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The Impacts of an Academic English Competitive Mahjong Game on Learners' Motivation

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Abstract: We developed an Academic English Competitive Mahjong Game (AECMG) to help learners improve the understandings of academic English via a gaming process. In addition, an empirical study was conducted to examine how learners reacted to a single-player game (SPG) and multiple-player game (MPG) from the perspective of task difficulties. The results indicated that the difficulty of the tasks did not significantly affect the learning performance but increased learners' task time and mistakes during the gaming process. On the other hand, learners with the MPG had better task scores and used fewer hints, regardless of the easy or difficult tasks. Furthermore, learners with the SPG checked the answers at the beginning of the task to collect more information while those with the MPG checked the answers after re-ordering the cards `without collecting learning information. These findings suggested that learners with the SPG had more intrinsic motivation to gain additional understandings while learners with the MPG had extrinsic motivation to pay attention to gain external bonus. Based on the aforementioned findings, we developed a framework, which can contribute the understandings of the impacts of competition on learners' motivation.

Keywords: competitive digital game-based learning, multiple-player, task difficulty

1. Introduction

English is the main communication language in international academic areas. When writing English academic papers, the first step is to make meaningful English sentences. However, learning how to make meaningful English sentences is difficult to some students. On the other hand, past research pointed out that digital game-based learning (DGBL) can not only improve students' learning motivation, but also improve their learning effectiveness. For example, Hwang, Chiu, and Chen (2015) used DGBL to support social courses and they found that DGBL could promote students' learning motivation. In addition, Wu's (2018) study used a mobile game to support English vocabulary learning and their results indicated that compared to traditional teaching methods, the mobile game made students have higher learning performance.

The above research indicated that DGBL has positive impacts on student learning because it contains many game elements, e.g., challenges, competition, feedback, goals, and rules (Presnsky, 2003). Among these game elements, competition has been also paid much attention. In particular, researchers found that multiplayer competitive game learning environments could increase learners' motivation (Cagiltay, Ozcelik & Ozcelik, 2015; Julian & Perry, 1967). For example, Hung (2015) claimed that competition could motivate individuals to participate in challenging tasks. Due to the above-mentioned benefits, this study integrates competition into DGBL. More specifically, this study developed an Academic English Competitive Mahjong Game (AECMG) to help students learn how to make meaningful English sentences.

On the other hand, there is a difference between a single-player game (SPG) and multiple-player game (MPG) because the former focuses on self-assessment, while the latter emphasizes on fairness among players (Westin, 2016). Due to their different features, the SPG and the MPG may different impacts on student learning. For example, Hainey (2016) thought that players who liked to play with the SPG and those who liked to play with the MPG may have

different motivations. In addition, Song et al. (2013) believed that intrinsic motivation was affected by individual differences and their results indicated that a competitive environment could reduce the intrinsic motivation of low-competitive individuals. Because of such different impacts, it is necessary to examine how students react to the SPG and the MPG from the perspective of learning motivation.

Regardless of the SPG or the MPG, a digital game may provide tasks with different levels of difficulties. Elshout (1987) found that the difficulty of the task that exceeds the learner's ability could affect the learner's problem-solving abilities. Therefore, it is necessary to consider task difficulties according to learners' abilities (Brevik, 2018). To this end, multiple levels of tasks were included in the AECMG, i.e., easy tasks and difficult tasks. Accordingly, the aims of this study are two-fold. One is to develop the AECMG to support learning of academic English. The other is to investigate the impacts of competitive game-based learning on learners' motivation, in terms of both easy tasks and difficult tasks.

2. Academic English Competitive Mahjong Game

Due to the importance of academic English and the benefits of the DGBL, we attempted to develop an English DGBL by integrating competitiveness and entertainment of Mahjong together (Figure 1). In other words, this study developed an AECMG, where words were presented as the form of cards in the AECMG, which was simulated as a real Mahjong table.

