

# The Effect of a Simple Simulation Game on Long-Term Vocabulary Retention

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## Abstract

*Recent studies have shown that simulation games may be useful tools for supporting foreign language education. However, much of this research has focused on games using 3D graphic technology, which entail technical requirements that may render them too complex for use in many educational contexts. Accordingly, we wanted to determine if less complex simulation games could also support the acquisition of a foreign language. We conducted a quasi-experiment using whole classes comprising EFL learners at a Japanese university. A treatment group used an online vocabulary learning application (Quizlet) in conjunction with a simple simulation game (3rd World Farmer), and a control group used the vocabulary learning application alone. Although using the simulation game showed no short-term benefit, the treatment group outperformed the control group on a delayed post-test administered 11 weeks after treatment. We conclude that the effect of simulation games can be used in foreign language learning to improve long-term retention of target language vocabulary.*

KEYWORDS: SIMULATION GAME; VOCABULARY LEARNING; VOCABULARY RETENTION

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## Introduction

Research interest in digital game-based learning solutions for foreign language education has existed for several decades, and more current empirical investigations naturally tend to feature the latest technology as it becomes available. Thus, much of the recent empirical data on the effect of computer games on foreign language learning is centered around games rendered in 3D virtual worlds, such as *The Sims 3* or *Second Life* (Bakar & Nostratirad, 2013; Berns, Gonzalez-Pardo, & Camacho, 2013; Chen, 2014; Milton, Jonsen, Hirst, & Lindenburn, 2012; Ming, Ruan, & Gao, 2013; Peterson, 2011, 2012). A basis for this focus could be the assumption that 3D virtual environments offer the optimal learning affordances because of their capacity to provide sensory-rich experiences. However, while the results of these studies have been encouraging, 3D environments are often impractical in many educational contexts because they require sophisticated technical capabilities, and learners must undergo time-consuming training to operate the complex systems before they are able to begin learning the subject matter (Inman, Wright, & Hartman, 2010; Liou, 2012; Taylor & Chyung, 2008; Wang & Shao, 2012; Zhang, 2013). Additionally, it is notable that among the six advantages of 3D games raised by Berns, Gonzalez-Pardo, and Camacho (2013, p. 211), those being immersion, goals, real-time feedback, agency, engagement and learner-centeredness, only the first could pertain directly to games rendered in 3D, while the remaining five could be features of other types of learning activities. As Gee (2004, 2005) claims, the experience instilled by a game's mechanics is what makes it pedagogically effective, more so than its immersive 3D graphics. Thus, there is a question as to the necessity of 3D virtual environments. If simpler types of computer games are also effective at enhancing foreign language skills, they may offer an accessible alternative to learners and instructors with constraints on curricular flexibility, or without access to the requisite quality of computer infrastructure.

On the basis of these considerations, the purpose of this quasi-experimental study was to test the effectiveness of a type of simple online simulation game in facilitating vocabulary learning among learners of English as a Foreign Language (EFL). Moreover, we were interested in exploring the utility of simple simulation games as they would be applied in a practical educational setting, and also following best practices in foreign language education. That is, in accordance with a task-based approach, we wanted to study the computer game as a medium for a communicative task framed in pre- and post-task phases and in conjunction with enabling activities (Ellis, 2003; Nunn, 2006; Skehan, Xiaoyue, Qian, & Wang, 2012). Thus, we formulated the following research question to guide the present study.

RQ: What is the effect of collaborative gameplay using a simple simulation game in conjunction with enabling activities on foreign language learning outcomes?

## Conceptual framework

The study of digital game-based learning is a multi disciplinary field, so relevant constructs may warrant clarification at the outset. In particular, there appears to be some uncertainty regarding what constitutes a *game*. Following Schell (2008), we consider games as types of problem-solving activities (p. 37). Although this definition could theoretically include activities that are not digitally mediated (i.e., board games, card games, physical role plays, etc.), we are concerned here specifically with technology-mediated tools and materials to support language acquisition. Also, while attributes indicating whether an activity merits the label of *game* could arguably include *fun* and *engaging*, we focus here on the learning outcomes of activities, and consideration of the affective state of players does not fall within the scope of the present study.

In line with Chiu, Kao, and Reynolds (2012) and Rapeepisarn, Wong, Fung, and Khine (2008), we distinguish between two broad categories of games and the educational function that they purportedly serve. The game types and their characterizing features are summarized in Table 1. We do not propose these labels as absolute categories, but rather as extreme poles representing a continuum for educational games.

