The Effects of Game-based Peer Response on Writing Quality: High-ability vs. Low-ability

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Abstract: In this study, we proposed a game-based peer response to enhance student writing. In addition, we also examined how students with different levels of ability react to the game-based peer response. The results revealed that such a game-based peer response could enhance students' writing quality and narrow the gap between the high-ability students and the low-ability students. Moreover, the effects of the game-based peer response on the improvement of high-ability students' writing quality was limited and did not reach to a significant level. Conversely, the game-based peer response was able to significantly improve the writing quality of low-ability students, regardless the overall quality or each individual aspect of writing quality.

Keywords: Game-based learning, individual differences, peer response

1. Introduction

Peer response (Elbow, 1973; DiPardo & Freedman, 1988) is also known as peer review, which refers to a collaborative activity, in which learners work together to improve the quality of their works by providing comments for each other. Recently, a lot of researchers investigated the effects of peer response and found its benefits can be classified into four aspects: social, cognitive, affective and linguistic (Rollinson, 2005; Min, 2006). Regarding the social aspect, negotiations used in the process of peer response could enhance students' communication and collaboration skills (Mendonça & Johnson, 1994). Regarding the cognitive aspect, peer response could not only facilitate students to develop critical and analytical skills for writing (Stoddard & MacArthur, 1993), but also make them have a greater awareness of audience (Lockhart & Ng, 1993). Regarding the affective aspect, peer response could help students reduce apprehension and increase confidence (Leki, 1990) and develop a greater sense of the ownership of the work (Tsui & Ng, 2000). Regarding the linguistic aspect, peer response could help students gain more new ideas and different points of view (Lockhart & Ng, 1993) and improve the quality of their works (Cho & Schunn, 2007).

Due to the aforementioned benefits, peer response has been widely applied to enhance student writing. For example, Sims (2001) attempted to use peer comments to improve children's expressive writing, and found that peer response enhanced students' writing fluency. Subsequently, Boscolo and Ascorti (2004) attempted to apply peer response to assist children to improve the clarity of their narrative writing. They found that peer response fostered students' abilities to detect information gaps or inconsistencies in writing. Additionally, Tuzi (2004) also used electronic peer feedback to support the revisions of academic writing. He found that electronic peer feedback assisted students to understand how to structure an essay.

The aforementioned studies demonstrated the effectiveness of peer response. Nevertheless, all of these peer response approaches are still implemented in a traditional education context. As suggested by Tüzün, Yılmaz-Soylu, Karakuş, İnal, & Kızılkaya (2009), students in a traditional educational context may have low motivation. In particular, young students have a limited attention span (Moreno-Ger, Martinez-Ortiz, Sierra, & Fernandez-Manjon, 2008). Therefore, there is a need to use a mechanism that can catch students' attention and increase their motivation. Among various mechanisms, digital games have transformed the way people learn and make learners have enjoyable

experience (Marsh, 2011). Furthermore, some researchers found that digital games can motivate learners because they raise curiosity and allow learners to be in control of their own learning (Dickey, 2007; Huizenga, Admiraal, Akkerman, & ten Dam, 2009; Papastergiou, 2009). This may be the reason why game-based learning (GBL) emerged in the past ten years.

GBL possesses many positive effects on student learning (Pivec, 2007). In particular, previous research found that GBL could enhance students' learning motivation. For example, a study by Liu and Chu (2010) compared GBL and non-GBL in ubiquitous context. The results demonstrated that students with ubiquitous games could have better learning motivation than those with a non-gamed method. Thus, game-based learning can be a potential approach to address the problems of students' low motivation and short attention span. To this end, this study attempts to develop game-based peer response by incorporating GBL into peer response.

However, it is unknown whether such game-based peer response can be appreciated by all learners. This is due to the fact that game-based learning includes a variety of multimedia elements, which may cause cognitive overload. In other words, the game-based peer response delivers feedback via multiple information sources, which may increase students' cognitive load (Fried, 2008). In particular, learners are diverse so not all of learners have such a capacity to handle cognitive overload, which is usually happened when it is beyond the learners' capacity (Ang, Zaphiris, & Mahmood, 2007). Accordingly, there is a need to consider whether all learners can cope with such cognitive load. In other words, individual differences become an important issue. Among various individual differences, the diversity in learning abilities greatly affect students' perceptions (Cheng, Lam, & Chan, 2008), which, in turn, will influence their learning outcomes. Thus, such ability differences may affect how students react to this game-based peer response. Therefore, there is a need to examine the impacts of students' abilities on their reactions to the proposed game-based peer response.

To this end, the aims of this study are two folded. One is to develop game-based peer response while the other is to examine the effects of the ability differences on students' reactions to the game-based peer response. To correspond to the aforementioned two aims, two research questions are examined in this study:

(a) What are the effects of the game-based peer response on students' writing quality?
(b) How do high-ability students and low-ability students react differently to the game-based peer response?

