

## Article

# Impact Study of the Learning Effects and Motivation of Competitive Modes in Gamified Learning

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**Abstract:** At a time when game-based learning has become a research hotspot, this study focused on the competition mechanism in gamified learning, aiming to explore the impact of different competition modes on students' vocabulary learning effect and learning motivation. A group of 79 sixth grade students from China were randomly assigned to a non-competitive class, an individual competition class, and an inter-group competition class. The experiment was conducted in an English vocabulary course, and the game competition was carried out using the Quizlet Live game platform. The results indicated that: (1) the vocabulary learning effect and motivation of students in the competitive classes (individual competition and inter-group competition) were better than those in the non-competitive class; (2) the learning effect of students in the inter-group competitive class outperformed that of the individual competitive class, but there was no significant difference in learning motivation. Through the qualitative analysis of the students' interviews, it was found that the results of inter-group competition may be related to the student's perception of learning and emotional support. The findings of this study can provide relevant support for the subsequent game-based learning design.

**Keywords:** competition; digital game-based learning; English vocabulary acquisition; learning motivation



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## 1. Introduction

English has become the most important international language, and a growing number of people have begun to learn it. As the basis of the English language, vocabulary plays an important role in listening, speaking, reading, and writing [1]. Laufer and Sim (1985) believed that vocabulary learning was the most urgent learning focus for foreign language learners, as a lack of vocabulary is one of the main reasons for the failure of communication [2]. Therefore, the mastery of vocabulary plays a vital role in improving English language skills. Digital game-based learning (DGBL) has been widely used in foreign language learning [3], and its positive learning effect has been confirmed by many relevant studies [4–6]. Digital game-based learning has obvious advantages in terms of providing learners with an interactive learning environment, immersive learning experience, and reduced learning anxiety [7,8].

Scholars studying game-based learning suggest paying attention to some unique game elements and game design features in GBL and their impact on students' learning [9–12]. As an important element in games, competition cannot be ignored. Past studies have shown that competition can stimulate learners' interest, improve their participation, and enhance their learning motivation through challenges, rewards, and competing for ranking [13–15]. However, there are also studies pointing to the fact that competition can cause intense tension and frustration among lower-level students; therefore, competition is a controversial issue [16]. Only competition with appropriate learning strategies can make students achieve good learning results. Some scholars have pointed out that group cooperative learning can promote interaction between students and improve their academic performance [17,18]. Group cooperation provides opportunities for students, enabling them to

build self-confidence and develop intrinsic motivation, and creates a positive learning atmosphere [19]. In addition, cooperative learning can promote the development of students' cognitive, emotional, and social skills [20]. Considering the potential of integrated competition and group cooperation strategies in learning and the lack of relevant research, this study conducted empirical research which integrated the competitive attribute of gamification into an English vocabulary learning curriculum, and designed a competition mode of intra-group cooperation and inter group competition. The purpose was to explore whether the competitive factors in game learning would affect students' English vocabulary learning effect and motivation, and what kind of influence it would have on students' learning effect and motivation in the inter-group competition mode, so as to find conditions for the positive effect of competition and provide suggestions for game-based learning.

Based on the above description, the main problems discussed in this study are as follows:

- (1) Will the competition mechanism in game-based learning affect students' English vocabulary learning effect and motivation?
- (2) In game-based learning, compared with individual competition, will the inter-group competition mode have more effective impact on students' English vocabulary learning effect and motivation?

## 2. Literature Review

Differing from serious games, Digital game-based learning (DGBL) refers to the combination of digital games and learning content, using elements containing game design to attract players, promoting learning through playing, and creating an interesting learning environment [21]. It is more about using game design elements in non-game environments to let people complete tasks, rather than a complete game program [22] (p.10). In DGBL, storyline, challenge, competition, role play, goals, feedback, and social contact are the basic elements, among which competition is an effective way to encourage players to make progress and succeed in the game [23].