**Table 1:** Types of games, defining characteristics and examples

Game type	Characteristics	Examples
Flashcard games	Form-focused Discrete skills Repetition	Quizlet ALC Net Academy DynEd Hot Potatoes Suite
Simulation games	Meaning-focused Interactive narrative Fantasy Integrated skills	3rd World Farmer Energy City Pandemic World of Warcraft

Games comprised mainly of a rapid sequence of small challenges or tasks and characterized by a high degree of sequenced repetition exercising one or a small set of isolated skills will be considered *flashcard games* (following Rapeepisarn et al., 2008). Flashcard games are overwhelmingly present in the field of Computer-Assisted Language Learning (CALL), and are typically known as drill applications (Bax, 2003, 2011; Bush, 2008; McDonough, 2001). These activities generally involve a simple matching mechanic that requires learners to pair a target language (TL) form with a meaning represented by a

corresponding L1 form, a TL definition, an image, a context providing clues to the meaning, or the like. Another type of matching involves pairing one representational modality of a TL form (e.g., orthographic) with another (e.g., phonologic). These types of games are useful for drilling discrete form-focused skills such as spelling or word meaning, and are typical of popular CALL systems such as ALC Net Academy, DynEd (Brown, Campbell, & Weatherford, 2008) and the Hot Potatoes suite.

On the other hand, games that incorporate a narrative, or a series of inter-related events that involve fantasy which is, as described by Dickey (2006a, 2006b), playing a role or performing a function uncharacteristic of normal life, will be referred to as *simulation games*. A further characteristic of these games is that they require players to combine disparate skills and knowledge for application in problem solving or strategic thinking with the goal of enacting decisions that influence the outcomes of the narrative. Simulation games are not typically found in widespread use specifically as foreign language learning tools in educational institutions outside of an experimental context. Rather, commonly referred to as *serious games*, they are used in government and military training (Johnson, 2009; Orvis, Horn, & Belanich, 2009; Mills, Smith, & Swain, 2003; Wilson *et al.*, 2009), business or leadership training (Lopes, Fialho, Cunha, & Niveiros, 2013), training in medicine (Kron, Gjerde, Sen, & Fetters, 2010; Lynch-Sauer *et al.*, 2011), and increasingly for science, technology, engineering, and math education in primary, middle, and secondary levels of education in North America and Europe (A. Clark & Jeremy, 2010; D. B. Clark *et al.*, 2011; Lim, Nonis, & Hedberg, 2006; Thompson *et al.*, 2008).

## Review of literature

### Vocabulary learning and memory models

Following researchers in related studies (Miller & Hegelheimer, 2006; Ming, Ruan, & Gao, 2013; Ranalli, 2008), we also focus on TL vocabulary knowledge as an indicator of educational effectiveness. Theoretical frameworks on vocabulary and memory relevant to the present investigation are connectivity theory and richness of encoding.

Klimesch (2013) proposes connectivity theory, which uses the metaphor of a network of nodes and connectors to explain and predict memory-associated behavior. Nodes are distinct encodings from sensory, motor, and emotive inputs, and are interconnected into networks by associations made through lived experience. Stimulation at any node in a network can trigger retrieval of any other node, hence the greater the complexity of the interconnectedness, the more robust the memory. Macedonia and Klimesch (2014) found evidence to support connectivity theory by showing that novel words were retained longer when they were associated with a gesture than when they were

associated with images. The reason, they argue, is that gestures involve motor as well as visual and tactile input, as opposed to visual input alone, and so serve to generate a larger network. Thus, according to connectivity theory, the greater the number of connections in a network, the more retrievable a word will be.

Richness of encoding has been used to explain memory-based behavior related to situations. Kroneisen and Erdfelder (2011), and Kroneisen, Erdfelder, and Buchner (2013) argue that the richness of encoding framework provides the most suitable explanation for the *survival processing effect*, which is the improved retention of words when perceived as relevant to a survival scenario. The account generally proposes that consideration of the importance of a word's concept to a survival task generates multiple *relevance arguments* that act as memory prompts for retrieval (Kroneisen et al., 2013, p. 495). Additionally, Röer, Bell, and Buchner (2013) found that study participants who self-generated relevance arguments were able to produce more than participants who were provided arguments, and that the number of possible functions correlated positively with retrieval of novel words. Overall, the richness of encoding framework predicts that active participation and relevance to a context enhances learning and retention of words.

## Use of Simulation Games in SLA

The mainstream models of Second Language Acquisition (SLA) have roots in humanist accounts of situated learning as well as social-constructivist concepts of collaborative learning, and thus emphasize application of the TL in authentic communicative contexts. According to Long (1981), language acquisition occurs through interactive exposure to comprehensible TL input and the production of obtained TL output. Additionally, Gass (2000) claims that participation in goal-based communicative activities provide opportunities for learners to actively engage in the refining of their knowledge of TL, facilitating acquisition. The emphasis on using a TL in an authentic communicative situation is compatible with the concepts proposed by Klimesch (2013), and Kroneisen et al. (2013). Such usage would theoretically induce learners to create connections between language structures and situational, emotive, motor-sensory, and grammatical knowledge, thus improving retention and retrieval.