The answers to these two research questions can contribute to develop a deep understanding of how to undertake game-based peer response that can accommodate students' individual differences. By doing so, both high- and low-ability students can benefit from game-based peer response.

2. Methodology Design

This study was conducted in an elementary classroom. To correspond to the aforementioned research questions, an empirical study was conducted to evaluate the effects of game-based peer response. The details are described in this section, including the implementation of the game-based peer response, participants, a pre-test and a post-test, pedagogical activities, measurement of writing quality, and data analysis.

2.1 The Implementation of Game-based Peer Response

We developed a game-based peer response, where peer response was conducted with various game elements, including game activities and rewards. Regarding game activities, participants need to play as a head of a publisher and manage their own publisher by completing various game activities required by different departments of the publisher (Figure 1), such as editing drafts, giving feedback to their peers' works, evaluating feedback received, revising their own work, and publishing and promoting their completed works to other peers (Figure 2). The purpose of such a series of game activities was to extend students' attention span in learning, and, in turn, facilitate themselves to complete target learning tasks. This is because each of the aforementioned game activities is associated with a target task, which has a

clear sub-goal to be achieved. In other words, a complex writing process was decomposed into a series of tasks. When students complete a target task, they also achieve its sub-goal and can move to pursue the next sub-goal. Through the accumulation of these sub-goals, the ultimate goal is, accordingly, reached.

Figure 1. A Snapshot of the Game-based Peer Response (the Publisher)
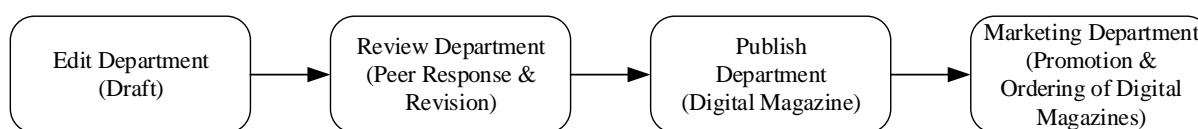

Figure 2. The Main Activities of the Game-based Peer Response

Further to a series of game activities, various reward mechanisms were also employed to extend students' attention span and increase their motivation and participation in learning activities, including virtual currency, leaderboards, and trophies. The virtual currency was used to reward students' behavior for their level of participation and hard working in each game activity and the earned virtual currency can be used to buy marketing tools for promoting users' published magazines or to order other peers' published ones. On the other hand, leaderboards and trophies were used in the responding tasks of the Review department. To ensure the responsibility and motivation of users in participating in responding activities, leaderboards and trophies were introduced as levels of social reputation. More specifically, students would receive various levels of trophies based on their ranking on the leaderboard for their feedback performance. In summary, the intention of developing this game context was to enhance students' engagement in peer response so that their writing quality can be improved.

2.2 Participants

Twenty-one third-grade elementary students participated in this study. They were aged 8-9 years and were recruited from the same class. In other words, they were taught by the same curriculum and were given the same writing assignments and instruction. Furthermore, they had no experience of peer response prior to taking parting in this study.

2.3 Pre-test and Post-test

To evaluate students' writing ability, participants needed to take a pre-test and a post-test at the beginning and the end of the experiment, respectively. More specifically, the pre-test was applied to examine students' prior writing abilities while the post-test was employed to assess their writing ability after taking the game-based peer response. The pre-test and post-test were represented as a composition test, where participants were given a theme-based topic and they were required to complete a narrative composition within an 80-minute period.

2.4 Pedagogical Activities

To help participants know how to act as the providers and recipients of peer response, instructions were given to them based on two guidelines: (a) the interaction between readers and writers proposed by Elbow (1973) and (b) the guidance for peer response proposed by Hansen and Liu (2005). By doing so, the participants could undertake peer response with proper attitudes and procedures. Moreover, they were introduced how to complete writing and responding tasks with the gamed-based peer response.

Then, all participants were evenly re-allocated into small peer response groups of four or five students. Furthermore, participants conducted a series of activities: (a) to receive writing instruction from their teacher, (b) to make drafts individually with a tablet laptop, (c) to receive feedback instruction from their teacher, (d) to read group-mates' drafts and give feedback, (e) to evaluate how useful the feedback received, (f) to revise their own drafts based on the feedback from their peers, (g) to collect completed works and publish them as a digital publication, (h) to make promotion for their published works to have opportunities to present their works to more audience. During this process, students would obtain various rewards, depending on their performance in the aforementioned target tasks.

