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How competitive, cooperative, and collaborative gamification impacts student learning and engagement

Shen Qiao, The Education University of Hong Kong

Susanna Siu-sze Yeung, The Education University of Hong Kong

Xiaoai Shen, The University of Hong Kong

Jac Ka Lok Leung, The Hong Kong University of Science and Technology

Davy Tsz Kit Ng, The University of Hong Kong

Samuel Kai Wah Chu, Hong Kong Metropolitan University

Abstract

Gamification is an increasingly popular approach to engage learners in educational contexts. Although many studies have examined the effects of gamification in comparison to a non-gamification approach, less attention has been paid to the impact of different ways of implementing gamification on students' learning and engagement. In this study, we performed a quasi-experiment on the competitive, cooperative, and collaborative types of gamification among secondary school students who learn English as a foreign language. The quantitative results indicate students in the competitive condition significantly outperformed their peers in the cooperative condition on a reading-related skill (morphological awareness), word reading, and reading comprehension. They also had higher gains in morphological awareness than students in the collaborative condition, although these two groups showed similar improvement in far-transfer measures (i.e., word reading and reading comprehension). Concerning engagement, qualitative data collected from interviews suggested gamification contributed to students' behavioural, emotional, and cognitive engagement. The qualitative data also reflected the possible reasons for the quantitative results. We conclude that cooperative and collaborative gamification should be designed carefully and take various factors into account (e.g., establishing shared goals and rewards, emphasising individual and collective contributions, and collaboration training) to ensure that the gamification approach does not hinder student learning.

Keywords: *Gamification, Competition, Cooperation, Collaboration*

Language(s) Learned in This Study: *English*

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Introduction

Gamification refers to “the use of game design elements in non-gaming contexts” (Deterding et al., 2011, p. 2). A variety of game design elements (e.g., points, badges, levels, progress bars, and leaderboards) can be incorporated into learning contexts or platforms to make learning gameful, enjoyable, and motivating (Zainuddin et al., 2020). Studies of gamification have focused primarily on comparing the effectiveness of the gamification approach with non-gamification methods, and these studies have yielded mixed findings.

Some studies have reported positive effects of gamification on student learning (Qiao et al., 2022; Sánchez et al., 2021), but others have reported no significant effect or even negative effects (Hanus & Fox, 2015). Hence, several researchers have cautioned that the positive benefits of gamification are conditional upon the appropriate incorporation of game design elements and pedagogical strategy (Jagušć et al., 2018; Sailer et al., 2017).

Gamification comes in many types. It can be applied to enhance individual learning (Li & Chu, 2021), cooperative learning (Dindar et al., 2021), or collaborative learning (Chen et al., 2020). Dindar et al. (2021) argued that most gamification studies have focused on the competitive features of game design elements or applying gamification in enhancing individual learning. However, one size does not fit all. Although competition may bring numerous positive effects for some learners, it could have the opposite effects on learners with lower achievement levels because of cognitive overload (Yang et al., 2020). For lower-achieving learners or those with low self-efficacy, competition may produce constant stress and frustration. For these students, cooperative or collaborative gamification, in which students work collectively and compete in teams, might be more successful. By working in teams, students can “master challenges they otherwise might not be able to overcome on their own, which can result in feelings of competence” (Sailer & Homner, 2020, p. 81). Unfortunately, the literature offers only a limited understanding on the design and impact of cooperative and collaborative gamification, and more nuanced gamification studies are needed.

Gamification is increasingly being used in the language learning field. It is recognised that learning English as a foreign language (EFL) or a second language (ESL) is challenging and involves tedious learning processes (Shortt et al., 2021). Gamification promises a fun, enjoyable, and engaging approach to learning, and there has been increasing research on incorporating gamification into EFL/ESL learning in recent years. In a systematic review, however, Dehghanzadeh et al. (2019) pointed out that the vast research on game-based language learning has not yet produced a clear picture of the use of gamification for EFL/ESL. They pointed out that most gamification studies focused on the effects of gamification on general learning processes and outcomes instead of on the EFL/ESL field. Compared to serious games, gamification can be integrated more closely with the instructional content by augmenting the learning process to make it game-like (Landers et al., 2018). It represents a cost-effective approach that can be easily adapted in the classroom (Sanchez et al., 2020). Out of the four overall language proficiency categories (reception, production, interaction, and mediation), as proposed by the Common European Framework of Reference for Languages (CEFR; Council of Europe, 2020), we focus on reading comprehension in the category of reception because reading is a key catalyst for students’ academic success (Billington, 2015). Thus, the present study focuses on the use of gamification to improve EFL students’ reading acquisition.

