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Factors Influencing Game-Based Learning in the Colombian Context: A Mixed Methods Study

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Abstract: Game-based learning (GBL) places high demand on educational resources and has been widely practiced in classrooms in many developed countries; however, few studies on GBL and its influencing factors have been conducted in developing countries. To address this research gap, a mixed-methods study was conducted in a state high school in the Amazon region of Colombia with 64 tenth-graders who were learning English as a foreign language to identify the factors that affect learners' learning outcomes when serious games are applied to vocabulary learning, with a specific focus on learning engagement. This study drew on both quantitative and qualitative data collected from surveys, interviews, and pre- and post-tests. The results showed that engagement and prior knowledge can positively predict GBL outcomes, while contextual factors and family condition had an adverse impact on GBL outcomes (Adjusted $R^2 = 0.635$, $p < 0.01$). The results also indicated that a male student with a higher level of prior knowledge would be more likely to achieve good grades in GBL. Based on the study results, several implications are proposed for incorporating serious games for vocabulary learning in less-developed regions. This study results provide important practical implications for high schools in developing countries to implementing GBL.

Keywords: serious games; game-based learning; vocabulary learning; engagement; Colombia

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1. Introduction

Serious games, which can be defined as customized digital games purposefully designed for educational settings, are widely acknowledged to be meaningful tools for learning because elements such as goals, challenges, rewards, and feedback are incorporated into them to keep students focused on the learning process [1]. Such games demonstrate the relationship between learning and entertainment. Serious games thus represent a significant learning opportunity for both teachers and students in the school context.

Prior research has shown that the integration of serious games into educational environments can lead to enhanced learning outcomes [2–4]. The results of a meta-analysis showed that digital game-based learning produced an improvement in learning outcomes with an overall effect size of 0.386 [5]. Good games operate by creating a sense of empowerment in the player [6–8], and they involve strong motivational factors [9] that lead to improvements in academic and emotional outcomes [10,11]. The challenging features of such games also make them more effective [12]. Serious games thus demonstrate that learning can take place in fun and enjoyable environments.

Although there is a notion that serious games enhance learning, the benefits of serious games are not warranted because the effectiveness of game-based learning (GBL) depends on many possible factors. First, for learners with different knowledge levels, serious games bring different learning achievements [3,13]. Second, several contextual factors, such as gender and family conditions, also affect the learning outcomes of GBL. Several studies have reported that gender is an important factor influencing game preference, which

may affect learners' motivations to participate in games [14,15]. Several studies have also confirmed that engagement is a potential factor affecting the learning effect of GBL [16–18]. Another constraint is that many serious games are conducted in classrooms for other disciplines in both Western and Asian countries, while there are few instances of the use of serious games in language learning in developing countries. To be engaging enough to lead to learning, serious games need to be contextualized and focused on students' needs.

Although prior studies have demonstrated the positive effects of serious games on learning, there has been insufficient research exploring the potential factors influencing learning outcomes with serious games designed for language learning in developing countries. We thus sought to explore the effect of using a serious game in a tenth-grade English class using empirical data that we collected from a game-based language learning intervention in the local context of Colombia and to identify the possible factors that influence GBL outcomes. The following two questions guided our research inquiry:

1. What are students' learning outcomes and experiences in the GBL intervention?
2. What are the possible factors that influence the outcomes of students' GBL, and how do these factors exert their influence?

The remainder of the paper is organized as follows. First, our paper presents a literature review in which we describe GBL, learning engagement and its influencing factors, and the benefits and limitations of GBL in language learning. Second, we provide a description of the GBL intervention as the instructional intervention of this study. Then, we describe the research methodology with a detailed definition of the participants, context, and data-collection and analysis procedures. Later, we report both the quantitative and the qualitative findings. Finally, we provide a discussion with practical implications, and the conclusions with limitations, and suggestions for further work.

2. Literature Review

2.1. GBL: Definition and Key Characteristics

To understand the integration of serious games into the school context, it is necessary to comprehend the learning theories that underlie GBL. Wu et al. [19] (p. 269) asserted that GBL is "'learning through the game,' rather than 'learning to play the game'". They identified three elements of GBL: game rules, game play, and game narratives. Each of these elements includes aspects from four learning theories: behaviorism, cognitivism, humanism, and constructivism. Table 1 summarizes some of the principles from the learning theories instantiated in GBL according to Wu et al. [19].

Table 1. Learning theories and game elements in game-based learning, adapted from Wu et al. [19].

	Behaviorism	**Cognitivism**	**Humanism**	**Constructivism**
Game rules	Players are aware of what can be done and what cannot be done.	Players need to predict or guess the rules through logical thinking.	Players engage in direct experiences and are encouraged to reflect upon them.	Game rules are constructed through experimentation and reflection.
Game play	Each action results in a specific response in the game world.	Learning is promoted through scaffolding, with context-dependent knowledge.	Players can play the games at their own pace and in their own mood, with a learner-centered design.	Players build expertise by developing new strategies and interacting with others.
Game narrative	Game narratives provide clear instructions on the learning tasks.	Players actively learn the meanings of settings, events, characters, and tactics by linking the game with previous gaming experiences.	Players learn about the meaning of the game through interactions with peers or avatars.	The player's perception of the game world is constructed through social dialogue and interaction.

