

The Effect of Computer Game-Based Learning on FL Vocabulary Transferability

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ABSTRACT

In theory, computer game-based learning can support several vocabulary learning affordances that have been identified in the foreign language learning research. In the observable evidence, learning with computer games has been shown to improve performance on vocabulary recall tests. However, while simple recall can be a sign of learning, observation of skill application in communication is a better indicator of skill mastery. Further, observing this use in separate communicative contexts could constitute evidence of transferability of skills. Hence, this paper presents the results of two investigations of learning outcomes in EFL classes at a Japanese university using computer game-based lessons. The first study was a quasi-experiment comparing use of targeted words in a writing task between a group of students who participated in a computer game-based lesson, and a group of students who did not. The second study was a cross sectional analysis comparing use of targeted vocabulary in a writing task with amount of participation in computer game-based lessons. The results suggest that computer game-based approaches to foreign language education in real-world classrooms can improve transferability of learned vocabulary.

Keywords

Computer game-based learning, Foreign language learning, Vocabulary learning, Transferability

Introduction

This paper reports on two studies to examine the effectiveness of computer game-based approaches in foreign language learning. A game-based approach follows mainstream foreign language education models that prescribe a “meaning-focused” activity wherein learners apply the target language to perform a task, supported by “form-focused” enabling tasks wherein learners learn and/or practice linguistic form, and followed by a post-activity phase for reflection and knowledge construction (Ellis, 2003). “Game-based” here simply denotes the use of a computer simulation game as the meaning-focused activity.

Computer games could theoretically provide several language learning affordances described in the literature on second language acquisition, and a growing body of empirical data on game-based approaches showing improved retention of learned words supports this notion (e.g., Ranalli, 2008).

This paper seeks to address two issues with the extant literature. Firstly, studies showing positive impacts on vocabulary acquisition as a result of using games rely heavily on data elicited with contrived vocabulary testing instruments as indicators of word retention, but many SLA researchers consider language data produced spontaneously in communicative acts as a more direct indicator of foreign language ability (Norris & Ortega, 2003). Secondly, simple retention may not be the only benefit of providing these learning affordances. Klimesch’s (1994) Connectivity Theory predicts that the same learning affordances that improve performance on recall tests can promote transferability of learned words. It is important to attain evidence that instructional techniques can enhance transferability if the goal of foreign language education is to foster the skills needed to use the language in various communicative contexts.

In view of the preceding, the purpose of this paper is to report the results of two studies of vocabulary learning outcomes from EFL lessons employing *Energy City*, an online simulation game, as core material in the meaning-focused activity. The first study was a quasi-experiment comparing spontaneous usage of targeted vocabulary in a writing task between a group of learners who learned the words in a drill application and subsequently used the words in a game-based lesson, and a group of learners who learned vocabulary with the drill application alone. The second study was a cross-sectional analysis of student work comparing amount of game-based learning with *Energy City* to spontaneous usage of targeted vocabulary in a separate writing task.

Review of literature

Vocabulary and game-based language learning affordances

Language use

The literature suggests that the use of targeted vocabulary in the proactive performance of some type of task improves recall of those words. Output-oriented activities such as writing facilitate word retention more than reading (Mármol, & Sánchez-Lafuente, 2013; Jahangard & Movassagh, 2011), and sentence scramble exercises are more effective than gap-fill (Haratmeh, 2012). Input-oriented tasks also appear to positively influence vocabulary acquisition when learners are required to perform an action based on the meaning of the input (Shintani, 2012). Overall, these studies support the notion that using language in the performance of tasks requires more “depth of processing,” proposed by Craik and Lockhart (1972). Deeper processing implies extensive cognitive processing such as that involved in searching and decision making, and is posited to facilitate learning and retention.

The proactive role of the player in games could facilitate deep processing of concepts represented by targeted words. Agency is an integral component of games and gameplay (e.g., Gee, 2005; Salen & Zimmerman, 2004). The ability to influence the game system presumably requires players to consider, before taking action, how various factors might influence future game states, and the nature of possible outcomes. This premeditation could evoke the deep processing proposed by Craik and Lockhart (1972). Thus, agency may positively influence vocabulary learning and memory.