In this study, we unpack the effectiveness of different types of gamification by conducting a quasi-experimental study to compare the competitive, cooperative, and collaborative types of gamification on EFL student reading performance and engagement. In this study, the quantitative data were collected from assessment tasks to measure students’ acquisition of a reading-related skill (morphological awareness), word reading, and reading comprehension in English. Morphological awareness, defined as a student’s awareness of and ability to manipulate the smallest meaningful units in a word, has been identified as one of the crucial predictors of word reading and reading comprehension (Qiao et al., 2021). Word reading was another important predictor of reading comprehension, as indicated by the Simple View of Reading (Garcia & Cain, 2014; Hoover & Gough, 1990). The qualitative data were collected from semi-structured interviews with a sample of participants to explore students’ engagement in gamified learning and the possible reasons for the quantitative results. Using a mixed-methods approach (Creswell & Clark, 2018), we addressed the following two research questions:

1. RQ1: How do different types of gamification affect students’ reading performance, including morphological awareness, word reading, and reading comprehension?
2. RQ2: How do students in different conditions perceive their gamified learning experiences?

Related Literature

Competition, Cooperation, and Collaboration

The motivation taxonomy proposed by Malone and Lepper (1987) was followed to design our gamified educational environments. This framework was used in a recent study to guide the design of serious games (Buchinger & Hounsell, 2018). In the present study:

- Competition refers to exogenous competition in which students work individually and there is no link between students' tasks (Malone & Lepper, 1987). For example, Li and Chu (2021) designed a gamified reading platform where students earned points by completing book battles. Students' collected points and finished book battles were ranked on the leaderboard. They worked individually and were ranked in the leaderboard based on their own achievement.
- Cooperation refers to exogenous cooperation in which students work individually and are assessed both individually and collaboratively (Malone & Lepper, 1987). For example, Dindar et al. (2021) designed a cooperative gamification where students worked individually on the studying task and group members' points were summed up to form a group score. The leaderboard presented the daily group scores rather than the individual group. Unlike Dindar et al. (2021) where students were assessed only collaboratively, the present study included both team and individual leaderboards.
- Collaboration refers to endogenous collaboration in which students work together in teams and are assessed as a team (Malone & Lepper, 1987). For example, Chen et al. (2020) designed a collaborative gamification where gamification was applied to collaborative digital reading. Students made annotations together with their peers and they could share ideas and comments.

The difference between cooperation and collaboration was explained by Roschelle and Teasley (1995) as the following statement: cooperation "... is accomplished by the division of labor among participants, as an activity where each person is responsible for a portion of the problem solving..." whereas collaboration means "... mutual engagement of participants in a coordinated effort to solve the problem together" (p. 70).

Competitive Gamification

Though gamification can have a variety of game design elements, the leaderboard is considered to be one of the most commonly used game elements to evaluate how a student performed as compared to other students (Bai et al., 2020). Leaderboards facilitate social comparison by providing a visual display of rankings that provides an objective assessment of and constant exposure to peer accomplishment (Wells & Skowronski, 2012). Social comparison naturally leads to competition because it gives individuals an awareness of the discrepancies between their own achievement and that of their peers (Hanus & Fox, 2015). Viewing the progress of others and perceiving the possible level of achievement gives individuals a tendency to make every effort to achieve their goals (Qiao et al., 2023). It is a strong motivator for individuals to strive for excellence and has positive aspects on learning because it presents additional challenges, which lead to increased motivation, active participation, focused attention, and excitement (Vandercruyssen et al., 2013). However, the leaderboard does not motivate all types of students. For instance, Çakıroğlu et al. (2017) and Leung (2019) found students were not motivated to participate in the activities when their ranking was low in the leaderboard. As found by a recent qualitative evidence synthesis (Bai et al., 2020), gamification can lead to anxiety or jealousy. Hence, the effect of gamification is not necessarily effective, and its design requires careful consideration.

Social Gamification

Gamification is not only able to create an environment for individual competition but also shows promise as a technique to foster collaboration between students (Kapp, 2012). Social gamification refers to applying gamification to social learning environments (Simões et al., 2013). In this study, the term *social*

gamification encompasses both collaborative and cooperative gamification. Social gamification can engage and motivate learners to exert shared efforts and collectively tackle their tasks in competition with other teams. Inter-group competition in a gamified learning environment encourages students to maximise their individual performance for the sake of the team (Hung et al., 2015). However, as mentioned above, the literature on gamification has focused primarily on the competitive features of game design elements rather than the social aspects (Dindar et al., 2021).

Few studies have investigated social gamification, and the empirical evidence for its effectiveness is mixed. For instance, with collaboration in mind, de-Marcos et al. (2016) compared the effects of four experimental conditions (educational game, gamification, social networking, and social gamification) on undergraduate students' learning performance. Social gamification in this study brings together the benefits of gamification and social networking in a single environment and harnesses the motivational power of both competition and collaboration. They found that social gamification led to better results on a range of outcomes over the other conditions. For instance, the social gamified group performed better on learning performance in comparison to the group using the educational game. Furthermore, a recent meta-analysis by Sailer and Homner (2020) showed that gamification combining competitive and collaborative approaches outperformed merely competitive gamification on behavioural learning outcomes.

