2 illustrates the design framework based to the results of this study, which should contribute to the design of future competitive learning models.

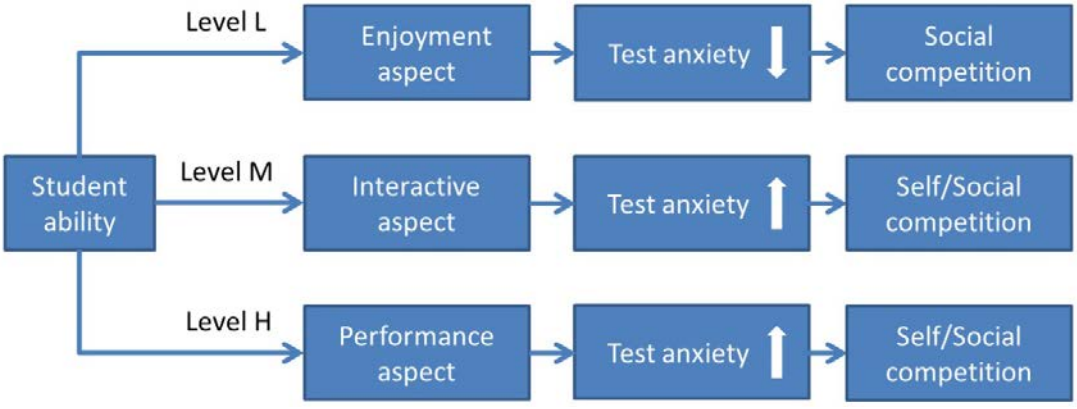


Figure 2. Design framework for competitive learning models

Low-ability students seemed to regard the competition as a game-playing activity, in which the enjoyment aspects (i.e., fun or excitement of competitive activities) are crucial. In other words, these students were concerned with the *enjoyment* aspect of competitive activities, rather than learning performance. Thus, they also experienced lower test anxiety. For those students, there is a need to take the enjoyment element of competitive activities into account when designing self-competition systems in the future.

As for medium-ability students, they tended to emphasize the *interactive* aspect of competitive activities. Specifically, some preferred social-competition because it could offer them the opportunities to interact with others, whereas others liked self-competition because it was helpful for self-improvement. Nevertheless, compared with the low-ability students, these students experienced higher test anxiety, perhaps due to the fact that enjoyment was not their major concern. Instead, these students chose their competitive activities based on their preference for the interactive aspects. Consequently, how to, on the one hand, enhance the interactivity of learning activities and, on the other hand, reduce students' test anxiety is a critical issue for designing competitive learning activities in the future.

Of the high-ability students, some chose self-competition because of its helpfulness to their learning performance while some chose social-competition because of its contribution to social interaction. The students had a high-level of test anxiety whether in self-competition or social-competition activities, suggesting that they regard competitive activities as serious assessments, rather than game-playing. In other words, it was more important to improve performance, rather than enjoy the activity or interaction. Consequently, how to provide those students with suitable information to help them reflect what they have learned, regulate their efforts, and improve their learning status either for self-competition or social-competition is an emerging issue in the future design of competitive learning activities.

Conclusion

In response to the research question posed in this study, *What are the learning preferences and motivation of different ability students for social-competition or self-competition?,* the findings indicated that: (1) Low-ability students preferred social-competition over self-competition because they emphasized on the enjoyment aspect of competitive learning activities; (2) and medium-ability and high-ability students showed similar preferences for social-competition and self-competition because they emphasized the interactive and performance aspects of competitive learning activities.

Based on the results of this study, the design of competitive learning activities could be further improved in the future. Regarding the low-ability students, the development of competitive learning might enhance the enjoyment experience, which could be realized by incorporating specific game genres. For example, students could play sports players in "management games" or heroes in "role-playing games". In both of these students are encouraged, on the one hand, to care about their learning progress and, on the other hand, to compete against others. By doing so, the enjoyment and interactivity of competitive learning could be enhanced. Regarding the medium- and high-ability students, the development of competitive learning might enhance their awareness of learning status and strategies used to improve learning outcomes, which could be further aligned with the processes of self-regulated learning (Zimmerman & Schunk, 2001), which might contribute to their learning through planning, monitoring, reflection, and regulation, in either self-competition or social-competition.

However, due to the limitations of this study, some further efforts are required. First, this study examines students' preferences on the choices of competitive learning but this was merely a short-term study. Students' perceptions might be influenced by the novel effect aroused by new technologies. Thus, the long-term effects are unclear and should be addressed in the future. Second, in this study students' ability level was measured based on examination scores in language learning, not as a measure of general cognitive ability. Thus, the application of the design framework generalizing should be limited to specifically relevant tasks, because different relationships may apply to different types of task (e.g., one requiring mathematical reasoning skills). Finally, this study emphasizes the avatar mechanism and surrogate mechanism as examples of self-competition and social-competition, which can offers a starting point to examine students' preference, but cannot reflect all competitive models. Thus, there is a need to examine its consistency with other competitive models in future works.

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References

Bandura, A., & Jourden, F. J. (1991). Self-regulatory mechanisms governing the impact of social comparison on complex decision making. *Journal of Personality and Social Psychology*, *87*, 611-623.

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD Research 1*(1). Retrieved March 1, 2012, from http://www.mud.co.uk/richard/hcds.htm

Chapell, M. S., Blanding, Z. B., Silverstein, M. E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test anxiety and academic performance in undergraduate and graduate students. *Journal of Educational Psychology*, *97*, 268-274.