How these learning theories are instantiated in GBL provides researchers with a clear overview of the learning principles and game mechanics integrated into serious games. These theories also give teachers and researchers knowledge about how students learn through interactions with serious games. It is thus important for teachers to be aware of these learning theories and game mechanics before implementing GBL interventions that incorporate serious games in a school setting.

2.2. Learning Engagement in Serious Games

Engagement, defined as the amount and type of learners' involvement and participation in a task, plays a crucial role in the GBL process with serious games. A study conducted in New Zealand showed that serious games can improve learning engagement and learning outcomes [20]. Similar results have also been reported with GBL practices in both the United States and Taiwan [21]. Following the research of Yu et al. [22], if students are positively and significantly engaged in a game, the learning effect can be influenced. Prior studies have highlighted the need to promote engaging learning environments that enhance students' learning outcomes through the integration of serious games into GBL interventions.

Because learning engagement is a complex, multilayer construct, enhancing students' learning engagement through serious games implies a focus on the characteristics of games and awareness of their outcomes. According to Fredricks et al. [23], there are three interrelated dimensions of engagement: behavioral, emotional, and cognitive. Following this definition, Hiver et al. [24] suggested that behavioral engagement is related to the amount and quality of learners' active participation in learning; cognitive engagement is linked to learners' mental efforts and mental activity in the process of learning; and emotional engagement can be evidenced in learners' personal affective reactions as they participate in target language–related activities or tasks. These three dimensions therefore need to be studied when researching engagement issues.

2.3. GBL in Language Teaching: Benefits and Limitations

Recent studies have shown that the integration of serious games into the language classroom has positive effects on language teaching and learning processes. One of these positive effects is related to improvements in vocabulary performance, which is promoted through GBL interventions that incorporate challenging, interesting, interactive, authentic, and exciting game competition and gamified assessment mechanisms through serious games [25]. The repetitive exposure to words in serious games also has a positive influence on incremental vocabulary acquisition [26]. Chiu et al. [27] also showed that meaningful and engaging games provide learners with more language learning opportunities than drills and practice games. According to the results of prior research, it appears that students acquire a greater vocabulary when serious games are incorporated into the learning process.

Another positive effect of GBL interventions that integrate serious games into language teaching and learning is their impact on engagement and motivation because serious games involve enjoyable and formative properties, which are attractive and motivating for both teachers and students [26]. Tlili et al. [28] pointed out that the attractiveness of serious games contributes to engaging students in the learning process while performing activities that improve their communicative language skills. The implementation of serious games is also attractive to teenagers because technology is incorporated into most of them, so they are accustomed to it [29]. Nevertheless, learning engagement is not automatically acquired: it depends on game design, implementation, and the context. This fact suggests that there is a need to assess whether the same game can be applied to different contexts, but most empirical evidence so far has been based on data collected from developed countries with abundant resources. Little is known about whether this process can have the same impact in developing countries.

While the benefits of serious games are well known, game design should follow the theoretical assumptions of learning and teaching. The implementation of serious

games in state schools in developing countries also faces obstacles, such as a lack of time to develop experimental interventions to test serious games [28]. The availability of classrooms equipped with technological devices, such as computers or tablets with access to the internet connection, is also limited in state schools. Thus, the design and implementation of GBL interventions that incorporate serious games tend to constitute a general constraint for teachers who want to engage students in language learning.

2.4. Influencing Factors for GBL

Several studies have shown that certain game factors influence outcomes in GBL environments, with prior knowledge, the experience of flow in the game, and the availability of feedback being particularly significant [30,31]. Prior studies have also recommended that game features, such as goal clarity and perceived usefulness, should be incorporated to improve students' learning outcomes and motivation [22,32,33]. These studies clearly indicated that game factors and features must be carefully designed and incorporated to address the target learning outcomes in GBL interventions. However, Dicheva et al. [34] and Yu et al. [22] asserted that a comprehensive review of the factors influencing the effectiveness of GBL remains lacking.

Based on the studies reviewed above, it appears necessary to review the learning and game mechanics that serious games incorporate to understand the factors that influence GBL. Factors such as entertainment, sense of community, enjoyment, and motivation are usually related to students' engagement in the learning process [24,33]. Multimodality in serious games has also been shown to promote knowledge acquisition [35], while interactivity promotes a connection between the game content and the player, and the game narrative enhances the comprehension of game tasks [36]. Chen et al. [12] also indicated that students' ages and native languages do not necessarily influence their language learning with serious games. Researchers in the field of GBL thus need to be aware of the game mechanics incorporated into serious games to further understand how they influence students' engagement and knowledge acquisition.