However, research results have not always favoured social gamification over competitive gamification. For example, Dindar et al. (2021) gamified English vocabulary learning and found no difference between the gamified cooperation and gamified competition conditions on students' task effort, learning outcomes, and motivation. Similarly, the study of Jagušť et al. (2018) showed that collaborative gamified conditions using collaboration, narrative, and adaptivity was not more effective than competitive gamified conditions for students' learning performance. Given the variation between classes in results obtained using the collaborative gamified approach, Jagušť et al. (2018) called for more empirical studies of the incorporation of social elements in the gamification context. Hence, the present study is timely in its effort to provide a more nuanced understanding of how social gamification works and to evaluate its effectiveness in comparison to a competitive gamification approach.

Methods

Participants

The participants ($N = 156$) in this study were Grade 7 students in a secondary school in mainland China. All of the students were learning English as a foreign language and had limited exposure to English outside of the classroom. The school is a typical secondary school for the local area with average academic performance. Three classes were selected on the basis of their comparable English performance in the school examination. Classes were randomly assigned to one of the three conditions: competitive ($n = 52$), cooperative ($n = 52$), or collaborative ($n = 52$). The students who did not attend pretest or posttest were removed from the final data analysis.

Experimental Conditions

The Identical Components Across Three Conditions

The three conditions had the same learning topics, activities, and facilitator to enable us to tease out confounding factors and allow for comparison. The three classes used a blended learning approach in which the instructor delivered the instructional content at the beginning of each session, and then the students engaged in online activities for the remainder of the class. The design of the morphological awareness activities followed Savage's (2023) work (see [Appendix A](#)). Learning management system Moodle was used as the platform to manage all online activities, incorporating the Level Up plugin to generate and display individual and team leaderboards. There were ten levels of exercises (nine regular sessions and one

review session) with two to four challenges at each level. The students earned one point for each correctly answered item, and the accumulated points determined their ranking on the leaderboard. Besides the leaderboard ranking, the students earned a different number of e-badges based on the quality of their performance. For each session, students who had the basic level of performance (60% accuracy rate) earned one e-badge; students who had the second level of performance (80%) earned two e-badges; students who had the third level of performance (90%) earned three e-badges. Besides, students would automatically level up with sufficient points. Students' completed and uncompleted activities were shown on a progress bar using different colours. The students would also receive one card when they answered the teachers' questions correctly. Based on the number of points and cards students earned, they would receive different levels of rewards after all sessions, such as postcards, notebooks, and pencils.

The Different Components Across Three Conditions

Table 1 provides an overview of the game elements and the pedagogy for each condition. In the *competitive* condition, each student had their own account to log in to Moodle. They tackled the task individually and their scores were ranked on an individual leaderboard. In the *cooperative* condition, the students not only competed against each other individually but also on teams. The students worked individually and the individual scores within each team were summed to produce a total team score. There were both individual and team leaderboards in this condition. The suggestion of Sankaranarayanan et al. (2020) in setting the group size to four was followed, which allowed for easy coordination and sufficient conflicting ideas. Heterogeneous grouping was used to ensure that the less able students would benefit from support (ter Vrugte et al., 2015). The *collaborative* condition was designed to encourage collaborative work and team competition rather than personal competition. Each team of four students shared a single account to log in to Moodle. The students sat together and worked on the same challenges as their peers in the other conditions. A team leaderboard showed the points earned by each team.

Table 1

Overview of Game Elements and Pedagogy in the Three Conditions

	Competitive	Cooperative	Collaborative
Game design elements (points, badges, levels, and progress bar)	+	+	+
Reading activities	+	+	+
Competition	+(individual)	+(individual/team)	+(team)
Cooperation	-	+(scores were summed up)	+
Peer discussion	-	-	+
Individual leaderboard	+	+	-
Team leaderboard	-	+	+

Measures

Reading measures (i.e., morphological awareness, word reading, and reading comprehension) were administered at pretest and posttest to evaluate the students' changes in reading performance. The three

measures included both oral and written tasks and required the students to process language at sublexical, lexical, and supralexic levels (Bowers et al., 2010). Word reading was evaluated through an oral task that students carried out individually with trained experimenters, and the remaining tasks were completed in groups. All of the measures had been used in previous studies and showed satisfactory to excellent reliability in this research (alphas ranging from .66 to .90).

Morphological awareness is a near-transfer measure that is closely related to the instructional content. It was assessed with the Test of Morphological Structure (Carlisle, 2000), which is the most commonly used task to assess morphological awareness (Qiao et al., 2021). In this 56-item task, the students were required to change the form of the target words to fit incomplete sentences (e.g., ‘Equal. Boys and girls are treated with _____’ [equality]). Each correct answer was awarded one point, for a maximum score of 56.

Word reading and *reading comprehension* are far-transfer measures that assess the transfer of instructed content to higher levels of reading outcomes. *Word reading* was measured with the standardised Wide Range Achievement Test-4 (Wilkinson & Robertson, 2006) and another task adopted in a previous study (Choi et al., 2017). In this task, a list of words was presented to the students by the experimenter, and the students were required to read the words one by one that were arranged in increasing levels of difficulty. This task included 27 single-syllable words and 88 multisyllabic words. As morphological awareness is particularly useful to facilitate multisyllabic word reading (Kirby et al., 2012), we focused only on multisyllabic word reading in the analysis. Each correct response was awarded one point, for a maximum score of 88.