Competition in a game is described as being "goal oriented and aimed at achieving one's own goals, although this may have a negative impact on other competitors" [24] (p. 5). In the past, empirical studies have examined the impact of competition on learning and motivation. Some studies have shown that there is a positive relationship between competition and students' learning motivation in DGBL. Students tend to make efforts to achieve better results in a competitive learning environment [13,25]. Competition can also produce positive results by increasing students' engagement, enhancing students' achievement and facilitating their creativity [26]. In a recent meta-analysis on competition, it was found that competition has a significant main effect on learning results by estimating the robust variance of 25 studies over a period of 10 years [27]. However, some scholars came to the opposite conclusion that competition has no effect on learning outcomes and motivation [28,29]. Some scholars even believe that the improper use of competition in games may have a negative impact on students. Due to the different learning experience of winners and losers in competitive games, students may feel anxiety and inferior when they fail in the game [30]. In addition, some researchers believe that although the competition can improve the academic performance of some students, for those students with poor learning ability, this competition may not be conducive to the establishment of their self-confidence [31]. Recently, Acquah and Katz (2020) found in a meta-analysis of DGBL that competition may distract learners and reduce their motivation and fun [32].

Considering that competition may be a double-edged sword [33], it is controversial because it can bring students negative emotions such as anxiety and a reduction in self-confidence. We should therefore make efforts to consider how to eliminate its negative effects.

Firstly, in previous studies, scholars have found that when students manage team cooperation through interaction, it can effectively help release their anxiety and establish a sense of support [34]. Later, researchers have verified through models that intra-group interaction in collaborative learning has a significant positive impact on students' emotional support [35]. Furthermore, students' active emotional interaction participation is directly

related to their academic achievements [36]. Through group emotional interaction, students have positive effects on learning participation and learning performance. Therefore, we consider strengthening group interaction in competition to enable students to obtain emotional support, so as to reduce anxiety. Secondly, some studies have shown that both cooperation and competition seem to have a strong incentive effect on students [37], and even the presence of both can have additional effects. For example, Chen et al. (2018) studied how different game designs affect learning outcomes. In a science class, they assigned 110 participants to four classes, respectively, individual competition, individual non-competition, peer competition, and peer non-competition, to learn knowledge of the motion of objects. The final results showed that the peer group (competitive and non-competitive classes) performed better than the individual group in conceptual knowledge; in particular, the peer competition group had higher interest and lower tension [38]. In this result, we can see that peer learning will achieve better results than individual learning, and especially in the competitive environment students will have a better experience. In addition, Hung, Young, and Lin (2015) considered how to improve the English proficiency and reduce the achievement gap of disadvantaged students [39]. They constructed a collaborative and competitive game-based learning environment, and put it into formal English teaching. The results showed that in the game-based learning environment based on intra-group cooperation and inter-group competition, students' performance significantly improved, and there was better interaction between students at different levels. This innovative method may have the potential to narrow the performance gap of poor students. Finally, there is literature which supports that inter-group competition can promote students' intra-group cooperation. Majoro (2017) observed in an experiment with 120 children that when each group of four children was competing against other groups, the cooperation within the groups was stronger than that in the control group [40].

Based on the above three considerations, we created a learning environment of intra-group cooperation and inter-group competition, to study whether the competition mode of intra-group cooperation and inter-group competition can bring new opportunities for game-based learning. Therefore, in addition to studying the effect of the competition mechanism, in this study, we also divided the competition mode into individual competition and group competition. Compared with individual competition, group competition includes intra-group cooperation and inter-group competition, which involves collaborative learning, communication, and peer help in the team. This study examined whether competition could play a positive role in language learning, and whether the cooperative competition model has a more significant effect.

### 3. Research Design

#### 3.1. Participants

The participants of this study were recruited from a primary school in Ouhai District, Wenzhou, with a total of 79 sixth grade graduates, aged about 11–13 years old. In this study, they were randomly assigned to a non-competitive class ( $N = 26$ , 19 boys and 7 girls), an individual competitive class ( $N = 27$ , 18 boys and 9 girls), and an inter-group competition class ( $N = 26$ , 15 boys, 11 girls).

In order to ensure that the overall level of each class was basically the same and there was no significant difference in students' English scores between classes, we conducted a single factor independent sample analysis on the latest English test scores of all students. According to the analysis results, there was no significant difference in English scores among the three classes,  $F(2,76) = 0.15$ ,  $p = 0.862$ ,  $\eta^2 = 0.004$ , and so subsequent experiments could be carried out.

#### 3.2. Quizlet Live: Game-Based Vocabulary Learning Platform

This experiment was conducted using a typical competitive design—ranking list [41]. The card English learning tool Quizlet (<https://quizlet.com>) was used as the learning platform. Quizlet, the product of American Online Education Technology Innovation

Company, is a working vocabulary learning tool. Studies have shown that Quizlet learners perform better in terms of vocabulary growth than non-Quizlet participants [42].