3. GBL Intervention

In our GBL intervention, we used the serious game "Be the (1): Challenge," which was designed by the National Ministry of Education in Colombia with the help of the British Council. It was launched in March 2020 to strengthen English language teaching and learning processes in Colombia for students in Grades 4–11. To understand the relationship between the pedagogical intentions and ludic elements that this serious game incorporates, we analyzed its learning mechanics (LM) and game mechanics (GM) following the LM-GM model proposed by Arnab et al. [37] (see Figure 1). This model served to describe the serious game based on different pedagogical approaches and GBL elements to better understand how it could be used within an educational setting.

In terms of game play, the serious game is focused on cognitivism and humanism because it offers four missions (Pre-A1, A1, A2, and B1), each with nine different locations (see Figure 2). Locations 1 and 2 focus on lexical knowledge, locations 3 and 4 on interactive use of English, location 5 on communicative knowledge, location 6 on grammar knowledge, location 7 on literal reading comprehension, location 8 on inferential reading comprehension, and location 9 on lexical and grammar knowledge. This emphasis implies that the learning process in this serious game is promoted through a scaffolding system with diverse learner-centered tasks in which players can engage at their own pace.

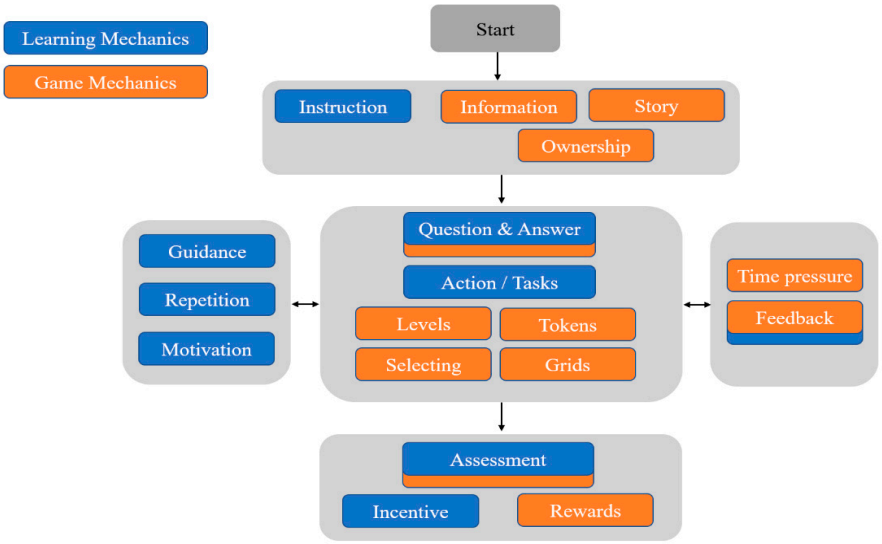

Figure 1. LM-GM in "Be (the) 1: Challenge" (informed by the work of Arnab et al. [37]).

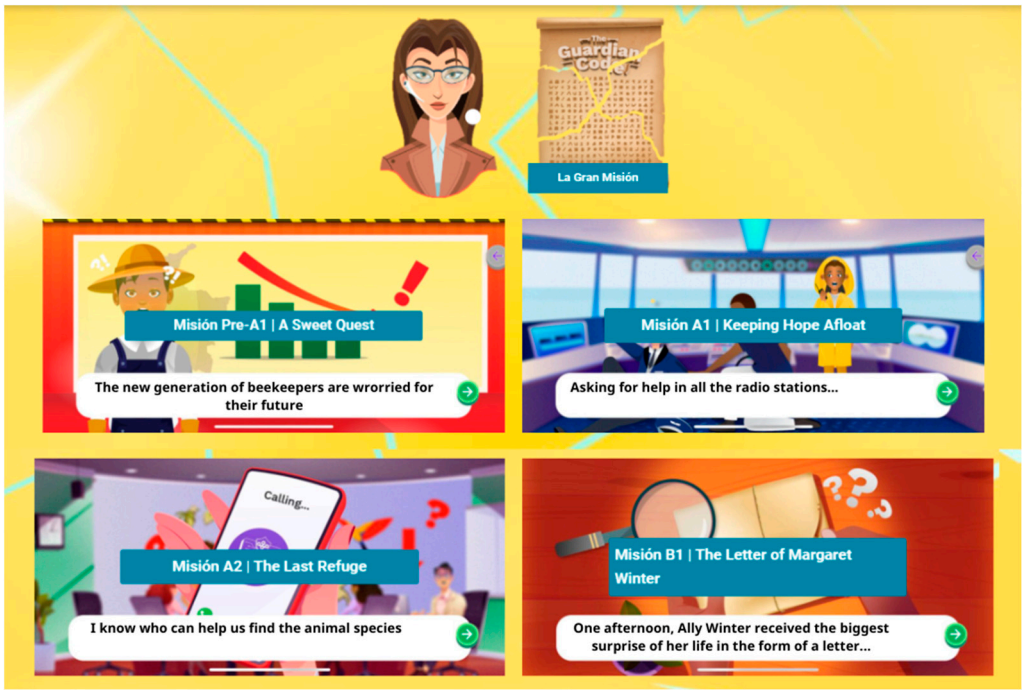

Figure 2. The four parchments in "Be (the) 1: Challenge". Screen capture is from https://eco.colombiaaprende.edu.co/betheone/ (accessed on 1 September 2022).