Reading comprehension was evaluated with the task used in the study of Tong et al. (2017). The students were asked to read two passages and answer 12 follow-up multiple-choice questions for each passage in a limited time. The maximum score was 24.

To explore the students’ perceptions and learning experiences in gamified learning, semi-structured interviews with six focus groups were conducted, with two groups for each condition (four students per group). The interview protocols were designed based on previous studies (Huang, 2019; Zainuddin, 2020). There are a total of ten interview questions that were planned in advance and served as an interview guide. In the course of the semi-structured interviews, there were some follow-up and probing questions allowing new ideas to be brought up. Sample interview questions include: ‘Which course do you prefer? Traditional class or gamified class? Why?’, ‘What do you think of the positive/negative aspect of gamified learning?’, and ‘What’s your perception toward the use of leaderboards in your condition?’

Quantitative Results

Preliminary Analysis

Table 2 shows the descriptive statistics of all measures at the pretest and posttest by group (means, standard derivations, and reliabilities). A preliminary analysis using one-way ANOVA showed no significant differences in all of the measures at the pretest ($p > .05$), indicating that the three conditions were comparable before the intervention. Levene’s test of homogeneity of variance was confirmed for all outcomes, indicating that it was appropriate to conduct an analysis of covariance.

Intervention Effects

A repeated-measures ANOVA was used to examine the change of reading outcomes across groups. Table 2 shows the repeated-measures ANOVA results. When a significant Time X Group interaction effect was found, a one-way ANCOVA was used to compare the posttest scores across conditions, with pretest scores as the covariates and the conditions as the independent variables. If a significant difference on posttest scores was detected, a follow-up pairwise comparison using least significant different (LSD) tests was performed to compare all possible means. Table 3 shows the one-way ANCOVA results.

Morphological awareness. As revealed by the repeated-measures ANOVA, there was a significant Time X Group interaction effect, $F(2, 144) = 4.26, p = .016$, indicating a statistically significant difference in improvement between the three groups on morphological awareness. The subsequent one-way ANCOVA showed a significant main group effect across three groups, $F(2, 143) = 3.76, p = .026$, indicating differences in performance between the three groups after receiving the intervention when controlling their pretest scores. The follow-up pairwise comparisons using LSD tests showed that students in the competitive condition ($M = 15.75$) significantly outperformed their peers in the cooperative ($M = 13.90$) and collaborative ($M = 13.58$) conditions, $p < .05$.

Table 2

Descriptive Statistics (Mean, SD, Reliability) and Results of the Repeated-measures ANOVA or ANCOVA

Observed variable	Condition	N	Mean (SD)		Time X Group interaction effect	Reliability	
			Pretest	Posttest		F	T1
Morphological awareness	a	51	5.57 (3.38)	15.49 (4.96)	4.26*	.68	.78
	b	47	6.00 (2.38)	13.96 (4.39)			
	c	49	6.22 (3.22)	13.80 (4.92)			
Word reading	a	50	12.96 (6.07)	19.82 (5.12)	3.05 ($p = .05$)	.89	.90
	b	50	13.80 (5.48)	18.58 (7.09)			
	c	50	11.98 (6.70)	17.78 (7.34)			
Reading comprehension	a	51	11.67 (4.03)	14.37 (4.64)	4.22*	.66	.75
	b	47	12.17 (3.52)	13.36 (3.70)			
	c	49	10.71 (3.22)	13.88 (4.29)			

Note. a = competitive condition; b = cooperative condition; c = collaborative condition

* $p < .05$

Word reading. A repeated-measures ANCOVA was used with phonological awareness entered as a covariate because of its great influence on word reading (Yeung & Chan, 2012). The repeated-measures ANCOVA revealed a marginally significant Time X Group interaction effect, $F(2, 146) = 3.05, p = .05$. The follow-up one-way ANCOVA showed that the three conditions differed significantly on posttest scores, $F(2, 145) = 3.09, p = .048$. The pairwise comparisons indicated that the competitive group ($M = 19.81$) significantly outperformed the cooperative group ($M = 17.75$), $p < .05$ but had similar performance to the collaborative group ($M = 18.62$), $p > .05$.

Reading comprehension. A repeated-measures ANOVA indicated a significant Time X Condition effect on reading comprehension, $F(2, 144) = 4.22, p = .017$. Using a one-way ANCOVA, we found a significant main condition effect, $F(2, 143) = 3.09, p = .049$. Subsequent pairwise comparisons indicated that the

students in the competitive condition ($M = 14.26$) and collaborative condition ($M = 14.46$) had similar levels of reading comprehension and that both significantly outperformed the students in the cooperative condition ($M = 12.88$), $p < .05$.