This SLA framework has given rise to the Task-Based Language Teaching (TBLT) practicum (Ellis, 2003; Kumaravadivelu, 2006; Oxford, 2006). Current applications of this approach distinguish between form-focused *enabling tasks* for learning and internalizing discrete skills, and meaning-focused *communicative tasks* for integrating multiple discrete skills (Littlewood, 2004), with the role of the former being to support learner performance in the latter. That

is, enabling tasks are seen as supplementary in that satisfactory performance in a communicative task is considered the central goal of a learning program (Nunn, 2006). From a cognitive processing standpoint, we do not recognize any meaningful difference between enabling tasks and flashcard games, nor between communicative tasks and simulation games. Explanations of these labels from both the fields of applied linguistics and game design are very similar, thus they are reasonably considered analogous (Franciosi, 2011).

As previously mentioned, computer game use in foreign language education typically entails flashcard games, which serve as enabling tasks. At the same time, however, several authors have claimed that simulation games fit well into the TBLT model as communicative tasks. Peterson (2009) argues that computer games may support language learning by involving learners in purposeful task-focused interactions, and also by exposing them to large amounts of TL input. In addition, approaches to learning with simulation games may not just offer extensive opportunities to use the TL, but also provide learning environments that are highly student centered (Ang & Zaphiris, 2006). Furthermore, participation in a simulation game can situate language use in an authentic context (Gee, 2004), and can increase learners' "willingness to communicate" that stimulates interaction (Connolly, Stansfield, & Hailey, 2011; Reinders & Wattana, 2011), which may continue even outside of gameplay (Ryu, 2013). Notably, these possible effects are what communicative tasks in TBLT are designed to induce. Thus, theoretically at least, simulation games are potentially beneficial tools for mediating communicative tasks that could support SLA.

Another conjecture that could be made based on the discussion is that simulation games would have more of an effect on long-term rather than short-term vocabulary retention. Several studies on the extent of processing during encoding have shown greater differences on delayed posttests between experimental and control groups than on immediate posttests (Haratmeh, 2012; Jahangard & Movassagh, 2011; Kim, 2011; Min, 2008; Taheri, 2014). A commonality among the treatment groups in these studies is that, in addition to performing enabling tasks, learners were required to proactively create and/or manipulate a context for the words by using them to compose sentences or communicate concepts with peers to collectively solve puzzles. These tasks are similar to those that players would undertake in a collaboratively played simulation game. On the other hand, the control groups were either provided a preexisting and static context through a passage, or used the words in the limited context of a matching-type drill with little or no authentic relevance to the word. These tasks are similar to those that players undertake in a flashcard game. At the same time, enabling tasks have shown comparable results to communicative tasks in the short term (Jahangard & Movassagh, 2011; Taheri,

2014). Additionally, such results are easily explained with frameworks such as connectivity theory (Klimesch, 2013) and richness of encoding (Kroneisen, Erdfelder, & Buchner, 2013) by positing that authentic contexts for learned words produce more associations with nonverbal types of information, creating more complex networks which are less susceptible to memory decay. On the other hand, enabling tasks focus primarily on reinforcing one association, often between two verbal representations. Thus, the benefits of simulation games on vocabulary learning may include an extended duration that the new information remains accessible.

There is empirical evidence to support the notion that simulation games are effective vocabulary learning tools. Miller and Hegelheimer (2006) demonstrated that the Sims could be used to increase adult learner vocabulary if the game were configured to conform to certain best practices in foreign language education. Specifically, learners should be provided supplementary, form-focused activities (enabling tasks), and given clear goals to accomplish within the game. In a modified replication of this work, Ranalli (2008) found that the vocabulary gains as a result of using the simulation game in this manner were significant among university level international students learning English.

Following these results, there has been a cluster of recent studies focusing on simulation games rendered in 3D virtual environments. Milton, Jonsen, Hirst, and Lindenburn (2012) found evidence of improved fluency and TL exposure in the Vill@ge, an island in Second Life established by the European Lifelong Learning Project. Bakar and Nosratirad (2013) report that the 3D-rendered sequel to the Sims, the Sims 3, could be modified to support vocabulary learning for independent adult learners of English. In a preliminary study, Berns, Gonzalez-Pardo, and Camacho (2013) relate improved learning outcomes using a 3D virtual learning environment constructed with OpenSimulator, a free open source platform developed by IBM. Ming, Ruan, and Gao (2013) describe the preliminary testing of a Mandarin learning system that they are developing which incorporates 3D virtual world and voice recognition technology. Finally, Chen (2014) found vocabulary improvement among students using a 3D virtual learning environment developed with MAYA, Unity, and Photoshop. Thus, the empirical evidence overall appears to support the proposition that simulation games in general, and 3D virtually rendered games in particular, offer effective tools for supporting foreign language education.

### **Limitations of 3D Technology in Educational Settings**

Simulation games appear to be potentially beneficial as language-learning media, and researchers may naturally focus attention on games employing 3D virtual world technology. The attraction of 3D graphic technology is understandable in that it offers a rich sensory experience, while at the same time

there is much evidence to suggest that non-linguistic and/or multisensory input enhances vocabulary retention (Al-Seghayer, 2001; Ikeda, 1999; Sadoski, 2005). Accordingly, Berns et al. (2013) cite the “immersive” quality of 3D environments as rationale for choosing this particular modality (p. 211). However, there are some disadvantages to using games with 3D environments based on technical and operational complexity which could prove prohibitive to adoption in many educational situations.