A further way that gameplay could influence the use of learned vocabulary is through spontaneous and/or informal communication between game players outside of the game itself. Games are known to engender communities of players that engage in considerable knowledge sharing (Nardi, 2010). Ryu (2013) analyzed discourse generated by an online game community and concluded that this aspect of “game culture” provides ideal opportunities for foreign language learning and practice. Additionally, gameplay has been shown to lower inhibitions and stimulate meaningful communication among language learners (Reinders & Wattana, 2011; Wu, Chen, & Huang, 2014). Thus, games seem capable of facilitating natural discourse among players.

In addition to spontaneous and informal communication, game-based learning can also involve formalized discourse. Most game- and simulation-based learning scholars are strong advocates of including debriefing as an integral component of instruction (Crookall, 2010). The insistence that debriefing be included is based on Kolb’s (1984) idea that learning optimally comprises experiences (such as gameplay) interspersed with periods of reflection on those experiences. For example, Kriz (2008) prescribes a semi-structured discussion approach to guiding post-game discussion, and Oertig (2008) reports on the use of a forum to allow learners to share written debriefing reports. While the objective of debriefing for these authors is presumably to learn about non-linguistic concepts in a game or simulation, the process of debriefing itself obviously involves communicative use of language. Whether using language to communicate about a game is spontaneous or formalized, spoken or written, the literature reviewed here indicates that doing so has a beneficial impact on vocabulary learning and memory.

Association with non-linguistic information

Association of linguistic and non-linguistic information has also been found to facilitate vocabulary learning and memory. Such information includes audiovisual cues (Chuang & Ku, 2011), particularly dynamic images as in video (Al-Seghayer, 2001; Hsu, 2014), as well as iconic physical movements such as gestures (Macedonia & Klimesch, 2014). The presence of non-linguistic information at the time of learning seems to involve activation of areas of the brain associated with non-linguistic as well as linguistic processing, and this increased activity correlates with superior performance on recall tests for novel words (Takashima, Bakker, van Hell, Janzen, & McQueen, 2014). Thus, diversity of information available to a learner at the time of learning may have a positive impact on vocabulary retention.

Computer games can present non-linguistic (audiovisual) information together with targeted linguistic constructs. Sophisticated graphics and audio are commonly considered fundamental components of most computer games (Rollings & Adams, 2003; Rouse, 2005). Although the literature cited above indicates that associating words with images and sounds enhances recall, the studies on the effects of multi-media game environments on learning demonstrate mixed results. For example, “low-immersive” environments appear to

assist learning more than “high-immersive” ones (Schrader & Bastiaens, 2012), but 3D virtual world environments have been reported to be superior to standard paper textbooks (Barab et al., 2009). However, Neville and Shelton (2009) point out that sensory immersion can and should be adjusted to accord with specific learners and learning goals. In sum, the literature indicates that non-linguistic sensory information in games may support vocabulary learning provided that it is not overwhelming.

Association with interesting scenarios

Learners recall words more readily when they judge the concepts represented by the words as success-relevant to a compelling problem-solving scenario. Novel words for items relevant to a survival scenario in the wilderness are better recalled than novel words related to moving a residence in the city (Nairne, Thompson, & Pandeirada, 2007), and this “survival processing effect” may result from a sense of urgency that motivates learners to brainstorm multiple roles for these items (Toyota & Kikuchi, 2005). Interestingly, Soderstrom and McCabe (2011) discovered that learners are more likely to recall words relevant to a survival scenario involving zombies compared to one involving natural predators or human attackers, suggesting that strong affective factors (e.g., fear, excitement) related to an imagined scenario can play a role in facilitating memory and recall. Overall, this research indicates that level of interest in a scenario can influence vocabulary learning.

One of the hallmarks of many games, particularly those commonly classified as belonging to the role-playing, simulation or strategic genres, is the creation of compelling stories comprised of interrelated situations. Game designers strive to give players an obstacle to overcome, a problem to solve, or a decision to be made in each situation (Koster, 2005). Ideally, these challenges motivate learners to search for a variety of problem-solving means. Further, strong emotions may also result when the nature of the contrived situations matches the interests of the players, but not every challenge or scenario presented by a game is compelling for every learner (Schell, 2008). Therefore, games could facilitate vocabulary learning depending on the extent to which learners are interested in the subject matter represented by the game.