Table 3

One-way ANCOVA Results for All Reading Outcomes Across the Three Conditions

Observed variables	Condition	Adjusted mean	Adjusted SD	<i>F</i>	Partial eta squared	Post-hoc pairwise comparisons
Morphological awareness	a	15.75	.60	3.76*	.50	a > b ($p = .03^*$)
	b	13.90	.62			a > c ($p = .01^*$)
	c	13.58	.61			b = c ($p = .71$)
Word reading	a	19.81	.59	3.09*	.04	a > b ($p = .01^*$)
	b	17.75	.59			a = c ($p = .16$)
	c	18.62	.59			b = c ($p = .30$)
Reading comprehension	a	14.26	.47	3.09*	.04	a > b ($p = .04^*$)
	b	12.88	.49			a = c ($p = .77$)
	c	14.46	.48			b < c ($p = .02^*$)

Note. a = competitive condition; b = cooperative condition; c = collaborative condition

* $p < .05$

Qualitative Results

For qualitative data analysis, the procedures of thematic analysis (Braun & Clarke, 2006) were followed. First, students' original responses were coded and the codes that related to the research questions were highlighted. Second, the initial codes were examined, and the themes were formulated by combining codes with repeated patterns. Third, the themes were further examined and refined through discussions between two coders. Finally, the themes were described and finalised. The data analysis was conducted by two independent coders, with an inter-rater reliability of 91%.

The Common Themes Across Three Conditions

Based on the qualitative data, the influence of gamification on student learning experiences fell into three themes: behavioural, emotional, and cognitive engagement (see [Appendix B](#)). Respondents emphasised that they feel more engaged to participate in the class activities in this gamified classroom as compared to their regular non-gamified classroom (i.e., behavioural engagement). The main reasons were to earn as many badges as possible, complete the activities on the progress bar, level up, and improve their status in the leaderboard. As one student remarked, 'I study harder to earn badges. The badges are beautiful. It's attractive to me.' Another student noted, '...I am familiar with game mechanics...The progress bar in this gamified classroom reminds me to do more tasks.' Leaderboard is the game design element that is

mentioned most frequently by students. It helped students to track learning performance, get recognition from other students, and maintain learning motivation. As one student reported, ‘When my ranking in the leaderboard is lower, I’d like to make more efforts (such as listening to the teacher’s lecture more carefully) and catch up with others as fast as possible. When my ranking is higher, I feel very happy and have a sense of accomplishment.’

Most students perceived the gamified classroom as fun, enjoyable, and rewarding (i.e., emotional engagement). For instance, one respondent reported, ‘The gamified classroom made me feel like learning was not suffering. Rather, learning was fun in this classroom.’ Students perceived the positive feedback induced by game design elements as important contributors to their positive emotions towards learning materials and activities. For instance, one student stated, ‘It is a positive learning environment. We don’t get punished for wrong answers but obtain awards for our efforts. So we are not afraid to make mistakes.’ Another student reported, ‘When we submit our answers, we can immediately see whether our answers are correct or wrong. When we see the green tick, we feel extremely happy. Earning badges or levelling up are positive feedback to our learning.’ However, gamification is reported to cause a feeling of inferiority for lower-ranked students in the leaderboard. To illustrate, one student remarked, ‘Ranking lower in the leaderboard may lead to a feeling of inferiority. You might be immersed in such feelings for a while and are not motivated to climb up the leaderboard.’

Additionally, students also indicated how the gamification approach affected their cognitive engagement by motivating them to make every means to win, such as reviewing course content, seeking help from English teachers, and bringing dictionaries to the computer lab. As one student said, ‘We work for the higher ranking in the leaderboard. We make efforts to outperform others, such as listening to the lecture carefully and making notes.’ Additionally, gamification seemed to help students retain knowledge for a long term. For instance, one student said, ‘I remembered a knowledge point very clearly and for a long time when I or my good friends were awarded for it.’

The Difference of Themes Across Three Conditions

The qualitative results further indicated that the different arrangements of the leaderboard influenced students’ learning in different ways (see [Appendix C](#)). The eight interviewees in the competitive condition were all satisfied with the individual leaderboard. Although three out of eight students preferred to work in groups and have balanced grouping, when asked what type of leaderboard they preferred, all participants chose the individual leaderboard because they were concerned with the free-rider issue arising from the use of a team leaderboard. For instance, one student in the competitive condition suggested working with another student but he soon retracted this idea when he realized that pairing a higher achiever with a lower achiever would create problems, such as an over-reliance on the higher achiever.

In the cooperative condition, all eight interviewees preferred a combination of individual and team leaderboards: ‘adding a team leaderboard gives me a better chance to get awards.’ Although these students generally expressed their interest in the team leaderboard, two students did not know the name of their team and could not identify their team members. They suggested that the groupings would be of more interest if real situations were taken into consideration, such as students’ personalities, appearances, and hobbies, which would make them more curious about their team members.

In the collaborative condition, all four participants in one focus group mentioned the need to improve the leaderboard, with two reasons given. First, two students preferred an individual over a team leaderboard because they felt that their team members had dragged their rankings down. Second, two students preferred a combination of individual and team leaderboards because if their team was not ranked high, they would feel better if they had a high individual ranking. Team competitiveness was obvious in this condition, with students reporting that they were equally disappointed if their individual or team rankings were low. Another focus group did not express their viewpoints on this topic.