As presented in the model, the serious game "Be (the) 1: Challenge" follows the game rule, game play, and game narrative GBL elements proposed by Wu et al. [19]. In its game rules, the serious game follows a mix of behaviorism and humanism, as it provides players with instructions and information about how to accomplish each mission while guiding the player and giving feedback. This fact means that the serious game explains what to do in each mission and how to achieve the learning task so that the players are focused on learning reflection.

This serious game is more focused on behaviorism in its game narrative because its narrative tells the players that they are detectives in the Security Organization for Outstanding Solving (SOFOS), "the best private detectives' agency" in the world. The plot tells the players that they have been asked to find the four stolen pieces of "The Guardian Code" parchment. To find the pieces, the players must complete the four missions

previously described. After completing each mission, the serious game gives the players one piece of the parchment. In the end, if the players successfully collect all the pieces, they will complete the parchment. Overall, analyzing the learning mechanics and game mechanics of this serious game and the GBL elements incorporated into it provides insights for investigating the link between learning and engagement in this serious game.

4. Methodology

4.1. Participants

Our study involved 64 high school students from Jorge Eliécer Gaitán High School, a public school in Florencia, Caquetá, Colombia. All of them were beginner English learners aged between 15 and 19 years old, with a median age of 16. There were 57.8% female participants and 42.2% male participants, indicating a roughly equal gender distribution in the sample. These students are a representative sample of the average high school students in this region of the country since most participants came from poor families, and 56.3% did not live with their parents. Additionally, these students attend a high school that shares many of the same characteristics as other schools in the region, such as similar numbers of students, teachers, and classrooms. Unfortunately, as in other schools in the region, this school faces significant challenges, such as lack of internet access, intermittent electricity and water services, and poor building conditions. The basic demographic information of the participants is presented in Table 2. These students and their guardians were aware of the research purpose and protocol, and they signed informed consent forms before the research started. Given the qualitative nature of the data, students' names were anonymized; we distinguished their responses with unique identifiers [S + Number + Gender] (F for female and M for male). This research study was also approved by the School Academic Board.

Table 2. Participant demographic characteristics.

Basic Information	Categories (Assigned Value)	Number	Percentage
Gender	Female (0)	37	57.8%
	Male (1)	27	42.2%
Age	15	23	35.9%
	16	26	40.6%
	17	11	17.2%
	18	3	4.7%
	19	1	1.6%
Living with both parents	No (living with one/neither) (0)	36	56.3%
	Yes (1)	23	43.8%
Economic condition	Poor [a] (0)	44	68.8%
	Lower middle-class [b] (1)	20	31.3%

[a] Living in stratum 1 or 2, with very low income. [b] Living in stratum 3, with low income.

4.2. Context and Procedure

The study was conducted in Caquetá, a department located in the Amazon region of Colombia, which is in the south of the country. This department was affected by armed conflict and the forced displacement of many families from rural areas to the city. This constant movement of people from one area to another has resulted in a mixture of cultures, ways of viewing the world, and ways of building knowledge. This mix is reflected in the diversity of students entering elementary and secondary education in the public institutions of the department. This school has more than 2000 students who live in vulnerable conditions and around 100 teachers, of whom seven are English teachers.

The specific experimental process of the whole study is shown in Figure 3. In the first stage (before game play), participants were given a one-hour pre-test to test their prior English vocabulary knowledge. After the pre-test, the teacher presented and explained the game program to be used in the experiment. In the second stage (game play), the

participants officially engaged in GBL for two hours. In the third stage (after game play), the participants took a knowledge test after finishing the game to examine the learning outcomes of GBL and to survey the basic information of the participants and their learning engagement in GBL. After the quantitative study, we interviewed 64 participants to collect qualitative data. We implemented a mixed-method approach to explore the possible factors that influence students' learning outcomes and engagement in GBL. A major advantage of using this method is that the combination of both quantitative and qualitative data provides a better understanding of our research problem [28], so this method served to thoroughly answer our research questions.

