Received: 14 February 2024 | Revised: 26 March 2024 | Accepted: 2 April 2024 | Published online: 15 April 2024

RESEARCH ARTICLE

International Journal of Changes in Education
2024, Vol. 1(2) 97–102
DOI: 10.47852/bonviewIJCE42022615

BON VIEW PUBLISHING

Enhancing Freshman English Learning: A Study of Solo vs Collaborative Educational Gameplay Effects on Achievement and Motivation

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Abstract: This research compared the effects of solo and collaborative gameplay formats on learning achievement and motivation among freshmen English students. Sixty students were randomly assigned to play educational games either individually or in small groups over 10 weeks. While both groups received similar instructional time, one played independently using individual devices, while the other played in small groups sharing a single device. A pre-test and post-test design was used, with a 20-multiple-choice exam assessing freshman English knowledge. A modified Motivated Strategies for Learning Questionnaire was also administered to measure five dimensions of motivation (intrinsic goal orientation, extrinsic goal orientation, task value beliefs, control beliefs, and self-efficacy for learning). Post-test scores were significantly higher for the collaborative gameplay group, suggesting team-based interaction enhanced learning. However, a multivariate analysis of variance showed no significant differences between groups on any of the motivation dimensions measured. The findings demonstrate collaborative gameplay may boost achievement without compromising motivation when compared to solo gameplay.

Keywords: Game-Based Learning, collaboration, learning motivation, learning achievement

1. Introduction

Game-based learning (GBL) has become increasingly popular in educational settings to motivate and engage students [1, 2]. Previous studies have shown the positive effects of video games on learning in a variety of domains, including improved motivation, engagement, and material mastering [3, 4]. Both the general concept of GBL and the digital GBL platform, Minecraft Education, have demonstrated the potential to support student learning and raise academic performance [5].

According to Choosang et al. [6], GBL offers dynamic and engaging educational experiences, inspiring skill development through immersive activities. These games, adaptable to various settings, provide feedback-driven progress, fostering collaboration, simplifying complex concepts, and promoting emotional connections to learning. Ultimately, GBL enhances confidence, independence, and critical thinking in students' educational journeys.

Game-based collaborative learning offers numerous advantages in educational contexts. Recognizing the pivotal role of collaboration in successful GBL, McGonigal [7] emphasized that online games foster exceptional levels of collaboration, asserting that gamers are among the most collaborative individuals on earth. Acknowledged as a potent educational tool, collaborative serious games have been identified for their ability to facilitate high-level learning experiences [8].

There is a dearth of research that directly compares the effects of playing games with others (collaborative GBL) versus alone (solitary GBL) on student learning results. Single-player and multiplayer GBL each have special advantages. Collaborative GBL integrates social interactions, while solitary GBL permits self-paced learning. A greater understanding of the relative effectiveness of solo versus group gaming experiences could help determine the best way to utilize them in classrooms.

The aim of this research is thus to compare how students' learning achievement is affected by solo and group GBL. The relative efficacy of various GBL implementations will also be provided by this study. Findings about the best GBL design and its effect on student outcomes can give educators important directions in future teaching design and teacher professional development training.

2. Literature Review

2.1. Game-based learning

The term "game-based learning" describes the application of video games and gaming components to improve learning. It is based on the notion that well-made games have elements of successful learning, including motivation, active engagement, progress monitoring,

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scaffolded tasks, and immediate feedback [9]. The motivational and engaging aspects of games, together with their connection with certain learning principles, contributed to the success of GBL [10]. Still, there are concerns about the best ways to apply GBL and its efficacy.

More and more academic disciplines are using games to improve their students' cognitive, emotional, and psychomotor skills [11]. In addition to goals, games include things like imagination, rules, challenge, feedback, competition, collaboration, control, and storytelling [12].