Liou (2012) studied the use of Second Life as an English learning tool among third-year college students, the majority of whom were preservice EFL teachers at a Taiwanese university. The author claimed that games like Second Life, which depend on an internet server, do not necessarily provide the best learning experience because they require a stable Internet connection. Specifically, anxiety due to unstable access might negatively affect language learning. The study showed that unstable bandwidth accounted for 64% of the students’ frustration with learning English through the game. Furthermore, only a third of the subjects had access to suitable Internet connections outside of the school facilities, hindering most of them from performing extracurricular studies. On the other hand, while it is possible to deploy a game using an in-house server and intranet connection, this would necessitate an understanding of network systems requirements and increase commitment in time and logistical effort on the part of the instructor or institution.

In addition to a stable Internet connection, 3D virtual worlds generally require high-end equipment to run smoothly, but this type of device is not necessarily available in every school or to every learner. In a study conducted in a university in north China on the use of Second Life in an EFL program, Zhang (2013) reported that only 10 out of the 23 students who had originally signed up for the program owned computers that could satisfactorily run the application. By the same token, while Milton et al. (2012) reported that the technology was robust overall, intermittent technical glitches took time from learning interactions. Thus, institutions wishing to use game environments rendered in 3D may be obliged to expend additional resources to ensure that all students have adequate access.

The operational complexity of virtual 3D environments may also present a hurdle for learners. In Milton et al.’s (2012) study of Second Life, the authors found that becoming accustomed to operating avatars, navigating the environment, manipulating objects, and communicating through typed chat takes time for learners, yet adequate mastery of “the business of participating in the environment” (p. 111) is prerequisite to engaging with the TL. Further, learners had to learn a new mode of communication because the chat medium lacked verbal cues to assist communication, and learners reported that turn-taking was challenging. This training period for learners may compel extended

use of the system in order to recover the time invested in learning how to use it. In this sense 3D simulation games are less flexible in that, if employed, they may discourage the use of other effective materials.

Zhang (2013) also points out that 3D environments can be complex not only to learners, but also to teachers, resulting in increased workloads. In order to take full advantage of the technology, instructors are expected to have a reasonable level of IT literacy, which is often absent (Mishra & Koehler, 2006). Zhang (2013) claims that learning was frequently hindered by the teacher's lack of IT knowledge, and in order to assist their students in playing the game, teachers had to do more preparation work. At the same time, many foreign-language educators balk at the prospect of adopting technology-supported instructional methods because they already feel that they have a high work load (Franciosi, 2014). Moreover, according to Zhang (2013), the 3D virtual environment can make adequate monitoring of all students more challenging compared to a conventional classroom setting for many teachers with limited technical know-how.

## Summation and Hypotheses

The reviewed literature suggests that simulation games can serve to contextualize TL use within narratives, inducing learners to generate multiple connections between new vocabulary and episodic, emotive, motor-sensory, and linguistic memory networks. However, some sources report problems associated with some 3D virtual worlds that may render them impractical for use outside of a laboratory setting. However, there is a possibility that less technologically sophisticated (more versatile) games could also provide an educational benefit, making it worthwhile to investigate the relationship between gameplay with a simple simulation game and language learning outcomes.

There are many examples of simple simulation games that provide a scenario involving a problem to be solved and an interactive narrative, and additionally provide an element of fantasy. Examples include 3rd World Farmer (University of Copenhagen), Energy City (Filament Games), Medical School (ScrubGames.com), Pandemic 2 (Dark Realm Studios) and Platform Wars (MIT Sloan School of Management). Most of these games also include graphic renderings, but use 2D rather than 3D representations, and so do not necessitate the presence of high-end infrastructure. In addition, the operational complexity is generally simple, precluding the need for lengthy training sessions. An additional benefit is that many of these types of games are available free of cost. As a result, they are much more versatile than 3D games in that they may be used on a broader range of devices, and for shorter installments in a curriculum in conjunction with other materials. As they are less technically and operationally complex, they may be more readily adopted in actual educational contexts.

Furthermore, the literature on cognition, memory, and vocabulary learning suggests that the effect of using learned words in an interactive problem solving context such as a simulation game may be apparent over the long rather than the short term. Since the literature does not indicate an immediate benefit of engaging actively with a word's context through the use of a simulation game, we formulated the following hypotheses:

- H1: Collaborative gameplay using a simple simulation game in conjunction with flashcard games is not more effective than using flashcard games alone in facilitating short-term vocabulary retention.
- H2: Collaborative gameplay using a simple simulation game in conjunction with flashcard games is more effective than using flashcard games alone in facilitating long-term vocabulary retention.