Evidence of language learning in games

Several studies have uncovered evidence of efficacy regarding vocabulary learning in computer games and simulations. These studies have used a variety of measurement protocols, such as vocabulary recognition, multiple choice, matching, cloze tests (Bakar & Nosratirad, 2013; Berns, Gonzalez-Pardo, & Camacho, 2013; Chen, 2014; Milton, Jonsen, Hirst, & Lindenburn, 2012; Ranalli, 2008), and a Vocabulary Knowledge Scale in which participants self-report on their mastery of a word (Smith et al., 2013). Thus, the effectiveness of computer games in vocabulary learning has been demonstrated.

The aforementioned studies largely relied on decontextualized measures of lexical knowledge to make their conclusions, with the exception of Milton et al. (2012) who also analyzed discourse generated among learners during gameplay. Such instruments are useful for indicating retention, but the extent to which they can be used to demonstrate transferability is more tenuous. Even in the case of Milton et al. (2012), the implications for transferability are unclear because the language analyzed was produced during the learning activity studied. Furthermore, while data obtained with elicitation devices such as quizzes and tests can be useful indicators of second language development (Ellis, 2008), spontaneous use of language in a communicative act is usually considered a more convincing sign of actual linguistic proficiency (Norris & Ortega, 2003). Furthermore, in Hsu’s (2014) study of audiovisual aids for writing, the author considered such use of vocabulary as more indicative of mastery than passive word recognition because the choice of words to produce was left to the learners who were free to, “avoid words that they considered problematic or were unsure of,” (p. 62). The present author further assumes that “mastery” of a skill entails the ability to use it productively in a variety of contexts, and thus use of vocabulary from a game in a separate task would suggest that game-based learning improves transferability of targeted words.

Learning and memory theory

In Connectivity Theory, Klimesch (1994) posits the metaphor of interconnected nodes to describe knowledge structure. Nodes represent a variety of information such as motor-sensory, emotional, and linguistic. Nodes become associated with each other in learning, and can have connections with multiple nodes forming a network. Klimesch posits that increased complexity of a network in terms of number and variety of connections increases

the retention and accessibility of the information contained therein. This notion is supported by Macedonia and Klimesch (2014), cited above, who found evidence that associating novel words with physical movements improves long-term retention. Klimesch's conceptualization of learning and memory is compatible with the observed evidence cited above. Deep processing, association with audiovisual information, and compelling problem-solving scenarios that evoke strong emotions would all serve to increase the number of interconnections and diversity of nodes in a network.

A further logical extension of the connectivity account of vocabulary knowledge is that the more interconnected a target language word becomes, the more transferable it is (i.e., the more readily it becomes usable in separate contexts). The reason is that nodes forming one network may belong to multiple separate networks which could be relevant for a variety of communicative situations. Thus, the more complex the network to which a target language word belongs, the more likely it would be usable in a situation outside of the environment in which it was learned. Learners using words spontaneously in a communicative act outside of the context in which they were learned would support the Connectivity account of knowledge structure, and constitute evidence of transferability.

Study 1

Method

The first study was a quasi-experiment comparing quantitative use of targeted vocabulary in a writing task between a group of learners who learned vocabulary with a drill application and subsequently used the words in a game-based lesson, and a group of learners who learned vocabulary with the drill application only.

Participants

This study employed a sample of convenience using students enrolled in four EFL courses taught by the author at a Japanese university. All classes were required general education courses for first and second year students. The nature of participation in the study was contingent on internet availability. One of the four classrooms was equipped with wireless network antennae allowing internet access from student laptop devices, so the author determined to employ game-based lessons using an online computer game in this class ($n = 23$), and compare learning outcomes with the remaining three classes ($n = 61$).

Instructional materials

Energy City

The online game simulates energy production and conservation strategies in urban settings (Figure 1).