Numerous studies demonstrate how, when used carefully, GBL can have positive effects on motivation, cognition, and social interaction. Using a meta-analysis, Wouters and van Oostendorp [13] discovered that GBL had greater effects on motivation and minor to moderately beneficial effects on learning outcomes. According to an experimental investigation, students' knowledge and comprehension of microbiology principles increased after playing a commercial platform game [14]. Intriguing gameplay mechanisms can also encourage intrinsic motivation to learn academic subjects more thoroughly, according to qualitative studies [15, 16]. Role-playing and multiplayer games offer opportunity to build social–emotional skills such as empathy, leadership, communication, teamwork, and conflict resolution [17].

Positive results are not assured, though. Scholars stress that in order for game integration to be effective, learners, pedagogy, gameplay, and content representation must all be in alignment [10]. Prensky [18] delineates eleven essential components that maximize the learning potential of games: objectives, rules, competitiveness, challenge, storytelling, interaction, feedback, win states, addictiveness, and aesthetics/motivation. Furthermore, engagement and transfer are enhanced by student initiative, scaffolding, and implicit learning in gameplay [19]. Additionally, intentionality and alignment are required for both teacher facilitation and assessments [9].

There are also obstacles that prevent GBL from being widely adopted. For example, difficulties arise when it comes to complicated serious games because of teacher insecurity, misconceptions about gaming, perceptions of limiting curricula, and inadequate technology availability and funds [20, 21]. Addiction and violence are two problematic gaming habits that are still being contested and require cautious advice [22]. Finally, there is currently a lack of cohesiveness and collaboration in the design and research landscape for the establishment of GBL standards [9].

2.2. Solo and collaborative GBL

The use of GBL as a teaching strategy is growing in popularity. According to research, it boosts motivation in pupils and facilitates successful learning [23–26]. Tüzün et al. [26] discovered, for instance, that students who engaged in mobile game play outperformed their peers in normal project-based sessions on a knowledge test. Research on important variables, such as solo versus group implementations, is still scarce.

Numerous studies show that single GBL can enhance knowledge gains and academic performance in a variety of fields. For instance, a study by Reinders and Wattana [27] discovered that playing alone enhanced participants' listening and reading abilities in English. Improved quiz results on microbiology subject were also made possible by solitary educational gaming [14]. Students can investigate ideas at their own pace in a solitary GBL setting [28]. It enables students to solve potential real-world issues and apply information directly [29–32]. Regarding how well solitary GBL improves learning outcomes, the results, however, are contradictory [33].

Students who participate in collaborative learning are compelled to actively explain ideas to others, which promotes higher-order thinking and meta-reflection [33, 34]. Students can overcome misconceptions, promote reflective thinking and problem solving, and exchange material meaningfully through collaborative GBL [35, 36]. Nonetheless, some research has not discovered any appreciable distinction in learning between solo and cooperative gaming [37, 38]. Effectiveness is probably dependent on group dynamics and certain design elements [13].

Less is known about how collaborative GBL improves learning. Barab et al. [39] studied Quest Atlantis and Liu et al. [40] studied Alien Rescue. Both studies found that compared to control conditions, cooperative games showed improvements in scientific test scores. However, as compared to solo play, several multiplayer games displayed no differences in performance or even a decline in learning metrics [38, 41]. While collaborative GBL shows consistent improvements in subjective outcomes like enjoyment, solitary GBL can enhance academic achievement. To maximize performance and the learning experience of students, more research is still required on flexible GBL designs.

3. Method

This study involved 60 first-year students from two freshman English courses at a private technical university. One class was assigned at random to the solo gaming condition, and the other was assigned to the cooperative gameplay condition. To gauge learning achievement, a knowledge exam including 20 multiple-choice questions about freshman English was developed and addressed throughout the game.

A Learning Motivation Scale was developed based on amended items from the Motivated Strategies for Learning Questionnaire (MSLQ) [42] to provide more insight into students' motivation for learning. With this updated measure, this study could better capture the motivational dispositions of students. Five dimensions were combined into one survey: intrinsic goal orientation (IGO), extrinsic goal orientation (EGO), task value (TV), control beliefs (CBs), and self-efficacy for learning and performance (SLP).