The AECMG was implemented with the Unity3D and the Unet-Networking engine and included two versions, i.e., the MPG and SPG. In the MPG, four learners must use the Internet connection to join to play the AECMG (Figure 2), where they needed to enter personal data first (Figure 3). Subsequently, four sentences of academic English were broken up into single-word cards and were assigned to four learners. During the gaming process, learners had made meaningful sentences which did not have any grammatical errors by exchanging cards and reordering the cards on the hand. In the SPG, three virtual surrogates were used to replace other three learners. In other words, learners needed to compete with the virtual surrogate, instead of three learners.

In summary, this AEMMG has the following features:

- SPG and MPG: Regardless of the SPG or the MPG, the game was played in a group of four learners. Learners could see the scores of other learners during the gaming process. Based on the scores, each player could get a badge, i.e., gold, silver, bronze and iron (Figure 4).
- Social Interaction: This game also provided a chat tool, with which learners could communicate with other learners so that they could help each other complete tasks. For example, learners could use the "I need adjectives" dialog option to express the need of having a card that presents an adjective.
- Scaffolding Instruction: In order to help learners, solve problems, the AECMG provided three types of hints (Table 1), which learners could use but their scores could be deduced. In addition, there were three tools, with which the learners could get additional support to perform tasks (Table 2). The purpose of such scaffolding instruction was to allow learners to get help in times so that the learners' interest and motivation could be promoted.
- Sense of Challenge: To let plays have the sense of challenge, learners needed to hand out a card within 60 seconds and complete the task within one hour. Therefore, learners had to think about each step and strategically used the hints to achieve the best results at the least cost.
- Immediate feedback: To help learners get immediate feedback, they were allowed to check the answer. The feedback was expressed in 1A2B format. More specifically, if there was a correct word and the placement position was correct, it was A. Conversely, if the word was correct, but the position was incorrect, it was B. Finally, learners could be informed of the number of A and B. By doing so, learners could immediately obtain the feedback so that they could know how to adjust the order of the words.

Table 1

The Scaffolding hints in the AECMG

Type	Item	Contents	Deduction points
Hint	Chinese translation	To display the Chinese translation of this word	10
	Missing card	To display the current missing word	10
	Sentence meaning	To display the Chinese meaning of the sentence.	20

Table 2

The tools in the AECMG

Type	Item	Contents
Tool	Answer check	To check that the answer is correct and show the number of correct positions and the correct words.
	Word insertion	To insert the selected word into the specified position to sort the words.
	Chat tool	To use the 10 conversation options available in the game to communicate with others.

Figure 1. Overview of the AECMG

Figure 2. The personal score interface (Left) and the chat selection window (Right)

3. Methodology design

The research method used in this study was a quasi-experimental method. The independent variables were the version of the AECMG, i.e., the SPG, the MPG, and the difficulty of the task, i.e., easy task and difficult task, and the dependent variables were learning performance and learning behavior.

3.1 Experimental subject

In this study, 11 master students from northern Taiwanese universities were selected as research subjects and all of them had Basic English skills and basic computing skills. More specifically, eight people were assigned to play with the MPG, where four people were formed as a group where were two groups. Remaining three people were allotted to play with the SPG, where each person with virtual surrogates.

3.2 Experimental procedure

At the beginning of the experiment, learners were asked to use a laptop computer to connect to the wireless network and played with the AECMG. The experiments were conducted twice a week with two easy tasks and two difficult tasks, and lasted two weeks. The easy task included 10 English words while the difficult task included 17 English words. When learners performed the easy or difficult tasks, their behavior was recorded in a log file.

4. Results and discussions

4.1 Learning performance

4.1.1 Task Score

In this study, we used an independent t-test to analyze the differences of task scores between the SPG and the MPG (Table 3). The results indicated that the difficulty of the tasks did not have significant effects, regardless of either the SPG or the MPG. However, we found that the mean score of learners with SPG was lower than that with the MPG. These results suggested that learners who used the SPG are less able to complete tasks than those who used the MPG when performing difficult tasks. In other words, they might need support from peers to help them complete the difficult tasks.