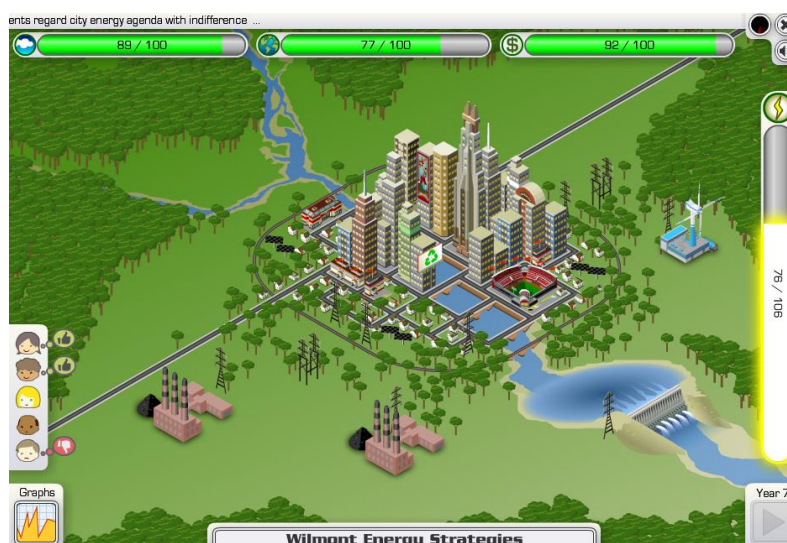


Figure 1. Screenshot of *Energy City*

This activity is considered “meaning-focused” in that while linguistic labels and explanations for important features are provided, operation of the simulation requires attention to be paid primarily to non-linguistic factors, such as the relative costs and benefits of various energy production technologies. The object of the game is to plan and implement a virtual city’s energy portfolio in order to maintain a sufficient supply of electricity over the course of twenty turns without overly imparting damage to the environment or depleting the city budget. The author chose this game because he assumed that the topic would be a compelling one for Japanese students given the increase in public discourse on the topic following the Fukushima nuclear disaster (Aldrich, 2013).

Debriefing session

The author included a debriefing session as an integral component of game and simulation based instruction according to best practices in game-based learning (Crookall, 2010). Following the tenets of Experiential Learning Theory (Kolb, 1984), the purpose of debriefing components is to facilitate critical reflective thought following experience in meaning-focused activities, thereby supporting new knowledge synthesis. The session was a semi-structured discussion generally following Kriz’s (2008) recommendations. The discussion followed five questions designed to elicit commentary on:

- affective state as a result of the experience
- memory of details
- new information garnered
- possible real-life applications of that information
- future plans for continued learning

Enabling task

Best practices in foreign language instruction prescribe the use of a form-focused enabling task to support language learning and accuracy (Ellis, 2003). Form-focused activities are typically characterized by repeated application of a narrow skill set. Hence, the present author made a study set in the online vocabulary learning application, *Quizlet* for 33 keywords from *Energy City* which, in the author’s judgment, were likely unfamiliar to most of the learners. *Quizlet* supports six learning activities designed to train a variety of form-focused vocabulary skills, such as word recognition and spelling. The core mechanic for each of these activities is matching, and because all of the participants were either native or fluent speakers of Japanese, the author configured the study set so that learners would be required to match targeted English vocabulary items with their Japanese counterparts.

Data collection tools

Vocabulary pretest and posttest

Because this study did not involve random selection, the author used a vocabulary recall test to establish a baseline for preexisting knowledge of the words in the vocabulary list as a means of improving validity. Additionally, in order to account for variation in mastery of the vocabulary items through use of *Quizlet*, the author also developed a post test. Items prompted respondents to write an English word by showing the Japanese counterpart. Both instruments tested knowledge of all 33 words in the *Quizlet* study set in separate random orders. The instruments were deployed on a Google form and scored with a search algorithm in a Google sheet.

Writing task

The author collected data on word use using a short writing task. Participants responded in two paragraphs to two writing prompts. The first paragraph was designed to be expository, wherein participants were asked to describe the current state of energy supply and use in Japan in approximately 50 words. The second was designed to be persuasive, wherein participants were asked to describe how they would change the status quo if they could or would in approximately 100 words. This task was deployed on a paper-based instrument, and later inputted into a Google sheet for scoring with a search algorithm that counted unique occurrences of targeted words in the text.

Procedures

Instructional treatment followed class schedules for Japanese universities, which hold classes once a week for 90 minutes. Treatment began in the second week of the semester after enrollment had closed.