The game activities in this experiment mainly made use of the online game competition mode of the platform: the Quizlet Live games function. The purpose of this feature is to allow students to participate in interesting and competitive vocabulary test games in the form of individuals or teams, help students strengthen the vocabulary and concepts they learn in the classroom, and realize classroom interaction, so as to test the learning effect of students. After the teacher chooses to create the game in either individual or group form, the platform will generate a QR code and invitation code, and students can join the game in either way. In the game, the progress bar for selecting the correct answer will increase, while it will return to the starting point and start again if a wrong answer is selected. All students participating in the game can see the real-time situation of the leaderboard, as shown in Figure 1. In the individual competition game mode, all students compete with each other, and only the fastest student with all the correct answers can win the competition. In the group competition game mode, the system randomly groups all students who participate in the game. There is a cooperative relationship between the group members and a competitive relationship between the groups. Each member of the group will be assigned the same word, but the correct answer will only be randomly assigned to the screen of one member of the group. Students need to pay close attention to observe whether the correct answer will appear on their screen. Students who are likely to be assigned the correct answer do not know what the correct answer is, so it requires teamwork to help choose answers. The distribution of word answers may be different each time, and everyone in the group must be fully involved in order to finish as quickly as possible and win.

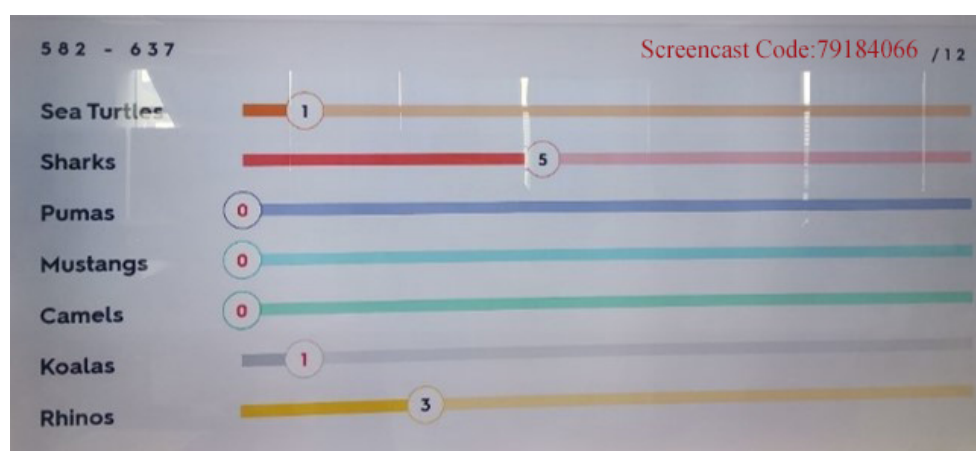
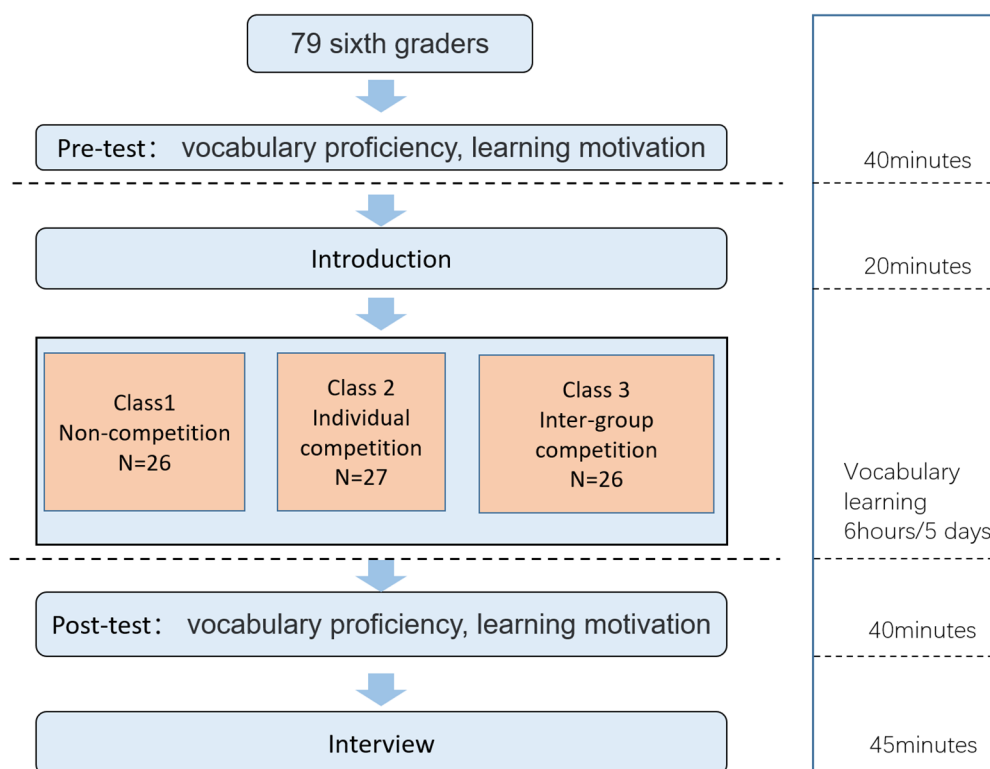