The reliability of the modified MSLQ's subscales was assessed using Cronbach's alpha. For IGO, Cronbach's α was 0.86; for EGO, it was 0.88; for TV, it was 0.98; for CBs, it was 0.88; and for self-efficacy, learning, and performance, it was 0.93. The modified MSLQ instrument's subscales evaluated five motivational traits, and the Cronbach's alpha coefficients demonstrated good to exceptional internal consistency for each of these characteristics.

Both solitary and collaborative classes received an early pre-test on freshman English knowledge before any gaming started to provide a baseline. One class of students engaged with the educational game individually, with each student using a different device to play alone. This added variation to the gameplay experience between the two classes. The other class worked together in small, assigned groups to play the same game content. In particular, the thirty pupils in the class were split up into six smaller groups, each consisting of five people. To play the game together, each group had a single device

(a tablet or a mobile phone). Throughout the whole interactive session, the five students in each group needed to actively debate and make decisions about the gaming as a team while gathered around their shared device.

A 10-week GBL program was used to cover the assigned freshman English course. There were no changes to the solo or group settings over the 10 weeks. There was one hundred minutes of instruction each week. Usually, group discussions and lecture-based instruction took up the first 85 min. After that, 15 minutes were spent on GBL. This study made use of a number of GBL tools, including Quizizz, Kahoot, and Wordwall.net. The game was to be played alone by students in one class and in groups by students in the other.

After 10 weeks of GBL was over, both classes took a post-test in which the freshman English knowledge exam was given again. To further evaluate the impact of the 10-week GBL experience, students also completed a comprehensive MSLQ survey after the intervention. The MSLQ utilized a standard 5-point Likert scale ranging from "strongly agree" to "strongly disagree". Additionally, three open-ended questions were included in the survey to gather qualitative feedback from participants about their experience with and responses to the educational games. This mixed-methods approach provided both quantitative and qualitative insight into how the game may have influenced students' motivation and overall learning process.

4. Results

4.1. Learning achievement

To analyze differences in learning performance between groups, a one-way repeated measures ANOVA was conducted. The ANOVA tested freshman English learning performance with two factors: (1) a between-subjects factor of group (solo vs collaborative) and (2) a within-subjects factor of time (pre-test vs post-test). The dependent variable was test scores. The repeated measures ANOVA with a Greenhouse–Geisser correction found a significant difference between test scores over time, $F(1, 58) = 8.74$, $p = 0.005$, indicating freshman English learning changed significantly. At pre-test, the solo ($M = 60$, $SD = 28.28$) and collaboration ($M = 62.67$, $SD = 20.83$) groups scored similarly, demonstrating baseline equivalence. However, at post-test, the collaboration group ($M = 80$, $SD = 11.45$) outperformed the solo group ($M = 70$, $SD = 30.51$). Specifically, collaborative students' scores increased 28% from pre- to post-test, compared to a 17% increase for individuals. Thus, while both conditions improved over time, collaboration yielded a greater enhancement in English learning outcomes.

4.2. Learning motivation

A motivational survey was administered based on revisions to the MSLQ [42]. The survey included five dimensions: IGO, EGO, TV, CBs, and SLP. To analyze for differences in learning motivation between the two groups, a Bonferroni-adjusted one-way multivariate analysis of variance (MANOVA) was performed on the five motivation dimensions assessed by the survey. This statistical analysis evaluated whether the solo and collaborative groups exhibited any differences in motivational factors as captured by the revised MSLQ measure. The results of the MANOVA indicated there were no statistically significant differences between the solo and collaborative groups across any of the five motivation dimensions assessed. This is aligned with the previous studies [1, 38] which also found no significant differences in terms of motivation between individual and collaborative gameplay formats. Table 1 presents the means and standard deviations for each dimension by group.