Game-based learning group

In the initial treatment session, the students were pretested in class on their mobile devices (ownership of which was determined to be ubiquitous) and assigned the *Quizlet* study set as homework. They were informed that they would be tested again on the vocabulary items the following week. In the second session, the students were first post-tested for mastery of the vocabulary list, after which *Energy City* was introduced and demonstrated on a large screen for approximately ten minutes. Students were then asked to play the game in small groups of three to four members on their own laptop devices for up to 60 minutes. The author provided students with paper copies of the debriefing report questions, informed them that these would be discussed in class the following week, and invited them to prepare their responses. In the final session, students debriefed in small groups and the writing task was assigned to be completed in class without dictionaries.

Control group

In the initial treatment session, the students were pretested in class and assigned the *Quizlet* study set as homework so that the quasi-experimental comparison would focus on the game/debriefing method. Students were informed that they would be tested again on the vocabulary items the following week. In the second session, the students were posttested in class and the writing task was assigned to be completed in class without dictionaries.

Analyses and results

Pre- and posttests and the writing task scores were inputted into NCSS 9 for analysis. An ANCOVA was conducted to determine any difference in the amount of targeted words used in the writing task between the game-based lesson group and control group, while accounting for preexisting knowledge of the words by using the pretest scores as covariate. There was a significant effect of game-based learning on the number of vocabulary list words used in the writing task after controlling for pretest scores; $F(1, 81) = 10.41, p = .002$. Omega squared was selected as benchmark for effect size because it is considered the least biased indicator when dealing with relatively small sample sizes, such as in the present study. Thus, the effect size was determined and interpreted as “medium” ($\omega^2 = 0.1$) according to Field’s (2013) guidelines (p. 474) by calculating omega squared according to the following equation:

$$\omega^2 = \frac{SS_{Effect} - (df_{Effect})(MS_{Error})}{SS_{Total} + MS_{Error}} = \frac{40.5 - (1)(3.9)}{360.7 + 3.9} = 0.1$$

A second ANCOVA was conducted to determine any difference in the amount of targeted word usage between groups while accounting for variation in mastery of the vocabulary with *Quizlet* by setting the posttest scores as covariate. Significance was detected in this test as well; $F(1,81) = 10.13, p = .002$. The effect size was determined and interpreted as “medium” ($\omega^2 = 0.09$) according to Field’s (2013) guidelines (p. 474) by calculating omega squared according to the following equation:

$$\omega^2 = \frac{SS_{Effect} - (df_{Effect})(MS_{Error})}{SS_{Total} + MS_{Error}} = \frac{37.8 - (1)(3.7)}{360.7 + 3.7} = 0.09$$

As shown in Figure 2, students who experienced the game-based lesson after learning with *Quizlet* used words from the study set an average of approximately four times in the writing task, with 50% of them using between two and five of the words. By contrast, students that only learned with *Quizlet* used an average of approximately two of the words, with over 75% of them using fewer than four.

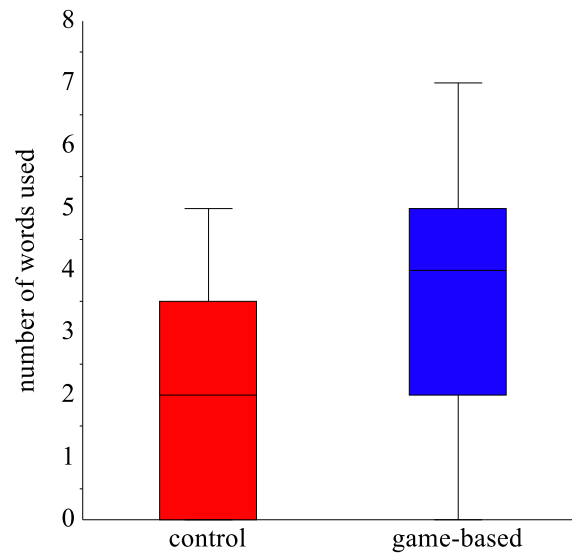


Figure 2. Number of targeted words used by group

Study 2

Method

The second study was a cross-sectional analysis of student work comparing amount of game-based instruction with *Energy City* to spontaneous usage of targeted vocabulary in a separate writing task. This investigation relied on natural variation in student completion of class work to indicate causal relationships.