Table 3

Task scores between the SPG and the MPG when performing easy and difficult tasks

	CS	N	M	SD	df	t	p
MPG	Easy	32	939.68	101.233	62	1.999	.509
	Difficult	32	955.31	86.769			
SPG	Easy	12	925.83	81.515	22	2.073	.0513
	Difficult	12	759.16	268.038			

$^{*}p<.05$

4.1.2 Task Time

An independent t-test was used to analyze the differences of the task times between the SPG and the MPG (Table 4). The results indicated that the difficulty of the task had significant effects, including the MPG ($t = 1.999$, $p < .001$) and the SPG ($t = 2.073$, $p < .05$). These findings suggested that learners spent more time solving difficult tasks than solving simple tasks. Nevertheless, we found that learners with the SPG spent less time completing tasks than learners with the MPG when performing the easy tasks. The SPG interacted with the virtual competitor. Thus, this finding implied that virtual competitor's response could speed up learners' efficiency in solving the easy tasks. In contrast, we found that learners with the SPG spent more time completing tasks than learners with the MPG when performing the difficult tasks. In other words, the virtual competitor was not helpful to learners when conducting the difficult tasks.

Table 4

Task scores between the SPG and the MPG when performing easy and difficult tasks

	CS	N	M	SD	df	t	p
MPG	Easy	32	786.65	421.478	62	1.999	$.000^{***}$
	Difficult	32	1305.75	368.784			
SPG	Easy	12	475.66	178.221	22	2.073	$.001^{**}$
	Difficult	12	1432.33	853.846			

$^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$

4.2 Learning behavior

4.2.1 Frequency Analysis

In this study, we used an independent t-test to analyze the usage frequency of hints between the SPG and the MPG (Table 5). The results indicated that the usage frequency of hints did not have significant effects, regardless of the SPG or the MPG. However, we found that the usage frequency of hints of learners with the SPG was higher than that with the MPG. These results suggested that learners who used the SPG more relied on hints to complete the tasks when performing the difficult tasks.

Table 5

Hints use between the SPG and the MPG when performing easy and difficult tasks

	CS	N	M	SD	df	t	p
MPG	Easy	32	3.78	7.749	62	1.999	.747
	Difficult	32	3.15	7.717			
SPG	Easy	12	5.25	5.446	22	2.073	.0587
	Difficult	12	17.91	21.322			

$^{*}p<.05$

4.2.2 Lag Sequential Analysis

This study used the Lag Sequential Analysis to explore the influences of task difficulty on learning behavior. Table 6 shows the behavioral coding of the sequence analysis, thereby generating the results of two sets of sequence analyses (Figure 3 and Figure 4). More specifically, Figure 3 shows (a) learning behaviors when learners performing simple tasks, and (b) learning behaviors when learners performing difficult tasks. Then we analyze the similarities and differences.

Table 6

Hints use between the SPG and the MPG when performing easy and difficult tasks

Behavior	**Codes**	**Description**
Game Start	B	Start the game.
Card Sort	Q	Move cards to reorder words.
Use Hints	H	To use the direct hint, e.g., Chinese hint or Meaning hint.
Check Answer	A	Check that the current sentence is correct and present it in "1A2B" format.
Send Card	S	Send the selected card to the next person.
Auto Send	Y	After 60 seconds of each round, the system will automatically send a card.
Chat Tool	F	Use the system's 10 preset chat options to communicate with others.
Game Over	D	The cards are completely sorted and the game is over.