Figure 1. Quizlet Live Game leaderboard interface.

### 3.3. Study Procedure

The overall process of this experiment is shown in Figure 2 below. A total of 79 students were randomly assigned to three classes. Class 1 played the non-competitive game, class 2 played the individual competitive game, and class 3 played the inter-group competitive game. Before the teaching activities, all the students took an English vocabulary proficiency test and completed a questionnaire on learning motivation. We allocated computers to the class 1 and class 2 students. In order to make it easier for the students of class 3 to cooperate and communicate, each of them was assigned an iPad (because Quizlet supports both computer and tablet terminals). After that, a 5-day English vocabulary summer camp was held, during which the study time was 6 h a day, with 30 min of English vocabulary play time four times a day.



**Figure 2.** Experimental process.

In teaching, the three classes conducted experiments in accordance with the teaching links of introduction, autonomous learning, practice consolidation, interaction, and game. In the introduction link, each class adopted the same way. The teacher explained to the students the words to be learned in this class and the methods to help them learn and remember words. Then the students conducted self-study of the words in this class on the Quizlet platform and consolidated them by using the stand-alone review mode. In the interactive and game links (see Figure 3), non-competitive class 1 took the form of students' questions, let each student choose 20 words from the vocabulary they had learned as a test. Then the teacher collected the questions and gave them to each student randomly. After finishing, the students at the same table corrected each other's answers. Class 2 played an individual competitive game on Quizlet. At the beginning, the teacher gave the students time to review the vocabulary, then all the students joined in the game. Once one of the students successfully reached the point of progress, the game ended and the winning student got a star sticker from the teacher. After a short rest, the teacher started the personal competitive game again, and in this way, the students played about three rounds of games. In an inter-group competitive mode, every time the students of class 3 entered the game, they were randomly divided into four groups by the system. They played an intra-group cooperation and inter-group competition game based on the Quizlet platform. Similar to Class 2, the game was over when one group successfully reached the key point of the progress bar, and the winning group got a star sticker from the teacher. The difference is that group members needed to cooperate and communicate with each other in order to win the game.





**Figure 3.** Interactive and game sessions for the three classes.

### 3.4. Instruments

#### 3.4.1. Vocabulary Proficiency Test

The test paper design of students' vocabulary level refers to the vocabulary knowledge scale of Wesche and Paribakhr (1996) [43]. The test paper can measure the depth and breadth of students' English vocabulary. In the depth of vocabulary mastery, it is designed into four levels: A: I don't remember seeing this word before; B: I've seen this word before, but I don't know its meaning; C I've seen this word before. It means\_\_; D I know many meanings of this word\_\_. The total score of the vocabulary test paper is vocabulary breadth. The vocabulary of the test questions in this study came from the key vocabulary in the teaching materials from primary school to senior one. The pre-test paper and post-test paper each contained 60 words, which were extracted from the four stages of primary school, junior one, junior two, junior three, and senior one, respectively, with 15, 20, 15, and 10 words. In the test paper, option A is 0.5 points, B is 1 point, C is 1.5 points, but a wrong answer is 1 point, D is 2 points for acquiring more than two correct answers, 1.5 points for acquiring one wrong answer, and 1 point for acquiring all wrong answers. The total score is 120 points. Before the experiment, the reliability of the pre-test and post-test vocabulary level test was analyzed. The results showed that the Cronbach's alpha of the pre-test and post-test vocabulary level test was 0.994.