Participants

The study employed a sample of convenience from students enrolled in four EFL courses taught by the author at a Japanese university ($n = 143$). The classes were the same as in Study 1, but held in the following semester with a different group of students.

Instructional materials

This study employed the same simulation game and enabling task used in Study 1. One important difference in use was that instead of playing only one of the six city scenarios available in *Energy City*, Study 2 utilized all six. Also, the questions for the debriefing report were deployed online using a Google form.

Data collection tools

This study employed the same writing task and scoring algorithm as described in Study 1. Additionally, the present author asked the students to submit a score from the *Quizlet* test activity. The test activity of *Quizlet* randomly generates a 20-item test employing written, matching, multiple choice and true/false questions. Finally, the author assumed that the number of debriefing reports submitted online was an indicator of the amount of participation in game-based learning (i.e., the assumption is that no student submitted a report without first playing the game).

Treatment and data collection procedures

The *Quizlet* study set was first assigned as homework. Students were instructed to use the activities for one week and submit their best score on the test activity. In the following session, *Energy City* was demonstrated in class and assigned as homework. Students were instructed to play each city scenario individually and submit a

debriefing report online. The timing of completion was left up to the students, but they were given six weeks to complete all six scenarios. A week after the deadline, students were assigned the writing task as homework.

Analyses and results

Quizlet test scores, the number of debriefing reports submitted, and scoring results of the writing task were inputted into NCSS 9 for analysis. A correlation coefficient was calculated to assess the relationship between the amount of participation in the game-based lessons ($M = 5$, $SD = 2$) and the unique occurrences of vocabulary list words in the writing task ($M = 4.9$, $SD = 2.8$). There was a small positive correlation between the two variables, $r = 0.29$, $n = 143$, $p = .0004$. As shown in Figure 3, the more the students completed the game-based lessons, the more likely they were to use keywords in the writing task. The data indicate that participation in the game-based lessons accounted for 8% of the variation in targeted word use in the writing task ($R^2 = 0.08$). The effect size of the correlation (r) is “small” according to Cohen’s (1988) benchmarks.

Mastery of vocabulary by virtue of *Quizlet* may also influence keyword use in the writing task. Thus, a correlation coefficient was calculated to assess the relationship between the test score ($M = 86.5$, $SD = 34$) and unique occurrences of vocabulary list words in the writing task. There was no correlation between the two variables, $r = 0.13$, $n = 143$, $p = .11$. Mastery of vocabulary in *Quizlet* had no apparent influence on targeted word use in this study.

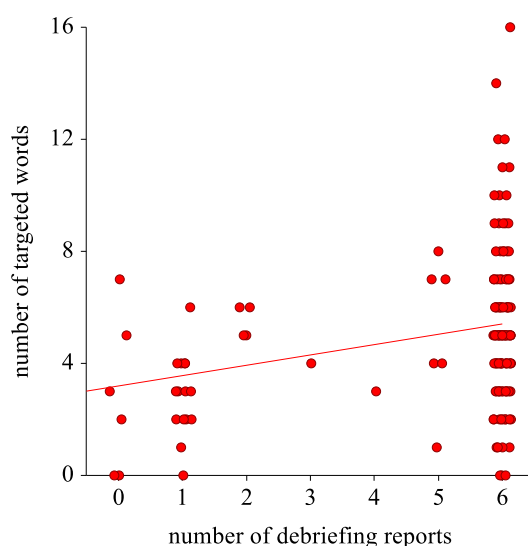


Figure 3. Scatter plot of submitted reports and targeted words

Discussion

Overall, the results of both studies suggest that instructional approaches using simulation games can support vocabulary transferability in second language learners. Participation in the lessons using *Energy City* as core material is related in both studies to the number of targeted vocabulary words used in the writing task. The writing task comprises a communicative context that is distinct from learning vocabulary with *Quizlet*, playing the game or participating in a debriefing session. This result is predicted by Connectivity Theory (Klimesch, 1994), which posits that the learning affordances provided in the lessons would lead to greater interconnection between the targeted words and a variety of other information, and that this in turn would increase accessibility to the words allowing learners to use them more readily in separate contexts. Transferability is important to acknowledge because one of the primary purposes of foreign language teaching is to impart communicative skills which can be used outside of the learning context.