Students' Recommendations of Practice

Negative comments were also reported regarding unsatisfactory teamwork in collaborative gamification conditions. One negative comment reported reliance on leaders, blame among team members for incorrectly answered items, and free-riders. For instance, one top-achieving student in the collaborative condition complained, 'In my team, only me and another student discussed. The other two low-performing students waited for our results. They relied on me because I am the top student. They blamed me if I made mistakes, which made me nervous and sad. This teamwork influenced my perceptions towards gamification.' To avoid an overreliance on top achievers in the collaborative condition, one student suggested that the team leader should assign complementary roles to team members at the beginning of the course. He discussed how his team worked: 'Our team didn't have such a phenomenon perhaps because we assigned four interdependent roles to each other. One student took notes, including key knowledge points, incorrect items, and feedback [Notetaker]. The student who could type the fastest was assigned to inputting our answers into the computer [Typist]. The top-performing student made the final decision on our answers based on the discussion [Thinker]. I am outgoing so I was responsible for raising my hands to seek help from teachers and to answer teachers' questions [Speaker].'

Discussion

This study investigated the effects of three different types of gamification (i.e., competitive, cooperative, and collaborative) on EFL students' English reading performance and engagement. It moves beyond a simple comparison of gamification and non-gamification to provide a more nuanced understanding of how and under what circumstances gamification works or fails.

Foreign language learning can be challenging and stressful (Iaremenko, 2017). Across the three conditions, we found that gamification with a package of game design elements can create an engaging learning environment that fosters students' behavioural, emotional, and cognitive engagement. Regarding the behavioural engagement, students tend to actively participate in the activities in order to gain points, earn badges, advance levels, complete progress bars, and maintain their positions on the leaderboard. This finding is in line with the conclusion of Ding et al. (2018) and Chen et al. (2020) that the gamification approach increases students' participation rates in learning, such as making more contributions in online learning platforms. Regarding the emotional engagement, students felt more fun with the gamified activities and had positive emotions towards learning thanks to the positive feedback given to their efforts. For instance, the badges fulfil students' need for recognition and serve as a type of positive reinforcement. More specifically, students were given badges to acknowledge their efforts in completing tasks. As a result, the likelihood of such desired behaviour occurring again would increase (Bai et al., 2020). Additionally, gamification is also beneficial to foreign language acquisition (Rueckert et al., 2020) and cognitive efforts (Qiao et al., 2022). Students reported that they made every effort to win, such as looking words up in the dictionary, reviewing the course content, and seeking help from others. However, our qualitative data also showed that although the leaderboard was perceived as useful to track progress and get recognition from other students, it may also create a sense of inferiority if ranking lower in the leaderboard. Future studies may explore the ways to protect those low-ranked students.

For the differences across three types of gamification, our first important finding is that students in the competitive condition achieved significantly greater improvement in their reading performance on the three measures of morphological awareness, word reading, and reading comprehension than students in the cooperative condition. This finding appears to contradict Dindar et al. (2021), who found that cooperative gamification was as effective as competitive gamification for student learning. The contradictory results might be due to differences in the design of cooperative gamification. Unlike Dindar et al. (2021), which only included a team leaderboard displaying the sum of points earned by team members, we used both individual and team leaderboards. As mentioned above, our participants reported focusing more on their

individual ranking in the presence of both individual and team leaderboards. Given that some students admitted that they were not even aware of their team members or team name, there is a possibility that the participants had no sense of shared goals but only a sense of shared rewards. If students can easily obtain team rewards without making extra effort or when they are not expecting them, some students might reject gamification. We therefore conclude that having shared rewards without shared goals and collective effort might have a detrimental impact on student learning.

Our second important finding is that the students in the competitive condition performed significantly better in morphological awareness than their peers in the collaborative condition. Our result, which is consistent with Jagušt et al. (2018), challenges the prevalent belief in the positive impact of collaborative learning approaches. In regard to this unexpected finding, we make the same speculation as Jagušt et al. (2018)—that it relates to our team leaderboard not giving credit to the individual contributions made to collaborative efforts. Students are likely to feel demotivated if they do not gain recognition from others for their personal contributions to team performance. Additionally, as indicated in the focus groups, the students were upset when other team members dragged the team ranking down. The students reported that having an individual leaderboard would make them less bothered by the team ranking because they could focus on their individual ranking. Hence, we suggest that when introducing social elements into gamification, the design should provide recognition for individual contribution.

Another factor might be related to collaborative learning issues. In our design, collaboration was fostered among heterogeneous groups of higher and lower achievers. We expected that applying collaboration in this way would give students the benefits of playing the roles of both teachers and students, creating more explicit knowledge to aid generalisation and receiving support when necessary (ter Vrugte et al., 2015; Webb, 1982). However, our qualitative findings indicated that in some teams, the lower achievers tended to rely on the top achievers, with some free-riders who just waited for results. Social support between team members was not evident in such teams. Worse still, students might have been distracted by various collaborative issues, such as the free-rider problem. In contrast, students in competitive settings might have had more consistent concentration and focused their efforts on learning. Thus, we caution that having students working together in teams does not necessarily result in effective and meaningful collaboration (Kreijns et al., 2003). Rather, it is necessary to train students in collaboration techniques, such as accepting opposing viewpoints, negotiating, elaboration, and seeking and providing help.