#### 3.4.2. Learning Motivation

The learning motivation measure was developed by Wang and Chen (2010) based on the measure proposed by Pintrich, Smith, Garcia, and McKeachie (1991) [44,45]. The reason for choosing this questionnaire is that we found it widely accepted by many researchers [46,47]. This questionnaire contains six items. The first three items measure students' intrinsic motivation, such as "In this course, I prefer challenging textbooks because I can learn new things." The last three items measure students' extrinsic motivation, such as "Getting good grades in this course is the most satisfying thing for me." The whole questionnaire is scored with a 5-point Likert scale (1 = strongly disagree, 2 = Disagree, 3 = uncertain, 4 = Agree, 5 = strongly agree). The Cronbach's alpha of the questionnaire is 0.76.

#### 3.4.3. Interview

The interview outline is revised with reference to the interview content of Hwang (2009) [48], including seven questions. The purpose of the interview was to understand students' feelings and gains in this course, understand the advantages and disadvantages of the teaching methods from the perspective of the students, so as to provide a reference for future research and improvement.

## 4. Results

### 4.1. English Vocabulary Learning Effect

#### 4.1.1. The Influence of the Competition Mechanism on Students' English Vocabulary Learning Effect

In order to study the influence of non-competition and competition on learning effect, the data of class 1 were used as the control group data of non-competition mode, and the data of class 2 and class 3 were used as the experimental group data of competition mode.

As seen in Table 1, descriptive statistics and statistical analyses were provided. The means and standard deviations of the vocabulary proficiency pre-test showed no statistical difference between groups,  $F(2,76) = 2.44$ ,  $p = 0.094$ ,  $\eta^2 = 0.060$ . A single factor independent sample ANCOVA was used to analyze the vocabulary proficiency post-test. The ANCOVA results indicated that competitive function has a positive impact on students' English vocabulary learning effect,  $F(2,75) = 4.91$ ,  $p = 0.010$ ,  $\eta^2 = 0.116$ . The average values of non-competitive class 1 and competitive classes 2 and 3 are: class 1 ( $M = 76.73$ ,  $SD = 8.46$ ), class 2 ( $M = 77.70$ ,  $SD = 11.81$ ), and class 3 ( $M = 80.46$ ,  $SD = 9.54$ ); the post-test scores of competitive classes 2 and 3 are higher than those of non-competitive class 1.

**Table 1.** Descriptive statistics and results of ANCOVA on student's learning effect pre- test and post-test.

Source	Mean	SD	df	F	p	$\eta_p^2$
Pre-test						
Class 1	70.12	7.23	2	2.44	0.094	0.060
Class 2	69.28	8.81				
Class 3	65.10	10.12				
Post-test						
Class 1	76.73	8.46	2	4.91	0.010 *	0.116
Class 2	77.70	11.81				
Class 3	80.46	9.54				

Note: \*  $p < 0.05$ .

#### 4.1.2. The Influence of Different Competition Modes on Students' English Vocabulary Learning Effect

In order to explore the impact of different competition modes on students' English vocabulary learning effect, the results of English vocabulary of class 2 in individual competition mode and class 3 in inter-group competition were compared.

We ran single factor independent sample ANCOVA analysis to examine the influence of prior knowledge as well as the two competition modes for learning effect. Without violating the assumption of regression homogeneity in covariance analysis ( $p = 0.640 > 0.05$ ), the analysis results are shown in Table 2,  $F(1,50) = 4.86$ ,  $p = 0.032$ ,  $\eta^2 = 0.089$ . The results indicate that there were significant differences in the effects of different competition modes on students' English vocabulary learning effect. The adjusted average values of individual competitive 2 class and inter-group competitive 3 class are, respectively: class 2 ( $M = 77.70$ ,  $SD = 11.81$ ) and class 3 ( $M = 80.46$ ,  $SD = 9.54$ ). As can be seen, the post-test scores of both classes improved, but the value of class 3 was significantly higher than that of class 2. It can be seen that there were significant differences between the individual competition mode and the inter-group competition mode in students' English vocabulary learning effect. Inter-group competition can better improve students' English vocabulary performance, and the effect is above medium ( $0.058 \leq \eta^2 < 0.138$ ).

**Table 2.** ANCOVA analysis of the learning effect post-test for individual competition and inter-group competition.

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected model	2070.159 <sup>a</sup>	2	1035.080	13.177	0.000
Intercept	1218.989	1	1218.989	15.518	0.000
Pre-test	1969.420	1	1969.420	25.071	0.000
Class	381.516	1	381.516	4.86	0.032 <sup>*</sup>
Error	3927.671	50	78.553		
Total	337,245.000	53			
Corrected total	337,245.00	52			

Note: Dependent variable: post-test. <sup>a</sup>  $R^2 = 0.345$  (adjusted  $R^2 = 0.319$ ). \*  $p < 0.05$ .