Chan, T. W., Chung, Y. L., Ho, R. G., Hou, W. J., & Lin, G. L. (1992). Distributed learning companion systems -- WEST revisited. In C. Frasson, G. Gauthier, & G. McCalla (Eds.), *Lecture Notes in Computer Science, 608*, 643-650.

Chan, T. W., & Lai, J. A. (1995). Contest-kid: A competitive distributed social learning environment. In J. D. Tinsley & T. J. Weert (Eds.), *World conference on computers in education VI* (pp. 767-776). New York, NY: Chapman-Hall.

Chen, Z. H., Chien, T. C., & Chan, T. W. (2011). My-Avatar: Using avatars to promote self-competition in pupils' idiom learning. In T. Hirashima et al. (Eds.), *Proceedings of the 19th International Conference on Computers in Education* (pp.449-456). Chiang Mai, Thailand: Asia-Pacific Society for Computers in Education.

Chen, Z. H., Chou, C. Y., Biswas, G., & Chan, T. W. (2012). Substitutive competition: Virtual pets as competitive buffers to alleviate possible negative influence on pupils. *British Journal of Educational Technology*, *43*(2), 247-258.

Chen, Z. H., Liao, C. C. Y., Chien, T. C., & Chan, T. W. (2011). Animal companions: Fostering children's effort-Making by nurturing virtual pets. *British Journal of Educational Technology*, *42*(1), 166-180.

Cheng, H. N. H., Wu, W. M. C., Liao, C. C. Y., & Chan, T. W. (2009). Equal opportunity tactic: Lessening negative effect in competition games in classrooms. *Computers and Education*, *53*(3), 866-876.

Davis, G., & Rimm, S. (1985). *Education of the gifted and talented*. Englewood Cliffs, NJ: Prentice-Hall.

De Wever, B., Schellens, T., Valcke, M., & Van Keer, H. (2006). Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers & Education*, *46*(1), 6–28.

Dweck, C. (2000). *Self-theories: Their role in motivation, personality, and development* (Essays in Social Psychology). Philadelphia, PA: Psychology Press.

Gilbert, D. T., Giesler, R. B., & Morris, K. A. (1995). When comparisons arise. *Journal of Personality and Social Psychology*, *69*, 227–236.

Harter, S. (1978). Effectance motivation reconsidered: Toward a developmental model. *Human Development, 21*, 34–64.

Harter, S. (1981). A model of mastery motivation in children: Individual differences and developmental change. In W. A. Collins (Ed.), *Aspects of the development of competence* (pp.215-255). Hillsdale, NJ: Erlbaum.

Horn, T. S. (2008). *Advances in sport psychology*. Champaign, IL: Human Kinetics.

Horn, T. S., & Amorose, A. J. (1998). Sources of competence information. In J. L. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp.81-101). Morgantown, WV: Fitness Information Technology.

Ke, F. (2008a). Computer games application within alternative classroom goal structures: Cognitive, metacognitive, and affective evaluation. *Educational Technology Research and Development*, *56*(5), 539-556.

Ke, F. (2008b). Alternative goal structures for computer game-based learning. *International Journal of Computer-Supported Collaborative Learning*, *3*(4), 429-445.

Martens, R. (1976). Competition: In need of a theory. In D. M. Landers (Ed.), *Social problems in athletics* (pp. 9-14). Urbana, IL: University of Illinois Press.

Morahan-Martin, J., & Schumacher, P. (2003). Loneliness and social uses of the Internet. *Computers in Human Behavior, 19*, 659–671.

Mussweiler, T. (2003). Comparison processes in social judgment: Mechanisms and consequences. *Psychological Review, 110*, 472–489.

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). *A manual for the use of the motivated strategies for learning questionnaire (MSLQ)*. Washington, DC: National Center for Research to Improve Postsecondary Teaching and Learning.

Schunk, D. H., & Zimmerman, B. J. (1998). *Self-regulated learning: From teaching to self-reflective practice*. New York, NY: Guilford Press.

Slavin, R. E. (1990). *Cooperative learning: Theory, research, and practice*. Englewood Cliffs, NJ: Prentice-Hall.

Stapesl, D. A., & Koomen, W. (2005). Competition, cooperation, and the effects of others on me. *Journal of Personality and Social Psychology, 88*, 1029-1038.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review, 92*, 548-573.

Weiner, B. (1986). *An attributional theory of motivation and* emotion. New York, NY: Springer-Verlag.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit-formation. *Journal of Comparative Neurology and Psychology, 18*, 459-482.

Yu, F. Y., Chang, L. J., Liu, Y. H., & Chan, T. W. (2002). Learning preferences towards computerized competitive mode. *Journal of Computer-Assisted Learning, 18*, 341-350.

Yu, F. Y., Han, C. L., & Chan, T. W. (2008). Experimental comparisons of face-to-face and anonymous real-time team competition in a networked gaming learning environment. *CyberPsychology and Behavior, 11* (4), 511-514.

Yu, F. Y., & Liu, Y. H. (2009). Creating a psychologically safe online space for a student-generated questions learning activity via different identity revelation modes. *British Journal of Educational Technology, 40*(6), 1109-1123.

Zeidner, M. (1998). *Test anxiety: The state of the art*. New York, NY: Plenum.

Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in Web and Mobile App*. Sebastopol, CA: O'Reilly Media.

Zimmerman, B. J., & Schunk, D. H. (2001). *Self-regulated learning and academic achievement: Theoretical perspectives*. Mahwah, NJ: Lawrence Erlbaum Associates.