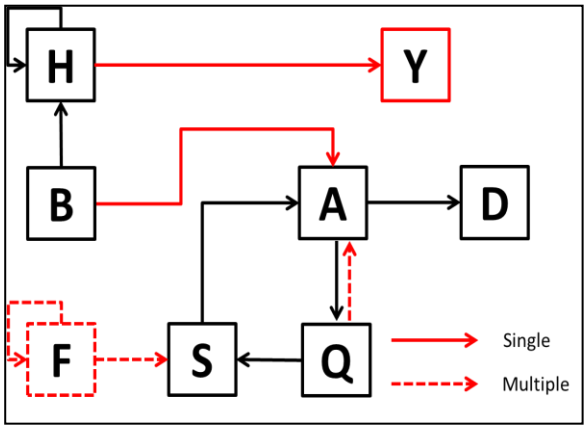

Figure 3. The behavioral transition diagram of Easy Task (left)

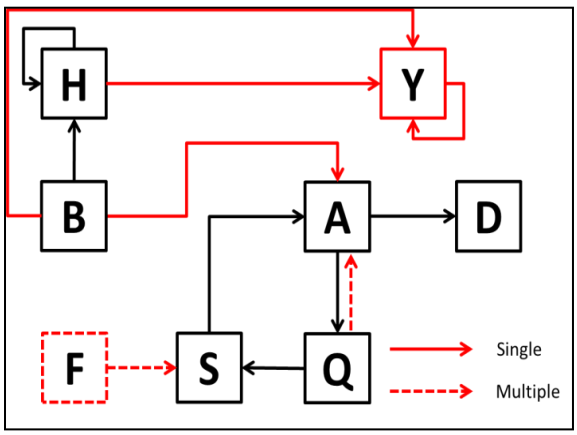

Figure 4. The behavioral transition diagram of Difficult Task (right)

4.2.2.1. Easy Task

4.2.2.1.1. Similarities

The results from the LSA indicated that learners with the SPG and those with the MPG demonstrated some similar behavior sequences when performing the easy tasks, i.e., S→A→Q→S, B→H↔H, A→D. The details are, discussed below.

- B→H↔H: Learners repeatedly used the hints at the beginning of the task.
- A→Q→S→A: Learners checked the answers before sorting the cards. Subsequently, they sent the card and checked the answer again.
- A→D: Learners completed the task after checking the answers.

These findings suggested that the hints were helpful to learners when they started their tasks. This is due to the fact that they tended to repeatedly use the hints (B→H↔H) when starting new tasks.

In addition, after checking the answers, they tended to rearrange the cards, and then send out unwanted cards before checking the answers again (A→Q→S→A). Finally, they completed the task by checking the answers (A→D). These findings implied that they were keen to check the answer. This might be owing to the fact that.

4.2.2.1.2. Differences

The results of the LSA indicated that learners with the SPG and those with the MPG demonstrated some different behavior sequences when performing the easy tasks. These different behavioral sequences are discussed below.

- B→A (SPG) vs. Q→A (MPG): Learners with the SPG checked the answers at the beginning of the task while learners with the MPG checked the answers after sorting the cards.
- H→Y (SPG) vs. None (MPG): Learners with the SPG automatically sent cards after using the hints, but learners with the MPG did not have the behavior.
- None (SPG) vs. F↔F→S (MPG): Learners with the MPG sent cards after repeatedly using the chat tool, but learners with the SPG did not have the behavior.

These findings suggested that learners with the SPG checked the answer at the beginning of the task (B→A). In contrast, learners with the MPG checked the answer after sorting the cards (Q→A). These findings suggested that learners with the SPG checked the answer at the beginning of the task (B→A). In contrast, learners with the MPG checked the answer after sorting the cards (Q→A). Such a sequence difference suggested that the former tended to collect more information by checking the answer at the beginning of the task. On the other hand, the latter undertook the tasks without collecting additional information. This might be due to the fact that the former had high intrinsic motivation (Cerasoli et al., 2014) so they were willing to allocate more attention and resources on tasks (Patall, Cooper, & Robinson, 2008). Conversely, the latter had lower intrinsic motivation because of competition (Deci, 1981; Liang, Wang, Wang & Xue, 2018). Accordingly, they did not pay attention to collecting extra information.