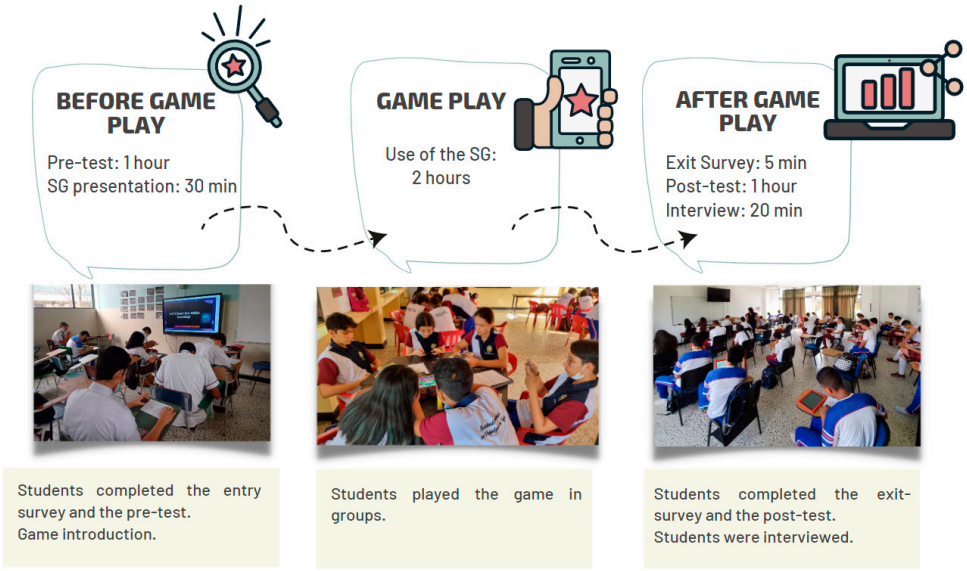

Figure 3. Research procedure.

4.3. Data Collection

We collected both quantitative and qualitative data. For the quantitative data, we administered one survey with 14 five-point Likert scale items adapted from the Motivation, Attitude, Knowledge, and Engagement (MAKE) framework developed by Haruna et al. [38] to measure the learning engagement of the participants during the GBL intervention in terms of cognitive (4 items), emotional (6 items), and behavioral engagement (4 items) (see Appendix A). Only the engagement scale of the MAKE framework was utilized to inform our survey design. These survey items had a Cronbach's α value of 0.82, which suggested that the survey instrument has good reliability. Additionally, we conducted pre- and post-tests to measure the students' vocabulary levels before and after the GBL intervention. The pre-test performance indicated students' prior knowledge, and the post-test performance indicated students' learning outcomes. The pre- and post-tests were designed using the vocabulary presented in the serious game. These tests included a list of 30 words that students were asked to describe. Both tests were validated by experienced teachers from two different universities in Colombia and China.

For the qualitative data, our interviews with the participants formed the main data source. The interview protocol contained six questions to collect in-depth information from the students regarding their learning experience and perceived learning gains with the serious game during the GBL intervention. Sample questions included: (1) What is your perception regarding the use of the game? Why? (2) Did you feel engaged while using the game? If so, could you describe your engagement? (3) Do you think you learned English vocabulary while using the game? Which vocabulary words? (4) What strategies did you use to succeed in the missions with which you faced difficulties during the game-playing process? The interviews were conducted in Spanish, which is the mother tongue of the participants, and were captured using a recording device. They were later transcribed and

translated into English for the analytic procedure. The interview data were based on 3.5 h of recorded conversation and 19,182 words of text transcript.

4.4. Data Analysis

Pearson's correlation and hierarchical linear regression were used for quantitative data analysis. First, Pearson's correlation was used to explore the relationship between the variables. On this basis, we screened potential variables and entered them into a hierarchical linear regression model. A hierarchical linear regression model can observe the degree of prediction of interested variables regarding dependent variables under the condition of controlling several variables. To answer question 2, we constructed a hierarchical linear regression model. In this model, the post-test scores were taken as the dependent variable, while the demographic variables of the participants, as the control variables, were placed in the first block of the regression model; the pre-test scores, as independent variables, were placed in the second block; and finally, the engagement of the participants during the learning process was placed in the third block. Additionally, a series of analytical methods including Levene's test, variance inflation factors (VIFs), and Durbin–Watson statistics were used to ensure that all statistical assumptions of linear regression were met. IBM SPSS software (version 25) was used for quantitative data analysis.

The grounded theory process described by Creswell [39] was used in this study for qualitative data organization, analysis, and interpretation. The open, axial, and selective coding results are presented in Table 3. We also used the constant comparative method [40] to identify the similarities and differences in the constructs and to verify them. Overall, these techniques allowed us to identify themes, categories, and patterns that made sense of the data gathered to answer the research questions.

Table 3. Coding process.

Selective Coding	Axial Coding	Open Coding	Number of Codes
Contextual influence	Engaging versus distracting	Responsibility	56
		Willingness to learn	48
		Making an effort	35
		Motivation	31
		Perceived game difficulty	30
	Good game features versus bad game features	Use of games	38
		Game mechanics	45
	School support versus family support	Peer support	43
		Teacher support	37

5. Findings

5.1. Quantitative Findings

5.1.1. Correlational Results

We used correlation analysis to explore the relationships among participants' demographic variables, pre-test scores, engagement, and post-test scores. The results of the Pearson's correlation coefficients are shown in Table 4. Examining the post-test scores, gender, pre-test scores, emotional engagement, and behavioral engagement were significantly positively correlated with post-test scores ($r = 0.302$; $r = 0.739$; $r = 0.348$; $r = 0.402$), while participants' family economic condition was negatively correlated with their post-test scores ($r = -0.259$).