2.5 Measurement of Writing Quality

An assessment mechanism proposed by Yang, Ko, and Chung (2005) was adopted to assess students' writing quality because it was designed for elementary students, and then appropriate for our participants. This assessment covers five items: (1) elegant words, (2) clear paragraph, (3) coherence, (4) title consistence, and (5) new & original ideas. A five-point rating scale was used for each item. Thus, the total score for a composition was between the lowest score (5 points) and the highest score (25 points). Two raters were recruited to independently evaluate the participants' writing quality so each student's final score was defined based on the mean of scores by the raters, of which the inter-rater reliability was found to be Kappa = 0.728 ($p < .001$). In other words, a substantial level for the measure of agreement between the raters was reached.

2.6 Data Analysis

In this study, we investigated how high-ability students and low-ability students react differently to the game-based peer response. Therefore, students were classified into the high-ability and low-ability students based on the mean scores of the pre-test. Then, an Independent Samples t-test, which is suitable to test "the difference between the means of two independent groups" (Howell, 2007), was used to examine differences between the high-ability students and the low-ability students for the pre-test scores and the post-test scores. On the other hand, Paired Samples t-test, which is appropriate to test the difference between the means of paired samples (Howell, 2007), was employed to inspect differences between the pre-test scores and the post-test scores for the high-ability students and the low-ability students. These aforementioned analyses were undertaken by using SPSS for Windows (version 16.0). The level of significance was set at $p < .05$ for all comparisons.

3. Results and Discussion

This section is divided into three subsections. The first subsection is to present the writing quality of the high ability students and the low-ability students in the pre-test and the post-test. The second subsection is to describe how the high-ability students and the low-ability students performed differently before and after interacting with the game-based peer response. Then, the third subsection is to present a discussion of why the high-ability students and low-ability students reacted differently to the game-based peer response.

3.1 High-ability students vs. Low-ability students

3.1.1 Pre-test Scores

Regarding the pre-test scores, significant differences existed between the scores from the high-ability students and those from the low-ability students. More specifically, the former significantly outperformed the latter, not only in the aspect of overall quality, but also in the aspects of elegant words, clear paragraph, coherence, and new & original ideas (Table 1). These findings suggested that the high-ability students had a better lever of prior writing ability than the low-ability students. Accordingly, the former were more capable to use appropriate words and phrases and organize their paragraph structures, and also were better able to express thoughts in a distinctive ways.

On the other hand, the high-ability students did not perform significantly differently from the low-ability students, in the aspect of title consistence ($p > .05$). This finding implied that both of them had a similar level of prior ability in this aspect.

Table 1: Writing quality of the pre-test (high-ability vs. low-ability).

	HA (n = 11)	LA (n = 10)	Independent samples t-test
	M (SD)	M (SD)	t
Overall	15.27 (1.90)	11.50 (.85)	5.96***
Elegant words	2.73 (.79)	1.8 (.42)	3.41**
Clear paragraph	3.09 (.70)	2.20 (.63)	3.05**
Coherence	2.82 (.87)	2.10 (.32)	2.55*
Title consistence	4.00 (.00)	3.90 (.57)	.56
New & original ideas	2.64 (.81)	1.50 (.53)	3.77**

$* p < .05, ** p < .01, *** p < .001$

3.1.2 Post-test Scores

Regarding the post-test scores, no significant differences ($p > .05$) existed between the scores from the high-ability students and those from the low-ability students. This implied that both groups had a similar level of posterior writing ability, regardless the overall quality or the other aspects aforementioned after they undertook the game-based peer response (Table 2). In other words, the gap between these two groups was minimized.

However, it is still unclear why the aforementioned gap between the high-ability students and the low-ability students has been narrowed or who can benefit from this game-based peer response. Therefore, it is needed to further explore how the high-ability students and the low-ability students react differently to this game-based peer response. To address this issue, we conducted a comparison between students' pre-test scores and post-test scores, of which the results are presented in the subsection below.

Table 2: Writing quality of the post-test (high-ability vs. low-ability).

	HA (n = 11)	LA (n = 10)	Independent samples t-test
	M (SD)	M (SD)	t
Overall	16.18 (2.23)	16.80 (2.49)	-.60
Elegant words	2.73 (.47)	2.70 (.48)	.13
Clear paragraph	2.91 (.83)	3.40 (.84)	-1.34
Coherence	3.18 (.87)	3.10 (.74)	.23
Title consistence	4.55 (.69)	4.60 (.52)	-.20
New & original ideas	2.82 (.75)	3.00 (.67)	-.58

3.2 Pre-test vs. Post-test

3.2.1 High-ability students

Regarding how high-ability students react to the game-based peer response, small differences were found between their post-test scores and pre-test scores in the aspects of writing quality (Table 3).

However, such differences did not reach a statistically significant level ($p > .05$), apart from title consistence ($p < .05$). In other words, the writing quality of high-ability students was not greatly improved. These findings implied that the effect of the game-based peer response on high-ability students' writing ability was not obvious enough to improve their writing quality.