## Method

The present study is a quasi-experimental investigation of the effect of gameplay with a simple simulation on TL vocabulary learning and retention. It is a quasi-experimental study because it employs a sample of convenience and purposive sampling using whole groups comprising existing classes. However, we undertook various procedures described below to strengthen the internal validity of the data.

### Sources of Data

The population studied in the present investigation was comprised of 213 students enrolled in EFL courses taught by the principal investigator at a Japanese university. Since we had no control over which students would enroll in the classes, and since we decided, for logistical purposes, to compartmentalize treatments within classes (i.e., all members of the same class would receive the same treatment: experimental or control), we employed purposive sampling to assign whole classes into two groups of comparable size. One group was designated as the simulation game group (SIMG) and the other was designated as the control group (CNTRL).

### Tools

#### Simulation game

We adopted 3rd World Farmer as the treatment tool for the present study. The game simulates agricultural activity in a fictional location in Africa in which the players take on the role of a small farming family. It requires players to make decisions regarding the purchase of crop seed, tools, livestock, farm facilities, and local infrastructure. The game also requires players to make family-related decisions such as whether or not to bear children, and whether the children will attend school or work on the farm. The operation of the

game is highly intuitive, only requiring players to select options from menus. Each turn covers one year, and the game algorithm generates the outcome of a growing season in terms of dollars based on such factors as market prices for crops selected, the labor capacity (health) of the family, sociopolitical occurrences in the fictional country where the farm is located, and weather-related events. Players win by gaining sufficient economic stability to ensure survival, and lose if all family members are either deceased or have left the farm.



**Figure 1:** Screenshot of 3rd World Farmer. Used with permission of the 3rd World Farmer Team.

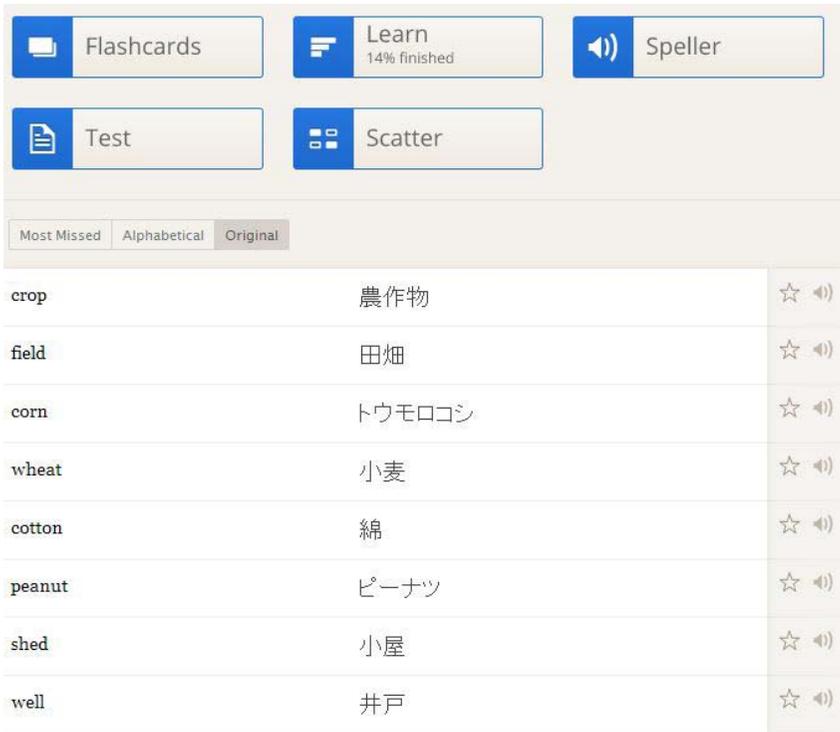
### Measurement instruments

We examined the simulation and produced a list of 29 words which we considered to be both important to operating the game correctly and unlikely to be familiar to study participants. The list was used to generate three vocabulary quizzes presenting the words in random order. Since nearly all participants were native speakers of Japanese, and since the small number of non-Japanese was determined to be comprised of highly proficient speakers of Japanese, we configured all the vocabulary quizzes to provide the Japanese version of the word and require the respondent to write in the English version (see Appendix A for the complete list). All three quizzes tested knowledge of all 29 words, but presented items in different random orders.

### Flashcard games

We adopted Quizlet as a flashcard game. Although this web service offers five study activities, two of which are billed specifically as games, all are based

on a simple matching mechanic and so are representative of what we consider flashcard games (see Figure 2). We created a study set in Quizlet using the list of 29 words. Based on the same reasoning for configuring the vocabulary quizzes, we created pairs with the words so that users would be required to match the English versions with their Japanese counterparts. The study set was added to a class created in Quizlet to allow the researchers to monitor use and control access by study participants.



**Figure 2:** Screenshot of Quizlet study set. Used with permission of Quizlet.

## Procedures

Treatment and data collection took place on four separate occasions during regular class meetings over the course of a 14-week semester. Regular class meetings were held once a week for 90 minutes. In the first meeting, the principal investigator explained the purpose of the project and the conditions of participation. Subsequently, all participants were pretested with a paper-based protocol using one of the three vocabulary quizzes.