#### 4.2. Learning Motivation

##### 4.2.1. The Influence of the Competition Mechanism on Students' Learning Motivation

Similarly, class 1 was taken as the control group and classes 2 and 3 as the experimental group. According to the descriptive statistics and statistical analyses in Table 3, it was found that there was no significant difference in the pre-tests of the two groups,  $F(2,69) = 0.302$ ,  $p = 0.740$ ,  $\eta^2 = 0.009$ . Using single factor independent sample ANCOVA to analyze the post-test of students' motivation,  $F(2,67) = 16.93$ ,  $p = 0.000$ ,  $\eta^2 = 0.336$ , the results show that the competitive mechanism had a significant impact on students' learning motivation. The values of non-competitive class 1 and competitive classes 2 and 3 are: class 1 ( $M = 3.14$ ,  $SD = 0.56$ ), class 2 ( $M = 3.83$ ,  $SD = 0.78$ ), and class 3 ( $M = 4.09$ ,  $SD = 0.65$ ). Class 2 and class 3 had higher learning motivation than class 1.

**Table 3.** Descriptive statistics and results of ANCOVA on students' learning motivation pre-test and post-test.

Source	Mean	SD	df	F	p	$\eta_p^2$
Pre-test						
Class 1	3.99	0.451	2	0.302	0.740	0.009
Class 2	3.87	0.658				
Class 3	3.98	0.576				
Post-test						
Class 1	3.14	0.56	2	16.93	0.000 ***	0.336
Class 2	3.83	0.78				
Class 3	4.09	0.65				

Note: \*\*\*  $p < 0.001$ .

##### 4.2.2. The Influence of Different Competition Modes on Students' Learning Motivation

In order to explore the impact of different competition modes on students' learning motivation, the results of learning motivation of class 2 in individual competition mode and class 3 in inter-group competition mode were compared.

The single factor independent sample ANCOVA was used to analyze the post-test of students' learning motivation. Without violating the assumption of regression homogeneity in covariance analysis ( $p = 0.236 > 0.05$ ), the analysis results are shown in Table 4,  $F(1,43) = 0.85$ ,  $p = 0.362$ ,  $\eta^2 = 0.019$ . The results show that there was no significant difference in the learning motivation of the individual competition class and the inter-group competition class. The adjusted average values of class 2 and 3 are: class 2 ( $M = 3.83$ ,  $SD = 0.78$ ) and class 3 ( $M = 4.10$ ,  $SD = 0.65$ ). It can be seen that the learning motivation of Class 3 with inter-group competition mode is slightly higher than that of Class 2 with individual competition mode, but there was no statistical difference. In the experiment, although there is no significant difference in the improvement of learning motivation of



individual competition mode and inter-group competition mode, inter-group competition can promote students' learning motivation to a certain extent.

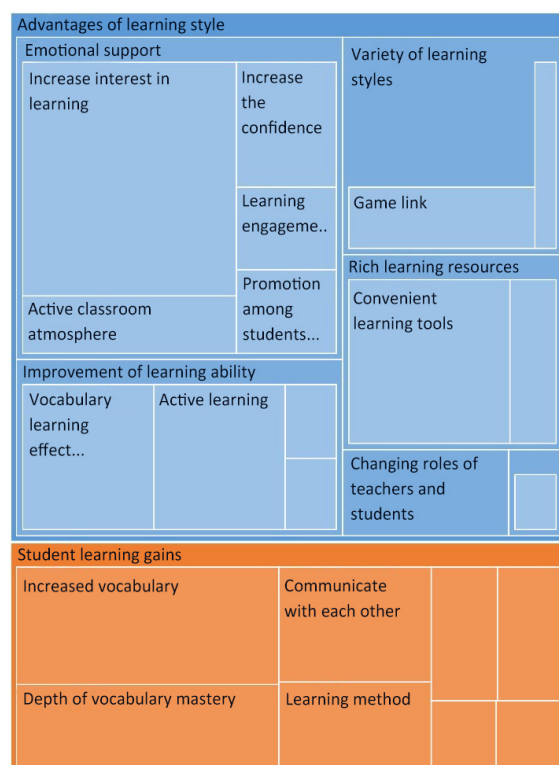
**Table 4.** ANCOVA analysis of the learning motivation post-test for individual competition and inter-group competition.