Furthermore, learners with the SPG automatically sent out cards (H→Y) after they used the hints. This finding revealed that learners with the SPG attempted to have some thought after using the hints so they could not make decisions in time. This might be due to the fact that there was no competitor in the SPG, so they did not have high extrinsic motivation to complete the tasks efficiently. In other words, the lack of competition might decrease the extrinsic motivation of learners (Cagiltay, Ozcelik & Ozcelik, 2015). On the other hand, learners who used the MPG repeatedly used the chat tool before sending cards (F↔F→S). This pattern indicated that the chat tool could help them complete the tasks. However, since the SPG did not have a chat partner, no such behavior occurs.

4.2.2.2. Difficult Task

4.2.2.2.1. Similarities

The results from the LSA indicated that learners with the SPG and those with the MPG demonstrated same behavior sequences when performing difficult tasks i.e., S→A→Q→S, B→H↔H, A→D. Such results were the same as those found in the easy tasks. In other words, Regardless of performing the easy tasks or difficult tasks, these behaviors were indispensable or beneficial to learners.

4.2.2.2.2. Differences

The results of the LSA indicated that learners with the SPG and those with the MPG demonstrated some different behavior sequences when performing difficult tasks. Among such different behavior sequences, B→A, Q→A, H→Y were similar to those found in the easy task so they are not discussed here again. Further to B→A, Q→A, H→Y, there were B→Y↔Y and F→S, which are discussed below.

- B→Y↔Y (Single) vs. None (Multiplayer): Learners with the SPG automatically sent cards repeatedly at the beginning of the task, but learners with the MPG did not have the behavior.
- None (Single) vs. F→S (Multiplayer): `Learners with the MPG sent cards after using the chat tool, but learners with the SPG did not have the behavior.

Based on the results, it could be observed that learners with the SPG automatically sent out cards repeatedly at the beginning when performing the difficult tasks (B→Y→Y). This might be because the difficult tasks increased the time they need to think. In other words, the difficult tasks made them encounter bottlenecks at the beginning.

In addition, learners with the MPG used the chat tool (F→S) before sending the card, which indicated that the chat tool could help them complete the task. Unlike the easy task, the chat tool was not used repeatedly when performing the difficult tasks. This might be because the difficult tasks increased the amount of time they need to think so most of them did not have redundant time to reuse the chat tool.

4.3 Discussions

4.3.1 Intrinsic Motivation vs. Extrinsic Motivation

The results of this study indicated that learners with the SPG or those with the MPG relied on the hints at the beginning of the task. However, learners with the SPG also relied on checking the answers when they started tasks. In contrast, learners with the MPG checked answer after sorting the cards. This result suggested that learners with the SPG tended to collect more information to perform tasks. Conversely, learners with the MPG performed the tasks when information was insufficient. These findings suggested that competition made learners with the MPG focus on speed so that they could get better rankings. In other words, learners with the SPG had intrinsic motivation to gain additional understandings. Conversely, learners with the MPG had extrinsic motivation to pay attention to gain external bonus (Cerasoli et al., 2014).

4.3.2 SPG vs. MPG

Regardless of performing the easy tasks or difficult tasks, we found that learners with the MPG had higher task scores and used fewer hints than those with the SPG. In addition, learners with SPG needed more time to complete the tasks than those with the MPG when performing the difficult tasks. In other words, learners with the MPG were more efficient than those the SPG. However, such efficiency might let them have a short learning process, where learners perhaps neglected a comprehensive understanding of the subject content, which might be the negative impact of the competitive environment (Vrugte et al., 2015).