Notably, both studies were conducted in actual educational contexts. Several of the studies supporting computer game-based language learning that have occurred in laboratory conditions are useful for offering guidance, but pedagogy is more reliably informed when models are field-tested in real-world classrooms. The present paper demonstrates the effectiveness of game-based learning when not every variable can be controlled, and within the constraints and requirements of genuine courses of study.

Also noteworthy was the difference in effect size between the two studies (“medium” in Study 1, and “small” in Study 2). Three design differences between the investigations could account for this. First, in Study 1 the writing task was carried out immediately following the debriefing session, so recency may have had a positive effect on vocabulary recall during the writing task. Second, in Study 1 both the game and the debriefing activities were done collectively in a face-to-face lesson, while in Study 2 these tasks were carried out individually as homework. Therefore, learners may have felt a social pressure to apply more effort during the task in the former, thereby improving their attentiveness and learning. Finally, while the writing task was conducted under instructor supervision without the use of dictionaries in Study 1, learners were left to complete the task on their own in Study 2 without the use of dictionaries being explicitly prohibited. Therefore, it is possible that the use of dictionaries acted to diminish the skill disparities between learners who had participated in game-based lessons and those who had not. Unfortunately, based on the present data, it is not possible to determine which if any of these factors played a significant role in creating the discrepancy in effect size.

The results of the studies presented in this paper include some further limitations that must be noted. First, based on data reported in this study, the author makes no claim that computer games are superior in terms of learning outcomes compared to other commonly used meaning-focused activities. Non-game activities in task based approaches include, for example, presentations, discussions, debates, or project work. Such lessons may very well provide all of the learning affordances described herein which are attributable to certain computer games, and the present data does not demonstrate otherwise. Second, no claims can be made regarding the respective degrees of effect among the lesson components. In other words, the game-based lesson must be treated as a single factor encompassing the enabling task (*Quizlet*), the game itself as well as the debriefing reports. The data can only suggest that this integrated lesson is superior to the enabling task alone at supporting transferability of vocabulary. Yet, such enabling tasks are likely useful for increasing scores on other measures of foreign language proficiency, such as the recall tasks used for pre- and posttesting in Study 1. Finally, although this particular game, *Energy City*, appeared to be effective for this particular group of learners, Japanese university students, the author does not suggest that it would necessarily work well with other demographics. Interest in a topic portrayed in a computer game depends largely on the individual user, as pointed out by Schell (2008), and whether or not the scenario is compelling for learners likely influences outcomes (Soderstrom & McCabe, 2011). Thus, the conclusion based on the present data must be limited to the claim that computer games can be used successfully to support transferability provided that best practices in applied linguistic, game and simulation methodology are followed (enabling and debriefing tasks are included), and that the subject matter matches learner interest.

Yet, this conclusion, although limited, is an important one. Educators who consider using games in their classes may do so in recognition of a positive motivational effect on students, which has been demonstrated many times in the literature (Ballou, 2009; Baltra, 1990; Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012; Liu & Chu, 2010; Roubstova, 2010; Suh, Kim, & Kim, 2010; Tao, Cheng, & Sun, 2009; Woo, 2014). At the same time, they may hesitate to use games, or marginalize their use, because of a perceived lack of effectiveness in terms of learning outcomes. The results reported in this paper strongly suggest that using computer games as a meaning-focused activity has a beneficial impact on language learning if the goal is to engender the ability to use learned skills in different communicative situations. Therefore, concern over learning outcomes alone should not dissuade educators from employing games.

Conclusion

This paper reported the results of two investigations on the learning outcomes of computer game-based lessons in two learning programs. The first study compared use of targeted words in a writing task between a group of students who learned the words with *Quizlet* and subsequently used them in a computer game-based lesson, and a group of students who only learned the words with *Quizlet*. The second study compared the relationship between participation in a game-based lesson and use of targeted words in a writing task. The author concludes that computer games can be used effectively as meaning-focused activities in foreign language education.

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