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected model	6.681 <sup>a</sup>	2	3.341	8.384	0.001
Intercept	2.627	1	2.627	6.592	0.014
Pre-test	5.878	1	5.878	14.752	0.000
Class	0.339	1	0.339	0.850	0.362
Error	17.133	43	0.398		
Total	742.583	46			
Corrected total	23.815	45			

Note: Dependent variable: post-test. <sup>a</sup>  $R^2 = 0.281$ (adjusted  $R^2 = 0.247$ ).

#### 4.3. Interview Results

In order to explore students' learning experience and feelings in the game-based learning environment of English vocabulary supported by competitive design, and to deeply understand the reasons behind the results of this experiment, five students were randomly selected from class 2 and eight students from class 3 for face-to-face interviews after the experiment. Based on grounded theory, the NVIVO 12.0 qualitative analysis software was used to process and analyze the data collected from the interviews. According to the analysis results, the experimenters summarized and obtained two primary nodes, that is, the advantages of learning style and students' learning harvest constitute the macro factors affecting the research. The comparison of reference points of these two first-level nodes written according to word codes is shown in Figure 4.



**Figure 4.** Compiled reference points comparison chart according to word code.

It can be seen from the orange area of the above figure that students' learning gains are mainly reflected in the increase of vocabulary, vocabulary depth, and learning methods. In the interview, 31.58% of the students mentioned that the way of competition improved the effect of vocabulary learning, made their memory stronger, and they knew multiple definitions of words, especially the vocabulary that led to their game failure made them remember more deeply. At the same time, in the competition, students needed to pay attention, devote themselves to the competition, and their brains had to operate flexibly, which is very important for consolidating the knowledge learned. Some students said that they were more willing to take the initiative to learn in such an environment, which improves their self-study ability and self-discipline ability, because competition has become their driving force. In order to win the competition, students had to work harder to memorize words, and checking their learning effect in the form of competition instead of teacher feedback made them feel more relaxed.

At the same time, in order to understand the reasons for the impact of inter-group competition, the interview responses of students in Class 3 were extracted and summarized, and the advantages of the inter-group competition mode for students' learning were obtained, as shown in Table 5. In addition to the learning gain and improvement of learning ability brought by competition, the advantages of inter-group competition are as follows: their study pressure was reduced, their weak vocabulary memory was deepened, there was a strong classroom atmosphere and high student participation, their communication was strengthened, and they were able to obtain emotional support which can also be found in the blue area of the text encoding in Figure 4. First of all, the form of inter-group competition involved intra-group cooperation so that everyone shared the pressure equally, thus making the study easier. In addition, when students made mistakes in the competition, the members of the group would correct them and explain, so as to deepen their memory of the words. Secondly, the inter-group competition brought students a strong immersion learning experience. The way of combining study and play made students actively participate in the study, and the pleasant learning atmosphere enlivened the classroom atmosphere. Finally, it is worth noting that intra-group cooperation provided emotional support for the students. Some students mentioned that this way is conducive to students' experience the feeling of being supported. The encouragement brought by peers makes them more confident in learning. Especially for students with poor performance, this form of learning can reduce their frustration.

**Table 5.** Summary of the advantages of inter-group competition.

The Core Node	Free Node Name	Content, for Example
Study pressure reduced, weak vocabulary memory deepened	Vocabulary memory is easier and stronger	"I'll remember it better, so I will remember the words in a more relaxed way"
	Clearly recognize and remember what went wrong	"Knowing where I went wrong so I won't be wrong again"
Strong classroom atmosphere and high student participation	Strong immersion and happy learning	"The class is more interesting than before, which increases the interest and makes me feel I am involved in it"
	Combine learning and rest, improve learning interest	"Games, competitions, and learning together will make the class lively and interesting, and can liven up the atmosphere of the class"
Strengthen communication and obtain emotional support	Promote communication and cooperation among students	"It can promote mutual communication among students"

## 5. Discussion

This study explored the impact of the competition mechanism and inter-group competition mode on students' learning effect and learning motivation in an English vocabulary game-based learning environment. For research question (1), this study found that: In game-based learning, the competition mechanism had a positive impact on students' learning effect and learning motivation. Students in the competitive design class had better English vocabulary learning effect and higher learning motivation than students in the non-competitive class. For research question (2), this study found that students in the competition environment, intra-group cooperation and inter-group competition class had better learning effects than students in the individual competitive class, but there was no significant difference in learning motivation. This shows that in the English vocabulary game-based learning environment, the intra-group cooperation and inter-group competition mode can have a more positive impact on students' learning effect.