During the second meeting, classes designated as SIMG were conducted as follows: The participants were given a demonstration on the use of the various

Quizlet study activities. They were subsequently allowed to use any one or more of the activities for approximately 40 minutes. During the second half of the period, they were divided into small teams of four to five to play 3rd World Farmer. We demonstrated the operation of the game for approximately five minutes before the teams commenced playing. Students were formed into small groups of four to five randomly, and each group used one computer to run the simulation. Teams played the game for approximately 35 minutes, working face-to-face to collaboratively formulate strategies and make decisions regarding which crops to plant, tools or livestock to buy, etc. During the final five minutes of the period, a debriefing session was held in which teams compared winning and losing strategies. Notably, the students were able to play the game on a variety of student-provided devices in classrooms lacking full Wi-Fi signals. There were no technical issues reported.

The second meeting of classes designated as CNTRL was conducted as follows. The participants were given a demonstration on the use of the various Quizlet study activities. They were subsequently allowed to use any one or more of the activities for the remaining 80 minutes of the period. The treatment time for both SIMG and CNTRL was approximately the same, carried out within a 90-minute period. When all classes had completed the second meeting, access to the Quizlet set for the 3rd World Farmer vocabulary list was closed.

During the third meeting in the following week, all participants were tested on the vocabulary list with an immediate posttest (IPT). Participants were then instructed to forgo playing the game or studying vocabulary lists related to the game for the remainder of the semester. The final delayed posttest (DPT) was administered 11 weeks after treatment at the end of the semester.

## Results and Analyses

The pretest, IPT and DPT were scored using absolute binary criteria. That is, no partial scores were awarded for responses that were partially correct. Individuals who opted out of participation or did not participate fully (i.e., exhibit a pretest, IPT, DPT, and record attendance during treatment sessions) were excluded from the data set. A large number (41, approximately 24%) opted out, failing to attend either data collection or treatment sessions. We attribute this to the facts that participation was uncompensated and voluntary, in conjunction with a notably high rate of absenteeism among Japanese university students (McVeigh, 2002, p. 188). The result was a sample of  $n = 89$  for SIMG and  $n = 73$  for CNTRL (total = 162). The data was inputted into NCSS 9 for analysis.

### Chi-Square Tests

Some demographic information was available through enrollment records, so we were able to account for three variables which could arguably influence the experimental results. First, the variable of grade (denoting first-, second-, third-, or fourth-year student) may reflect preexisting English proficiency by virtue of the number of EFL courses completed in college (members of the population in question are typically required to complete four EFL courses, and up to eight are available as electives). Therefore, to determine whether SIMG or CNTRL represented a greater number of older students, we cross-tabulated the group variable with grade and tested relationships using a chi-square statistical model. In order to achieve a valid test result (fewer than 20% of cells with an expected value of less than 5, and no cells with an expected value of 0), and because there was a small number of third and fourth year students, we collapsed the second-, third-, and fourth-year students into one category. The results were significant ( $\chi^2(1, n = 162) = 12.24, p = 0.00047$ ), with SIMG comprising a disproportionately large percentage of first year students compared to CNTRL (see Table 2).

Furthermore, nationality (Japanese or non-Japanese) is also a variable which could arguably influence the experimental results as country of origin may influence English proficiency (Educational Testing Service, 2012). However, there were insufficient numbers of non-Japanese nationals ( $n = 7$ ) to yield a valid chi-square test result.

Gender may also possibly influence experimental results because of variation in orientation toward technology and/or games (Bonanno & Komers, 2007; Cockburn & Ormrod, 1993). Thus, we cross-tabulated group with gender and tested significance using a chi-square statistical model. The results showed no differences between the SIMG and CNTRL based on gender. The demographic information of the groups is summarized in Table 2.

**Table 2:** Demographics of Study Participants ( $n = 162$ )

Variable	SIMG	CNTRL	p
Grade			
1st-year students	50	21	0.0018*
2nd–4th-year students	39	52	
Nationality			
Japanese	86	69	N/A
Non-Japanese	3	4	
Gender			
Male	58	49	0.793
Female	31	24	