Additionally, the competitive and collaborative approaches were found to facilitate word reading and reading comprehension to the same level. It is possible that effective collaborative gamification has an advantage for improving higher-order skills, such as word reading and reading comprehension. Word reading requires students to decompose the complex words into morphemes and arrive at the correct pronunciation. In reading comprehension, students need to read to identify questions and to locate, synthesise, and evaluate information (Leu et al., 2013). In the collaborative gamification condition, students have ample opportunities to do the challenging reading comprehension task and practice the reading of morphologically complex words with their team members rather than on their own. As suggested by ter Vrugte et al. (2015), the supportive network provided by collaboration might help to diminish students' frustration during deep-level processing. We echo their argument and suggest such interaction is key to their acquisition of such cognitively challenging skills.

Practical Implications

The design of collaborative gamification requires careful consideration to ensure that its beneficial effects are realised. In collaborative settings, it is important to give recognition for individual contributions, and practitioners may consider incorporating peer review or adding an individual leaderboard to rank the students' individual performance. Additionally, to mitigate possible dissatisfaction among students, instructors may consider ways to prevent free-rider and intra-group blame issues. Assigning students to distinct roles with well-defined responsibilities and rotating these roles after each challenge is one option

to discourage free-rider issues (Sankaranarayanan et al., 2020). Rather than simply providing a collaborative environment by asking students to tackle challenges in teams, collaboration training is necessary to inculcate the team cohesion, respect, and interaction underpinning the success of collaborative gamification.

In the cooperative setting, some students showed more competitive rather than cooperative learning attitudes and behaviour, as indicated by our qualitative data. To improve team relatedness in the presence of both individual and team leaderboards, instructors may consider (a) displaying the team members clearly in the system; (b) grouping students based on characteristics; (c) trying endogenous cooperation, in which the challenges of each team member are linked; or (d) giving students the autonomy to choose with whom they cooperate (Buchinger & Hounsell, 2018).

Conclusion, Limitations, and Future Work

This study examined the effects of competitive, cooperative, and collaborative gamification on English reading performance and learning engagement among EFL secondary school students. The results showed that competitive gamification produced a significantly higher improvement in student reading outcomes than cooperative and collaborative conditions. Cooperative gamification yielded the lowest performance in reading outcomes. Our results challenge the common belief of the effectiveness of collaborative or cooperative learning and suggest that the use of social gamification is quite complex because of a number of factors that should be considered, such as incorporating shared goals alongside shared rewards, grouping learners effectively, gamification system design, and the nature of team cohesion and interactions. This study lays the groundwork for the future design of and research into cooperative and collaborative gamification.

Our study has some limitations that present interesting avenues for further investigation. First, culture might influence the findings. Our participants worked well in competitive settings, but their collaborative skills were not nurtured in their normal classroom. This cultural factor may apply to Chinese students in other regions. Researchers should replicate this study with students from other cultures that emphasise the importance of collaborative learning. Second, factors that were not explored in this study may influence the effectiveness of different types of gamification, including personal factors (e.g., personality, learning styles), contextual factors (e.g., social norms), and technology acceptance factors (e.g., subjective perceptions towards collaborative learning/gamification). Future studies can explore whether these factors moderate the effects of gamification. Third, it is possible that competition produces better student learning results by increasing effort and concentration, whereas collaboration has a greater impact on soft skills. However, our study was unable to verify this assumption because the soft skills that social gamification targets were not assessed. Future studies could assess these different kinds of skills. Fourth, the cooperative gamification in our study refers to students' individual scores summed up to compete with other teams. We found splitting a task into discrete parts and assigning each team member to work on a single part is difficult to realize in our context using computers. Future studies may consider perfecting our cooperative gamification design and, in turn, realize a more successful division of labour through online activities.

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Appendix A. An Overview of Reading Activities Across Three Conditions (Savage et al., 2023)

Phases	Activities
Word sorting	Listening to a list of derived words and sorting them into different categories based on affixes.
Direct instruction	Direct instruction on morphological knowledge, including the form, pronunciation, and meaning of affixes as well as the grammatical function of suffixes.
Word mapping	Decomposing morphologically complex words into components (i.e., the root and the affix). Working out the meaning of the whole word through working out and combining the meaning of smaller pieces.
Counterexamples	Generate conversation about irregular words that have the same letters as an affix but are not that affix (e.g., does <i>university</i> contain the prefix -un?).
Word building	Building words with smaller pieces and determining whether the created word is a non-word or not.
Reading comprehension	Read a passage with a high intensity of taught affixes and guess the meaning of these words. Do the multiple-choice comprehension questions.