Table 4. Correlation analysis between variables.

	Mean	SD	1	2	3	4	5	6	7	8	9
1			1	0.214	−0.14	0.038	0.291 *	0.038	0.081	−0.139	0.302 *
2				1	0.193	0.034	−0.104	0.125	0.22	−0.072	−0.103
3					1	−0.017	−0.168	0.165	0.047	0.248 *	−0.148
4						1	−0.198	−0.224	−0.21	−0.03	−0.259 *
5	9.70	6.690					1	0.191	0.21	0.269 *	0.739 **
6	3.927	0.537						1	0.670 **	0.556 **	0.348 **
7	4.039	0.570							1	0.360 **	0.16
8	4.086	0.533								1	0.402 **
9	17.58	5.324									1

1: Gender, 2: Age, 3: Living with both parents, 4: Economic condition, 5: Pre-test, 6: Emotional engagement, 7: Cognitive engagement, 8: Behavioral engagement, 9: Post-test. * $p < 0.05$, ** $p < 0.005$.

5.1.2. Predictors of Post-Test Scores

To explore the predictive effects of the demographic variables, pre-test scores, and engagement on post-test scores, we established three hierarchical linear regression models (see Table 5). The results of Model 1 showed that participants' demographic variables were significant predictors of post-test scores (Adjusted $R^2 = 0.142$, $p < 0.05$), while gender and the economic condition of participants were significant predictors of post-test scores ($\beta = 0.334$, $p < 0.01$; $\beta = -0.268$, $p < 0.05$). The results of Model 1 indicated that male participants had better performance in the post-test for GBL. Compared with participants with poorer family conditions, participants with better family conditions performed worse after GBL. In Model 2, with the variables of Model 1 unchanged, the variance of the interpretation of the post-test scores increased by 37.6% after the pre-test scores were added. Model 2 showed that participants' pre-test scores had a significant effect on post-test scores (Adjusted $R^2 = 0.536$, $p < 0.001$). Participants with higher scores in the pre-test also performed relatively well in the post-test. In Model 3, we explored the effects of the three types of engagement on post-test scores beyond Model 2. After adding emotional engagement, cognitive engagement, and behavioral engagement to Model 3, the explanatory variance of post-test scores increased by 10.8% (Adjusted $R^2 = 0.635$, $p < 0.01$). Specifically, participants who reported higher emotional and behavioral engagement had higher post-test scores ($\beta = 0.257$, $p < 0.05$; $\beta = 0.243$, $p < 0.05$), while participants reporting higher cognitive engagement had lower post-test scores ($\beta = -0.258$, $p < 0.001$).

Table 5. Hierarchical linear regression analysis results for post-test scores.

Model 1					
Factors	***B***	***SE***	***β***	***t***	***VIF***
Gender	3.568	1.301	0.334	2.742 **	1.088
Age	−0.859	0.701	−0.151	−1.226	1.108
Living with both parents	−0.818	1.29	−0.077	−0.634	1.078
Economic condition	−3.052	1.331	−0.268	−2.293 *	1.003
R^2 (Adjusted R^2)	0.197 (0.142)				
ΔR^2	0.197				
ΔF	3.617 *				
Model 2					
Factors	*B*	*SE*	*β*	*t*	*VIF*
Gender	1.3	1.009	0.122	1.289	1.207
Age	−0.302	0.521	−0.053	−0.579	1.133
Living with both parents	−0.112	0.954	−0.011	−0.118	1.089
Economic condition	−1.468	1.004	−0.129	−1.462	1.054
Pre-test	0.534	0.075	0.671	7.142 ***	1.197

Table 5. *Cont.*

R^2 (Adjusted R^2)	0.573 (0.536)				
ΔR^2	0.376				
ΔF	51.010 ***				
	Model 3				
Factors	*B*	*SE*	*β*	*t*	*VIF*
Gender	1.805	0.92	0.169	1.963	1.275
Age	−0.053	0.482	−0.009	−0.11	1.231
Living with both parents	−1.26	0.892	−0.118	−1.412	1.212
Economic condition	−1.609	0.929	−0.141	−1.732	1.146
Pre-test	0.462	0.072	0.581	6.455 ***	1.395
Emotional engagement	2.551	1.167	0.257	2.187 *	2.389
Cognitive engagement	−2.407	0.991	−0.258	−2.428 *	1.948
Behavioral engagement	2.431	1.024	0.243	2.375 *	1.813
R^2 (Adjusted R^2)	0.681 (0.635)				
ΔR^2	0.108				
ΔF	6.235 **				

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; SE: Standard error; β: Standardized coefficient; *t*: The corresponding *t* value and *p* value of each independent variable together indicate whether the variable makes a significant contribution to predicting the dependent variable; *VIF*: Variance inflation factors can explain the severity of multicollinearity to test whether the model is collinear; Adjusted R^2: Adjusted R square indicates the degree of interpretation of variance of the dependent variable by the whole model.