Table 1
Descriptive statistics for the solo and collaboration groups ($N = 30$)

	No. of items	Solo Mean (S.D.)	Collaboration Mean (S.D.)
Intrinsic goal orientation	3	4.89 (0.36)	4.69 (0.81)
Extrinsic goal orientation	3	4.94 (0.25)	4.77 (0.73)
Task value	5	4.93 (0.33)	4.82 (0.67)
Control beliefs	3	4.92 (0.30)	4.84 (0.62)
Self-efficacy for learning and performance	6	4.87 (0.36)	4.79 (0.69)

4.3. Qualitative results

In order to understand more about participants' opinions and reactions to the GBL experience, the second section of the MSLQ survey had three open-ended questions. The answers to questions about the cooperative components of GBL are shown in Table 2. Positive answers to Question 1 showed that players had fun with the game and that working as a team helped them learn from each other. Based on comments, it appeared that the cooperative gaming features improved the learning process.

Table 2
Responses to collaborative game-based learning ($N = 30$)

	Question	Responses	*N*	%
1	What part of game do you like? Why?	Interesting & fun	18	60
		Collaboration	11	37
		Total	30	100
2	What part of game do you dislike? Why not?	N/A	25	83
		The content is too difficult	2	7
		Too slow	3	10
		Total	30	100
3	If you were to play the game again, would you prefer playing it on your own or playing it collaboratively with others?	Solo	5	17
		Collaboration	25	83
		Total	30	100

In Question 2, players were asked to list any aspects of the game that they did not enjoy. Eighty-three percent of respondents to this question said they did not dislike anything about the game. The remaining 17% of participants who left feedback on their dislikes said that the game's questions were too tough, while some said that the game's reaction time was too slow. It may be due to a poor WiFi signal when they were playing. Thus, a small percentage of respondents pointed out issues with the game's question difficulty and response time.

Finally, participants were asked if they would rather play the game alone or with others if they were given the chance to do so again. Consistent with the favorable input regarding teamwork from Question 1, the results showed that 83% of participants preferred to play with other team members. Those who could communicate with their teammates during games said they enjoyed them more. This supports the idea that the cooperative and social aspects of cooperative gaming improved players' engagement with the learning task and encouraged them to do so in the future.

The results of individuals who finished the GBL activity alone are displayed in Table 3. The majority of respondents (83%, or 25 out of 30) found the solo gaming experience to be interesting and enjoyable, and 17% (5 out of 30) claimed it assisted them in reviewing and solidifying the material they had acquired in class. These findings are consistent with results of the first research question.

Table 3
Responses to solo game-based learning ($N = 30$)

	Question	Responses	*N*	%
1	What part of game do you like? Why?	Interesting and fun	25	83
		Better understand content	5	17
		Total	30	100
2	What part of game do you dislike? Why not?	None	24	80
		The content is too difficult	3	10
		Too slow	3	10
		Total	30	100
3	If you were to play the game again, would you prefer playing it on your own or playing it collaboratively with others?	Solo	6	20
		Collaboration	24	80
		Total	30	100

In response to Question 2, which asked participants to list any features of the game they did not enjoy, three of the thirty players who played on their own said they thought the game's material was too challenging. Three players expressed dissatisfaction with the game's response time, saying they were too slow.

In Question 3, participants were asked whether they would rather play the game alone or with others if they had the chance to play it again. Out of the thirty players that played the game by themselves at first, twenty-four students (or 80%) said they would prefer to play the game with their friends in the future as opposed to on their alone. This suggests that most people would like to add a social and cooperative element by playing cooperatively in subsequent sessions, even after they have played solo the first time.

This study confirmed the findings of Chen et al. [1] that GBL enhanced engagement through collaborative and interactive elements of the games. Chen et al. [1] discovered that collaborative/team-based games may enhance academic performance while maintaining students' intrinsic motivation. This study's results support earlier research's finding by showing that, when done well, cooperative learning components in GBL can raise student achievement and engagement.