In the competitive environment, no matter whether students were in the individual competition or the inter-group competition, students could see the progress bar of the game in real time, that is, they could watch their own or their group's ranking. The competitive environment of this real-time ranking is an important factor to stimulate students' desire to learn and actively participate, because challenges are related to students' intrinsic motivation [49]. From the interview results, we can know that in order to win the competition, they promoted their self-learning ability and self-discipline ability, and stay focused during the competition. The existence of this motivation and high learning investment are important factors to promote students' learning effect. At the same time, the words that lead to the failure of the competition have become their memory points, which is also an important reason to improve students' vocabulary memory. In a word, from the results of this experiment, we can confirm that the competition mechanism in DGBL has a positive impact on learning effect and motivation, which is consistent with previous research [27]. The unique attribute of victory and failure of competition can promote students to obtain better grades and improve students' learning motivation.

As for the results of inter-group competition, we found that this is related to students' good learning perception of the learning environment of intra-group cooperation and inter-group competition and emotional support. First of all, compared with individual competition, in the form of group cooperation, everyone shares the learning pressure equally, and the members of the group will carry out communication and mutual assistance in order to win. This leads them to think of learning as a leisure activity rather than a job. As Shuell and Farber have studied, students' perception of the learning environment has an impact on their learning [50]. Secondly, low learning anxiety and good group interaction bring students a sense of supported. The atmosphere of trust is conducive to the development of group belonging, and especially for students with weak learning level, this emotional support reduces their frustration, and is conducive to their participation and learning outcomes [34]. Thirdly, Due to the existence of inter-group competition, the psychology of not wanting to burden group members will bring psychological pressure to students, but the emotional support obtained in group cooperation can help students adjust the relationship between their own pressure and the group's goals. This suggests that such intra-group emotional support is beneficial to the achievement of group goals, which also supports the previous research that there is a positive and significant relationship between emotional support in the group and the efficiency of cooperative learning (Hernández-Sellés et al., 2019) [35]. Unfortunately, this study did not find a significant difference in learning motivation between inter-group competition and individual competition. This may be due to the simple functional design of inter-group competition mode and individual competition mode in this experiment, which may affect students' interest in games. An interesting conclusion can be drawn by comparing class 1 without competition, class 2 with individual competition, and class 3 with inter-group competition. Although the competition mechanism in games can improve students' learning effect, different competition modes

have different impacts on improving students' learning effect. Compared with individual competition, inter-group competition was more effective in terms of improving grades.

## 6. Conclusions and Limitations

Our research confirms that competition, as an important mechanism in the game, has a positive impact on students' learning effect and learning motivation. The inter-group competition mode integrating intra-group cooperation and inter-group competition had a more obvious positive influence on students' learning effect, but there was no difference in motivation. In short, from this experiment, we can see that the students in the competitive classes showed obvious learning enthusiasm, could actively participate in the game, and their vocabulary level improved. In particular, the inter-group competitive game enabled students to communicate, interact, and generate good learning perception, obtain emotional support. Completing the game through team cooperation is a more effective way to promote students' English vocabulary level. Therefore, we suggest that in English language teaching, in order to improve students' participation in class, mobilize their learning interest, and stimulate their learning motivation, teachers can consider appropriately adding competition in educational games, because the attractive and stimulating learning environment has a positive impact on student's active learning. At the same time, in order to maximize the promotion of students' access to knowledge and to achieve the best learning effect, in the competitive game, teachers can encourage students to take the form of group cooperative learning for inter-group competition, and encourage students to have high-quality interaction and mutual positive encouragement and support in cooperative learning.

However, there are still some areas to be improved in this study. Firstly, the research sample is small and that it is not possible to give some greater conclusions about this topic. The sample size could be increased in future studies to provide more evidence for this research result. Secondly, since competition itself has a simple and complex distinction, this study adopted a relatively simple competitive design, which may be the reason why there was no significant difference in the learning motivation of the individual competition class and the inter-group competition class. Whether a rich competitive design can promote learning motivation is a problem worthy of further study. We call on researchers to enrich competition design in the future and further explore which characteristics of competition affect students' learning effect and learning motivation, so as to contribute to the sustainable development of gamified learning.

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