5.2. Qualitative Findings

5.2.1. Male and Female Students Differ in Learning Gains in the GBL Processes

As shown in the quantitative findings, gender played a significant role as a predictor of the outcomes of the GBL intervention. We found that male participants outperformed female participants in the post-test results, indicating that male participants had more learning gains than female participants. The interviews made it evident that, while male participants appeared to be highly motivated and felt encouraged for having participated in the GBL intervention, female participants were more disinterested, and their perceived willingness to use the game was less evident. Female participants stated that they did not like that "the game had a time limit". They also pointed out that it was "stressful due to the increase in game difficulty," so it became more demanding, and some of them "gave up and felt frustrated" with the game play process.

On the other hand, male participants demonstrated higher self-efficacy due to their perceived responsibility, their willingness to learn, and their motivation toward the game-based intervention. Male participants usually commented that they "liked to see how a videogame could be used as a way to learn English," and they were aware that it was their "responsibility to pass the levels and learn". Additionally, male participants assented to the idea that they "wanted to improve, use previous knowledge, and learn new things," and they mentioned that they were "focused on the game". Male participants also highlighted that the perceived game difficulty led them to make more of an effort in the game play process, which led to vocabulary learning gains. One male participant noted, "there were missions in which I had to read texts, so to fully understand them, I needed to know the meaning of the vocabulary, so it helped me to increase the vocabulary I already knew". This view was echoed by another male participant who agreed, "I felt motivated because I wanted to know what was beyond the mission or level I was playing. I wanted to know what came next". Overall, a great number of male participants responded that they "kept making an effort to continue the process". This finding suggests that male participants had greater learning motivations during the GBL intervention.

5.2.2. Students' Family Condition Influenced Their Performance in GBL

Although it is usually thought that students who have better family conditions (in terms of living with both parents and having good economic resources) also have more opportunities and greater access to quality learning, in our study, we found that participants with better family conditions had worse performance in GBL. After reviewing the interviews and based on classroom observation, we found that participants living with both parents played the serious game in isolation and did not seek other strategies when they faced difficulties in the serious game, while participants living with only one parent or a guardian asked "for help from those who have already completed the missions". One possible reason for this outcome is that the absence of parental involvement made these participants more willing to reach out to their peers and teachers, understanding that the learning process is not only an individual task and that their peers "sometimes know more" than they do. These participants also alluded to the notion of teacher support as a way to help them with "clues" to understand the game missions. Such students thus relied on their peers' and teachers' guidance and were more willing to request support to further understand the vocabulary in the serious game and pass the levels. By doing so, participants were engaged to collaboratively complete all of the missions in the serious game, to learn, and to improve more. This outcome indicates that peer and teacher support played a significant role in participants' performance in GBL.

5.2.3. Prior Knowledge Positively Influences Students' Performance in GBL

We found that participants recognized their prior knowledge as a factor influencing knowledge improvement because the game allowed them to "use the vocabulary" that they already knew in English. Additionally, participants' prior knowledge helped them to "infer the meaning of new words and learn them" during the GBL intervention, which provided evidence of their capacity to link prior knowledge with the new learning task. These participants also demonstrated higher self-efficacy; they indicated that they "could notice the improvement" in their English level while learning the meaning of new words. Additionally, participants' higher-order thinking skills of applying and creating may have contributed to greater learning benefits because they noticed that they "could use the known vocabulary to making phrases, sentences, etc.". All of these attributes are commonly found in high-achieving students and thus benefit the GBL process profoundly. Taken together, these results suggest that there is an association between participants' prior knowledge and their GBL performance.

5.2.4. The Effect of Engagement on GBL Performance

We found that participants with higher emotional and behavioral engagement had better learning outcomes. According to the interviews, this finding was possibly due to participants' willingness to use technology, which positively affected their emotional and behavioral engagement. Features such as the badge system, the game narrative, and the integration of technology into the classroom emotionally engaged students because these features allowed them to "be motivated to learn faster," and they considered it a "different way of learning that encourages the learning process," which helped them to "learn more easily" because they "wanted to get more badges and complete all the game levels". Moreover, one participant explained that "technology would open the doors to endless possibilities in the school context and a new and improved education, allowing young people to learn without limitations". Features such as the score and scaffolding system, frequent interaction with the tablet, and embodied cognition also behaviorally engaged students. Participants noted that, with these features, the English classes "are not traditional" and are "more dynamic" and that they can "de-stress". These features thus emotionally and behaviorally engaged participants and led to improvements in their GBL performance.