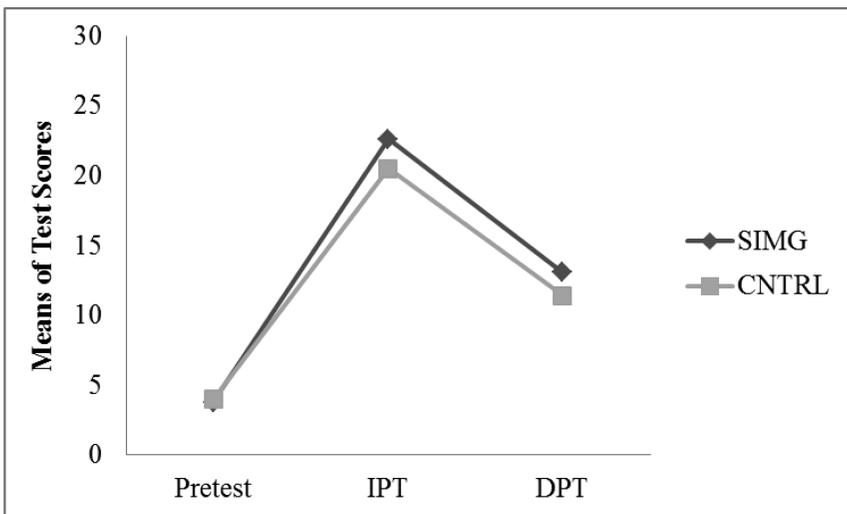
\* $p < 0.05$

### T-Tests

**Pretest.** A two sample *t*-test conducted to compare pretest scores at a 95% confidence interval ( $p < 0.05$ ) showed no significant difference between SIMG ( $M = 3.8$ ,  $SD = 1.9$ ) and CNTRL ( $M = 4$ ,  $SD = 2.6$ );  $t(160) = 1.98$ ,  $p = 0.52$ . This result indicates that both groups were beginning the treatment conditions at more or less the same level of knowledge of the words. Furthermore, the mean scores were very low, indicating that the selected vocabulary items were for the most part unknown to participants prior to participation in the study.

**IPT.** A two sample *t*-test conducted to compare IPT scores at a 95% confidence interval ( $p < 0.05$ ) showed no significant difference between SIMG ( $M = 22.6$ ,  $SD = 7.3$ ) and CNTRL ( $M = 20.5$ ,  $SD = 9.3$ );  $t(160) = 1.98$ ,  $p = 0.12$ . Although SIMG's improvement was slightly greater than CNTRL's, the comparison showed no significant difference. This result supports H1 of the present study, which proposes that gameplay using a simulation game offers no short-term advantage over flashcard games for learning TL vocabulary.

**DPT.** A two sample *t*-test conducted to compare DPT scores at a 95% confidence interval ( $p < 0.05$ ) showed a significant difference between SIMG ( $M = 13.12$ ,  $SD = 4.86$ ) and CNTRL ( $M = 11.44$ ,  $SD = 5.4$ ) groups;  $t(160) = 1.98$ ,  $p = 0.038$ ,  $d = 0.329$ . This result indicates that while the average score for both groups fell over time, SIMG displayed slightly superior long-term word retention. Thus, H2 of the present study, which proposes that collaborative gameplay using a simple simulation enhances the long-term retention of TL vocabulary, is supported. Results are summarized in Figure 3.



**Figure 3:** Relative changes in mean scores between measurements. Note. IPT = treatment + 1 week; DPT = treatment + 11 weeks.

## Discussion

The results of the present study support the notion that simple simulation games are useful for grounding TL use in authentic contexts and collaborative, goal-oriented tasks, thus improving long-term retention of vocabulary. Theoretical frameworks are available to account for this phenomenon. Under the richness of encoding framework (Kroneisen et al., 2013; Röer et al., 2013), we propose that using a concept represented by novel linguistic labels to make strategic decisions in a given scenario forces players to consider what role the concept plays within the scenario, and how it might influence the formation of future states in the narrative. This would encourage the creation of relevance arguments between the word and higher-order contextual representations that may entail a wide array of motor, sensory, and emotive memories. In accordance with connectivity theory (Macedonia & Klimesch, 2014), the number of associations between a word and other non-linguistic representations is significant in that a higher frequency of such relationships slows the deterioration of retrieval capabilities. Thus, simulation games enhance long-term retention of a vocabulary item by encouraging the creation of an extensive number of associations between a TL word and relevant non-linguistic representations.

However, there remains a question as to whether simple simulation games can be recommended to instructors as practical language learning tools. Notably, the effect size ( $d = 0.329$ ) of the treatment was “small” according to Cohen’s (1988) benchmarks, while both groups displayed large gains after studying the vocabulary list, as well as considerably diminished scores after 11 weeks of neglecting the words. Thus, it is uncertain whether achieving such a small effect size is worth the effort of adding a simulation game to course materials. To address this issue, we must first consider the time factors in the present study design.

The small effect size may be a result of the time allotted for the type of activity performed by the students. SIMG used the form-focused Quizlet for only half the time allowed to CNTRL. At the same time, literature reviewed by Sadoski (2005) suggests that this shorter focus on form may have negatively impacted the ability of SIMG to suitably respond to the test items due to spelling errors, even though students may have correctly remembered word meanings and/or pronunciations. In other words, had either the measurements been comprehension based (i.e., view written English and write the Japanese) rather than production based (i.e., view the Japanese and write the English), or had SIMG been allowed to use Quizlet for the same amount of time as CNTRL, the effect size may have been larger. In addition, Haratmeh (2012) argues that meaning-focused activities, such as simulation games, involve a longer time on task compared to form-focused activities by nature of their

design. From a brain science perspective, vocabulary learning may require more time in a meaning-focused activity compared to a form-focused activity due to the richness of associated nonlinguistic information present at the time of encoding (Takashima, Bakker, van Hell, Janzen, & McQueen, 2014). Thus, the effect size may have been larger if the students had been allowed more time to play the simulation relative to the time they were actually allowed. In other words, in attempting to control for time on task in our research design, we may have applied the activities in an unsuitable manner resulting in less than optimal outcomes.