Appendix B. Student Common Perceptions of Gamified Learning Experiences Across Three Conditions

Themes	Sub-themes	Example of quotation
Behavioural engagement	Feeling motivated to participate in activities due to game design elements, such as points, levels, badges, progress bar, and leaderboard	<p>“我为了拿徽章很努力地去学习。徽章很漂亮，很吸引我。”</p> <p>“I study harder to earn badges. The badges are beautiful. It’s attractive to me.”</p> <p>”我经常玩游戏所以我很熟悉游戏机制。在游戏化课堂里，只要每完成一项任务就会给我们发经验。而进度条提醒我完成更多的任务，这样经验就高，就可以领奖励，学习自然就进步了”</p> <p>“I always play games so I am familiar with game mechanics. In this gamified course, as you complete a task, the system will assign you points. The progress bar reminds me to do more tasks, so that I can have more points and obtain awards. In this way, I can learn better naturally.”</p> <p>“当我在排行榜上的排名降低的时候，我就想赶快努力，赶快追上其他人，所以我就会认真听讲。当我的排名提高的时候，我就很开心，有一种成就感。”</p> <p>“When my ranking in the leaderboard is lower, I’d like to make more efforts (such as listening to the teacher’s lecture more carefully) and catch up with others as fast as possible. When my ranking is higher, I feel very happy and have a sense of accomplishment.”</p>
Emotional engagement	Positive emotions due to positive feedback	<p>“这堂课的氛围很积极。我们不会因为答错问题而受惩罚。相反，我们会因为努力而获得奖励。所以在这堂课里我们不怕犯错。”</p> <p>“It is a positive learning environment. We don’t get punished for wrong answers but obtain awards for our efforts. So we are not afraid to make mistakes.”</p> <p>“当我们提交答案的时候，我们可以立即看到是否答对了。当我们看到绿色的勾勾，我们超级开心。获得徽章或者升级对我们都是积极的反馈。”</p> <p>“When we submit our answers, we can immediately see whether our answers are correct or wrong. When we see the green tick, we feel extremely happy. Earning badges or levelling up are positive feedback to our learning.”</p>

	A feeling of inferiority for lower-ranked students	“在排行榜上如果排名靠下会让我产生一种自卑感。有一段时间可能会沉浸在这种自卑感中，不想再继续努力攀爬上去。”
		“Ranking lower in the leaderboard may lead to a feeling of inferiority. You might be immersed in such feelings for a while and are not motivated to climb up the leaderboard.”
Cognitive engagement	Making efforts to win (e.g., review the course content, seek help from their English teachers, and bring a dictionary to the computer lab)	“为了在排行榜上能上升一些名次，我们会做各种努力，比如认真听讲，做笔记。”
		“We work for the higher ranking in the leaderboard. We make efforts to outperform others, such as listening to the lecture carefully and making notes.”
	Knowledge retention	“当我或者我的朋友因为一个知识点得到奖励的时候，我记这个知识点就记得特别清楚特别久。”
		“I remembered a knowledge point very clearly and for a long time when I or my good friends were awarded for it.”

Appendix C. Student Perceptions of Using the Leaderboard Across Three Conditions

Conditions	Themes	Example of quotation
Competitive condition	Prefer to have an individual leaderboard ($n = 8$)	<p>“我倾向于选择个人排行榜。如果一个成绩好的和一个成绩不好的同学搭配，那成绩不好的会拖累成绩好的同学的排名。”</p> <p>“I prefer to have an individual leaderboard. If a top-achieving student matches with a low-achieving student, the low-achieving student may drag the ranking.”</p>
	Prefer to work in groups and have balanced grouping ($n = 3$)	<p>“我喜欢合作式学习。两个同学在一台电脑前学习。我们可以互帮互助，知识一结合就能创造满分答案。”</p> <p>“I like collaborative learning. Two students work in front of one computer. We can help each other. The knowledge combined can create full marks.”</p>
Cooperative condition	Prefer a combination of individual and team leaderboards ($n = 8$)	<p>“有一个团队排行榜可以提高我获得奖励的机会。”</p> <p>“Adding a team leaderboard gives me a better chance to get awards.”</p>
	Not familiar with their team members and team name ($n = 2$)	<p>“我和 A 同学一样，我不太会操作电脑，所以我找不到我的组名是什么。”</p> <p>“I don't know how to operate a computer, as student A, so I don't know my team's name.”</p>
Collaborative condition	Prefer an individual over a team leaderboard ($n = 2$)	<p>“我最喜欢个人排行榜，因为团队会出现一些分歧。”</p> <p>“I like the individual leaderboard the best because of the conflicts in teams.”</p>
	Prefer a combination of individual and team leaderboards ($n = 2$)	<p>“我认为最好把个人和团队得分分开展示。比如我的团队名次降低，我就感觉很不好受。但如果有个人排行榜，它能展示我的个人排名还不错，我就会感觉良好。”</p> <p>“I think it's better to separate the individual and team scores. For example, when our team ranking in the leaderboard is getting lower, I feel bad. However, if there is an individual leaderboard and shows my ranking is good, I would feel better.”</p>