6. Discussion

It is important to note that the impact of GBL interventions on vocabulary learning, specifically in developing countries, is tied to certain factors. Our study thus identified several potential factors that influenced the effectiveness of the GBL intervention. It is not surprising to see that gender and prior knowledge played major roles in students' GBL performance. Gender differences are known to influence students' preferences and motivations for game genres [41]: girls in general prefer competitive games, while boys tend to be better at playing action games. Consistent with previous research [42–44], we found that male students outperformed female students in terms of learning gains in GBL because female students demonstrated lower motivation and lower willingness to use technology. In contrast, male students showed higher self-efficacy, which was related to their responsibility, willingness to learn, and motivation toward games. Previous research has shown that the frequency of game play plays a vital role in determining students' learning gains, so male students' frequent exposure to serious games may have positively influenced their learning gains compared to female students [42,45]. Regarding the role of prior knowledge, our study findings align with previous research [25,30] showing that prior knowledge has significant, direct effects on task performance in GBL [31].

That family condition had a slightly negative correlation with GBL performance is quite surprising. This finding is different from a previous research study showing that family income had no impact on students' participating in GBL [46]. Our interview analysis suggests that this difference might have occurred because students living with one parent or a guardian were more willing to request peer and teacher support than students living with both parents. This finding should serve to remind teachers that collaboration and interactivity are necessary elements of GBL [47], supporting Vygotsky's [48] assertions of mediation in learning and that students' living situations are an important condition in the learning process [31]. Consequently, our study strengthens the idea that peers constitute a support that students need to collaboratively advance in the missions of a serious game, encourage interaction, and improve their performance.

While a previously reviewed study suggested that higher emotional and behavioral engagement would lead to greater GBL performance [22], it was quite baffling to see that cognitive engagement had an adverse effect. There are two possible reasons for this outcome. First, students may have learned the mechanics of the game and how to pass the levels without remembering the words after passing the level. This process would mean that students knew how to answer each game task but did not recall the meaning of the words that they selected. Second, certain game features might have overloaded students' working memory, impeding their ability to recall the meanings of words. This possibility further supports the notion that learners' working memory is limited in capacity and duration when dealing with novel information [49]. If students' working memory was overloaded by the game dynamics, its multimodal presentation of information, or the number of words presented in the game, it might have caused the students' lower scores in the post-test.

Practical Implications

The findings of this study have several important implications for the future practice of GBL in developing countries. First, we suggest that teachers pay more attention to the participation and performance of female students in GBL. Second, we recommend that teachers recognize the individual differences in prior knowledge and family conditions by providing individualized facilitation and collaborative opportunities in GBL interventions. Third, we encourage game designers not only to incorporate features into serious games to engage students emotionally and behaviorally but also to pay attention to the issue of cognitive overload by further reducing the extrinsic cognitive load.

7. Conclusions

Our findings revealed that the GBL intervention positively influenced students' performance and engagement in vocabulary learning in the Colombian context. These findings are consistent with the findings of previous studies [32,50,51] asserting that engagement can be influenced by creating classroom contexts that increase self-determined reasons to accomplish the parts of learning that are not intrinsically fun [15]. Additionally, we corroborated previous research proving that strong engagement in a game positively and significantly influences the learning effects and leads to meaningful learning [11,22,24,45].

Limitations and Future Research

This study has several important limitations. First, the participants in this study were selected from a single course using convenience sampling, and they do not represent the entire middle school student population. Further research thus needs to be conducted in other regions with students from different age groups. Second, most participants in this study had not participated in GBL before, so its novel effects cannot be excluded. We recommend that future researchers evaluate the long-term effects of vocabulary learning after GBL interventions. Third, although this study systematically explored the impact of participants' demographic variables on their learning results and participation in GBL, the information collected was not detailed enough, yielding results that were not sufficiently clear. Future research could focus on learners at different levels of English, refine the questionnaire, and then re-conduct the investigation to enhance the generalizability and interpretability of the findings.

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Appendix A. Learning Engagement Questionnaire

Part One: Basic information

Name	Birth sex
Age	Grade
Living condition	Economic condition
(lives with both parents: Y or N)	(middle/low, poor condition)

Part two: Engagement

This section is about engagement in game-based learning. There are 14 items below, ranging from "strongly disagree-strongly agree"; please choose one according to your actual feelings.

Emotional engagement

1. The vocabulary in Bethe1Challenge was very easy to understand.
2. I was effective in using Bethe1Challenge since it was engaging.
3. The activities and missions presented in Bethe1Challenge facilitated my active participation.
4. Bethe1Challenge caught my attention.
5. Bethe1Challenge allowed for my learning of relevant vocabulary in English.
6. The use of a mobile device to play Bethe1Challenge made me interested.

Cognitive engagement

1. I demonstrated my interest and enthusiasm, as well as the use of positive humor, while using Bethe1Challenge.
2. Bethe1Challenge is relevant for engaging students in vocabulary learning.
3. Bethe1Challenge enhanced my engagement in learning English.
4. I focused on the missions assigned in Bethe1Challenge.

Behavioral engagement

1. I completed all the missions in the game.
2. I spent all the necessary time answering the questions in Bethe1Challenge.
3. If I could not complete a mission on the first attempt, I kept working on it until I completed it.
4. I want to continue using Bethe1Challenge in my learning process.

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