5. Discussion

The finding that collaborative gameplay led to significantly higher learning gains compared to solo play has important implications for educational practice. It suggests that intentionally designing group-based game activities, where students can interact, communicate strategies, and co-construct knowledge, may be a more effective approach than individual gameplay for enhancing academic achievement. The social dimensions of collaboration appear to provide learning benefits beyond solo engagement with the same game content. This aligns with theoretical perspectives emphasizing the value of peer interaction, articulation of ideas, and joint knowledge building for deeper-level understanding.

Interestingly, despite the achievement differences, students reported similar levels of motivation across the five dimensions measured, regardless of whether they engaged in solo or collaborative play. This indicates that group gameplay does not inherently increase or decrease factors like IGO, TV, self-efficacy and CBs related to the learning process. Both gameplay formats were comparably successful at triggering motivational engagement. However, the collaborative approach yielded stronger learning outcomes, implying the interactions helped students better grasp and retain the material.

These results suggest instructors should purposefully incorporate collaborative gameplay elements when using GBL, as the group interactions stimulate the kinds of cognitive processing that leads to greater understanding and achievement. However, both solo and collaborative approaches may be viable for sustaining student motivation through the engaging and interactive nature of digital games. Utilizing a strategic combination of individual and group-based gameplay could maximize the motivational benefits while more effectively targeting learning through social knowledge construction.

5.1. Limitations and future research

This study has a few fundamental limitations that should be addressed in future research. First, the sample was relatively small ($N = 60$) and drawn from a single university, limiting the findings' generalizability to other educational contexts. Larger and more diverse samples are needed to increase confidence in the results. Secondly, while the achievement differences favored collaborative gameplay, the lack of differences in motivational dimensions raises questions about the relationship between performance outcomes and self-reported motivation. More nuanced measurement approaches may be required. Third, an open question remains about why there were no observed motivational differences between the solo and collaborative gameplay environments. Potential factors like individual preferences, goal orientations, or group dynamics may play a role and warrant further investigation.

Some promising directions for future research building on these limitations include:

1) Replicating the study with larger sample sizes across multiple universities and educational levels
2) Directly comparing effects across different game genres
3) Incorporating observational data or physiological measures to triangulate motivational states
4) Exploring achievement goal orientations as mediating or moderating variables
5) Examining how individual differences in traits like extraversion impact solo vs collaborative preferences
6) Investigating optimal strategies for flexibly combining solo and collaborative gameplay segments

6. Conclusion

This study compared the effects of solo versus collaborative gameplay on learning achievement and motivation in a freshman

English course. The key findings and their implications are as follows. Students who played the educational games collaboratively in small groups achieved significantly higher learning gains compared to those who played individually. The 28% increase in test scores for the collaborative group versus 17% for the solo group suggests that group interactions and co-construction of knowledge through gameplay led to deeper understanding and retention of the English content. However, both solo and collaborative gameplay were equally effective at promoting motivation, with no significant differences between groups on IGO, extrinsic goals, TV, CBs, or self-efficacy. This demonstrates that GBL, whether individual or group-based, can leverage the motivating aspects of digital games.

The potential impact of these findings is that intentionally designing collaborative gameplay experiences, where students can interact, discuss strategies, and pool their knowledge, may optimize learning outcomes over solo play. At the same time, maintaining student motivation does not necessarily require group gameplay, as individual digital games were also highly engaging. Therefore, an ideal implementation of GBL could blend individual and collaborative elements. Solo gameplay segments could sustain motivation through the immersive and interactive nature of games, while collaborative multiplayer components leverage the cognitive benefits of social knowledge construction for maximized learning gains. This balanced approach, combining the motivational advantages of digital games with the learning advantages of collaborative gameplay, has the potential to create highly impactful and effective GBL environments across disciplines. Educators could strategically use this blend of solo and group activities to increase achievement while sustaining engagement.

Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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How to Cite: Lin, L., & Lin, D. (2024). Enhancing Freshman English Learning: A Study of Solo vs Collaborative Educational Gameplay Effects on Achievement and Motivation. *International Journal of Changes in Education*, *1*(2), 97–102. https://doi.org/10.47852/bonviewIJCE42022615