Table 3: Writing quality of the pre-test and the post-test (high-ability students).

	Post-test	Pre-test	Paired samples t-test
	M (SD)	M (SD)	*t*
Overall	16.18 (2.23)	15.27 (1.90)	1.61
Elegant words	2.73 (.47)	2.73 (.79)	.00
Clear paragraph	2.91 (.83)	3.09 (.70)	-.61
Coherence	3.18 (.87)	2.82 (.87)	1.00
Title consistence	4.55 (.69)	4.00 (.00)	2.63*
New & original ideas	2.82 (.75)	2.64 (.81)	.80

* *p* < .05

3.2.2 Low-ability students

Regarding how low-ability students react to the game-based peer response, significant differences were found between their post-test scores and pre-test scores, not only in the aspect of overall quality but also in the aspects of elegant words, clear paragraph, coherence, title consistence, and new & original ideas (Table 4). In other words, the game-based peer response is beneficial for the low-ability students in all aspects of writing quality. These findings suggested that the game-based peer response could significantly help low-ability students improve their writing quality.

Table 4: Writing quality of the pre-test and the post-test (low-ability students).

	Post-test	Pre-test	Paired samples t-test
	M (SD)	M (SD)	*t*
Overall	16.80 (2.49)	11.50 (.85)	5.62***
Elegant words	2.70 (.48)	1.8 (.42)	5.01**
Clear paragraph	3.40 (.84)	2.20 (.63)	3.67**
Coherence	3.10 (.74)	2.10 (.32)	3.35**
Title consistence	4.60 (.52)	3.90 (.57)	3.28*
New & original ideas	3.00 (.67)	1.50 (.53)	4.39**

* *p* < .05, ** *p* < .01, *** *p* < .001

3.3 Discussion

The results of independent samples t-tests presented in the previous subsections suggested that the game-based peer response could narrow the gap between the high-ability students and the low-ability students. More specifically, the change of this gap was from a significant level to a non-significant level. Furthermore, the aforementioned results of paired samples t-tests revealed that the effect of the game-based peer response on the improvement of high-ability students' writing quality was limited and did not reach to a significant level. Conversely, the game-based peer response was able to significantly improve the writing quality of low-ability students, regardless the overall quality or each individual aspect of writing quality. In brief, the low-ability students, but not the high-ability students, benefited from the game-based peer response. Due to such benefits, the former could demonstrate a similar level of writing quality as the latter at the post-test finally.

The fact that the high-ability students and the low-ability students reacted differently to the game-based peer response may be caused by the levels of ability that students possess. In general, high-ability students can obtain the sense of achievement from their works so they enjoy undertaking peer response from intrinsic motivation. Therefore, the impacts of the game context on the enhancement of high-ability students' motivation in peer response were limited. That is why there are no significant

differences between the high-ability students' pre-test scores and post-test scores in most aspects of writing quality.

On the other hand, the low-ability students with the game-based peer response showed significantly better performance in all the aspects of writing quality, including elegant words, clear paragraph, coherence, title consistence, and new & original ideas. It may not be easy for the low-ability students to get the sense of achievement from their works so there is a need to drive them by stimulating their extrinsic motivation. This may be the reason why the low-ability students had significant improvement in writing quality after interacting with the game-based peer response. In other words, the game-based peer response played as a mechanism that can stimulate their extrinsic motivation.

More specifically, such a playful mechanism used various game elements to motivate students. For example, the game-based peer response used points to help students get rewards when they accomplished peer response activities. The other game element is the leaderboards, which show how useful students' comments to their classmates are. By doing so, students' efforts in providing helpful commentary and criticism could be well recognized. In other words, these game elements could not only enhance low-ability students' motivation, but also let them have a stronger sense of achievement. Accordingly, the low-ability students demonstrated better progress with the gamed peer response in all the aspects of writing quality.

4. Conclusions

We proposed a game-based peer response to enhance student writing and investigated how students react to the game-based peer response. In addition, the levels of ability that students possess were also considered in this investigation. Therefore, two research questions were examined in this study. Regarding the first research question, i.e., *what are the effects of the game-based peer response on students' writing quality,* the results revealed that the game-based peer response could help students enhance their writing quality. Moreover, such a game-based peer response could reduce the gap between the high-ability students and the low-ability students from a significant level to a non-significant level.

Regarding the second research question, i.e., *how high-ability students and low-ability students react differently to the game-based peer response*, the results suggested that the game-based peer response was significantly beneficial to the low-ability students, but not to the high-ability students, in terms of writing quality. These aforementioned results are interesting but this study is conducted with a small-scale sample. Therefore, future work needs to be undertaken with a large-scale sample to provide more evidence.

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