4.3.3 Easy Task vs. Difficult Task

The results from this study indicated that the difficulty of the tasks did not have significant effects on either the task scores or the usage frequency of hints. However, learners with the SPG and those with the MPG significantly spent more time on the difficult tasks than the easy tasks. In addition, the difficult tasks made learners automatically send out the cards, regardless of learners with the SPG and those with the MPG. In other words, the difficult tasks made learners encounter bottlenecks and have more mistakes in the game. These findings implied that the difficulty of the tasks did not affect their learning performance, but game performance.

4.3.4 Cooperation vs. Competition

Cooperation and competition were often considered to be mutually antagonistic, but they could exist simultaneously in certain special circumstances. Learners who used the MPG mad exchange the cards with other learners to get the words they needed. However, they also had to send the cards that other learners need, otherwise they were unable to complete the tasks. In other words, they need to compete with each other and cooperate with each other. Therefore, the MPG is not only a competitive learning environment, but also has the nature of cooperative learning.

5. Conclusions

In this study, we aim to compare differences between the SPG and the MPG from the aspect of the task difficulty. The results indicated that learners with the MPG had higher task score and used fewer hints, regardless of easy or difficult tasks. In addition, learners with the MPG used less time when performing the difficult tasks. Regarding learning behavior, learners with the SPG had a higher intrinsic motivation to get more learning information at the beginning of the tasks. On the contrary, learners with the MPG had lower intrinsic motivation and did not collect sufficient information at the beginning of the tasks.

On the other hand, the task difficulty was not significantly different for the task score. However, the difficult tasks made learners spend more time to complete the tasks. In addition, the difficult tasks made learners with the SPG automatically send out cards repeatedly. In other words, the difficulty of the tasks did not have a significant impact on their learning performance but it made them have more mistakes.

According to the aforementioned findings, we propose a framework (Figure 5), which yielded fruitful results. However, this study also had some limitations. First, the sample is small, so we need to extend the sample to verify the results that will be presented in this study in the future. Second, this study also considered competition among four people. Therefore, further research should consider extending the number of competitors so that comprehensive findings can be obtained.

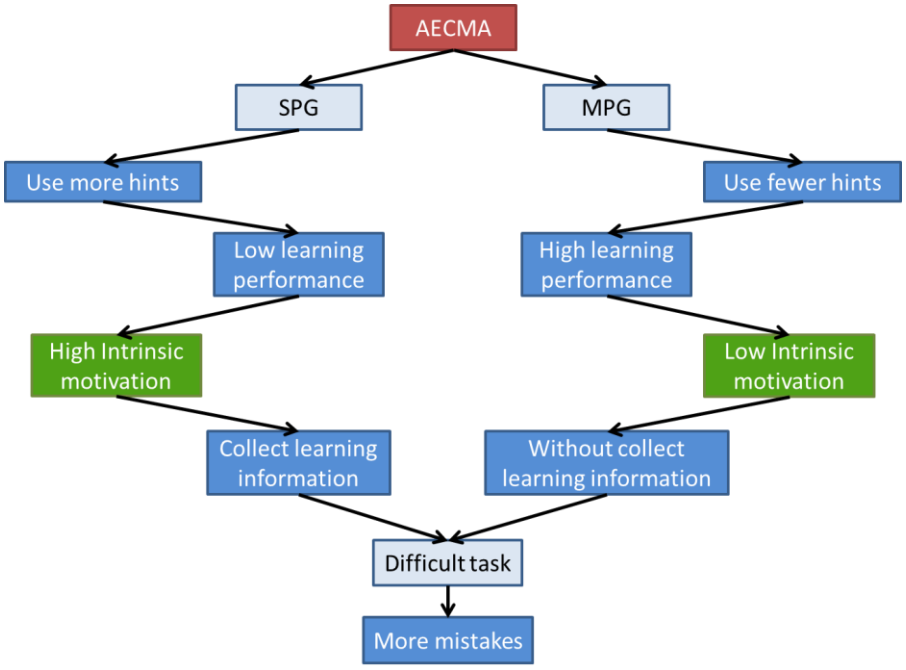

Figure 5. The framework to summarize the findings

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