It is also important to note that, while improved vocabulary retention among SIMG was not dramatic, it was present nonetheless. In other words, playing the simulation (even at the expense of time allotted to more commonly recognized modes of CALL) did not have a negative impact on outcomes. This result is meaningful because improved learning outcomes are not the only basis for using simulation games as meaning-focused learning activities. There is much literature to suggest that game-based learning has a positive effect on learner motivation (Ballou, 2009; Coleman, 1990; Connolly et al., 2011; Liu & Chu, 2010; Roubstova, 2010; Suh, Kim, & Kim, 2010; Tao, Cheng, & Sun, 2009). Also, there is evidence that meaning-focused tasks improve fluency even if they do not offer an advantage in terms of accuracy (Arslanyilmaz, 2013). Therefore, instructors should not consider simulation games an impediment to certain aspects of TL development if they are considering games as a means of fostering motivation.

Yet, educators may eschew adopting games for use in their classrooms due to the perceived complexity in implementation, a viewpoint which has grounds in the empirical evidence, particularly regarding those that employ 3D virtual world technology. However, the present study suggests that practitioners may be able to obtain the motivational and educational benefits of simulation games without having to cope with overly complex technologies. Simple simulation games offer a ready means for incorporating digital game-based learning into foreign language classrooms for educators with limited infrastructure resources, technical savvy, and/or considerable workloads.

The present study was limited by the lack of random selection in the population sampling. In particular, SIMG represented a disproportionately high number of freshmen compared to CNTRL. However, this specific attribute's effect in the present study is questionable. We could argue, for instance, that older students may have higher English proficiency by virtue of more EFL classes taken, and that this higher proficiency could lead to more exposure to English, resulting in a greater likelihood of retention. Yet, despite comprising more young students than CNTRL, SIMG was better able to retrieve the

vocabulary items over the long term. Thus, the role of age or class seniority in the present study may not be meaningful. On the other hand, since learning with computer games is relatively unknown in many EFL contexts in Japan, we may also argue that the older students were accustomed to learning a certain way, and the online activities fell outside of their expectations, hindering performance. Only further research may resolve this uncertainty.

The present study was further limited by the fact that we could not strictly control participant action outside of the classes in which they were enrolled. It is possible that some SIMG participants did not follow instructions and continued playing 3rd World Farmer over the course of the semester, although none reported doing so. Also, many students were enrolled in other EFL courses where they could have had exposure to words or concepts from the vocabulary list. Another factor that was unaccounted for was student motivation. Two of the classes that participated in the quasi-experiment were elective EFL courses, where students are reputed to be more actively engaged in English learning tasks. Both of these classes were assigned to CNTRL in the present study, which raises the possibility that a greater effect size would result if random selection were employed. In the future, we would like to test whether the present results replicate in a setting where more of the variables can be controlled.

## Conclusion

We reported a quasi-experimental test of the effectiveness of a simple simulation game on long-term foreign language vocabulary retention. Several studies have suggested that simulation games present a means of achieving desirable learning outcomes, as well as of engaging learners. However, many simulation game systems require fairly sophisticated technical savvy and high-end infrastructure to operate effectively, and are simply too complex for widespread use in all foreign language educational contexts. We therefore wanted to determine whether comparatively simpler and more user-friendly simulation games would provide an educational benefit. Our results suggest that gameplay with a simple simulation does enhance long-term vocabulary retention, thus we conclude that such activities may be beneficially applied in the acquisition of foreign language vocabulary.

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## Appendix A

### Vocabulary list from 3rd World Farmer game

1.	～を略奪する	plunder
2.	トラクター	tractor
3.	トウモロコシ	corn
4.	ピーナツ	peanut
5.	議員	representative
6.	田畑	field
7.	ゲリラ (兵)	guerilla
8.	家畜 (類)	livestock
9.	民兵組織	paramilitary
10.	シャベル	shovel
11.	畜牛	cattle
12.	綿	cotton
13.	エーカー	acre
14.	{農具の} すき	plow
15.	家畜小屋	barn
16.	農作物	crop
17.	難民	refugee
18.	収穫機	harvester
19.	小屋	shed
20.	産出量	yield
21.	急襲する	raid
22.	[草刈りや刈り入れ用の] 大鎌	scythe
23.	診療所	clinic
24.	市民軍	militia
25.	小麦	wheat
26.	井戸	well
27.	肥沃な	fertile
28.	干ばつ	drought
29.	収穫する	harvest