

Design and Assessment of a Location-based Game to Support English Vocabulary Learning in University

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Abstract: In this study, we designed and assessed a location-based game called “ItoScramble” to support English vocabulary learning in university based on Krashen’s input hypothesis. In recent years, the effectiveness of location-based learning environments and game-based learning in improving students’ motivation and performance have been proved through empirical research. When locations are connected with reality, a more authentic learning environment can be offered to improve learner motivation. On the other hand, Krashen’s input hypothesis can help improve learners’ vocabulary learning by offering words that are slightly more advanced than their current level. In this paper, we assessed the effectiveness of the game by conducting a t-test. The results of the research demonstrated that a location-based game based on Krashen’s input hypothesis could enhance learners’ motivation, and there seems to be a growing trend in learners’ performance in vocabulary learning.

Keywords: Vocabulary Learning, Game-based Learning, GPS, Informal Learning

1: Introduction

In language learning, the vocabulary acquired has a large influence on other aspects of language learning, such as grammar, listening, and reading. However, as Yip and Kwan (2006) pointed out, for those who have grown up in the digital age, vocabulary learning can be boring, so it is necessary to create an effective learning environment in which to stimulate learners’ motivation.

It has been demonstrated that games can enhance learners’ motivation in various subject domains, including language learning (Connolly et al., 2012; Connolly et al., 2011). Research regarding English learning has also demonstrated that games can effectively increase learner motivation (Liu & Chu, 2010). Chen and Hwang (2014) further identified that games can improve learning performance.

Although games are believed to be effective at improving learning motivation and performance, some studies have also indicated that, without adopting the appropriate learning strategies, knowledge construction tools, or educational theories, educational games might be less effective than anticipated (Chen & Hwang, 2014).

Krashen (1982) pointed out that, for language learners, input that is slightly beyond learners’ current levels of competence is very important in enhancing language learning. Therefore, it is necessary to take into account the difficulties acquired by vocabulary learners when designing a learning environment for vocabulary learning. In recent years, with the development of information communication technology, it has become possible to grasp learners’ information before the learning activity starts, and to provide personalized input according to that information. In particular, technology that can sense a learner’s context and location can provide a wider range of possibilities in creating a more engaging and personalized learning environment (Alnuaim et al., 2014).

A system that can examine the computing environment and react to changes in that environment is called context-aware computing (Schilit et al., 1994). According to Brown et al. (2010), context is “the formal or informal setting in which a situation occurs; it can include many aspects or dimensions, such as location, time (year/month/day), personal and social activity, resources, and goals and task structures of group and individuals.” It is considered that learning environments that adopt context-aware computing can offer authentic learning activities that are connected with real settings in which learning occurs and in

which effects have been approved (e.g., Peacock, 1997; Gilmore, 2011). As one dimension of context-aware learning, location-based learning has also come to researchers' attention (Alnuaim et al., 2014; Brown et al., 2010).

This study designed a location-based game to support English vocabulary learning in universities, based on Krashen's (1982) input hypothesis, which changes the game difficulty according to the difficulty of the vocabulary the learner has acquired, as a means to help learners to develop a richer English vocabulary.

1-1: Location-based learning

Over the past few years, the use of mobile technologies has accelerated the spread of the location-based learning approach, and thus has helped to shape new educational activities (Melero et al., 2015). Location-based games can not only offer authentic inquiry in which learners can become immersed (Squire & Jan, 2007), but also embed learning in authentic environments that can enhance learners' engagement in learning activities (Huizenga et al., 2009).

Besides the research into location-based learning environments, research into location-based games has also increased. In various subject domains, games have been acclaimed to be effective at enhancing learner motivation (e.g., Connolly et al., 2012; Hainey et al., 2011). For example, in Huizenga et al. (2009), to help pupils playfully acquire historical knowledge of medieval Amsterdam, a location-based mobile city game was developed. Pupils played the mobile city game on smart phones, which adopted GPS technology, while walking through the city in real life, learning about the backstory of the city. The results demonstrated that those pupils who had played the game were more engaged and gained significantly more historical knowledge than those pupils who had received regular project-based instruction.

Regarding language learning research, Waratani et al. (2012) developed and assessed an ubiquitous learning environment for students learning German that adopted GPS technology. The results demonstrated that, by experiencing a new type of learning environment, students became more active in their learning. However, because no test was conducted besides a questionnaire survey, it is difficult to say whether or not the ubiquitous learning environment affected students' learning achievements.

1-2: Educational games

The learning achievements of language learning, including English learning, are connected to how much the learner uses the language. Thus, it is necessary to provide language learners with a learning environment in which they have to use the target language (Waratani et al., 2012). Moreover, another important issue is how to enhance learners' motivation. To improve learners' motivation in language learning, research studies on language learning games have been conducted. For example, in Connolly et al. (2011), as part of a foreign language course, students from different parts of Europe collaborated with each other to save languages that are under threat, by learning more about each other's countries. The results demonstrated that the majority of students who completed the post-test questionnaire would be willing to play the game as part of a foreign language course over a prolonged time period.

In terms of instructional design, "relevance" from Keller and Suzuki's (1988) ARCS model of motivation has been regarded as a vital factor related to learner motivation, which has a strong connection to authenticity. Moreover, Gilmore (2011) pointed out that by combining with realistic scenes, the design of authentic language learning games can be realized.

To remedy the deficiencies of previous studies and to enhance learners' learning motivation and achievement, this research developed a location-based game to support English vocabulary learning in university, based on Krashen's (1982) input hypothesis.

1-3: Objective

This is an experimental study that aims to ascertain the effectiveness of the location-based English vocabulary learning game "ItoScramble." The effectiveness of the game application was analyzed from two perspectives:

- 1: Students' perceived learning motivation and attitude towards "ItoScramble"
- 2: Students' learning performance in relation to English vocabulary

2: System

In this study, we developed a location-based English vocabulary learning game called "ItoScramble"

using a game development platform (Wang et al., in press), which can easily be used to develop mobile games even by those who lack programming skills. Unity is also an important tool used in our system to develop and install the game application in both iOS and Android devices.

The Web application and client application of the game were published on the server. “ItoScramble” consists of three parts: (1) a location-based educational environment; (2) an immersive virtual environment; (3) the game elements. To further gamify ItoScramble, the game application was designed to meet the psychological structural framework of a game submitted by Wood et al. (2004). Table 1 shows the design elements that were added to ItoScramble to achieve the main categories of its characteristics.

Table 1. Main categories of characteristics and ItoScramble game design

Categories	Elements in ItoScramble
Background and setting	<ul style="list-style-type: none"> ▪ fictional game story ▪ game stages actually exist
Game dynamics	<ul style="list-style-type: none"> ▪ spots can be occupied by answering questions ▪ support tools
Winning and losing features	<ul style="list-style-type: none"> ▪ point and bonus system
Character development	<ul style="list-style-type: none"> ▪ level up by collecting points
Multiplayer features	<ul style="list-style-type: none"> ▪ team with multiple players ▪ visualizing player information

3: Evaluation

3-1: Subject

The subjects of the study comprised 63 first-year students enrolled in a university in Kyushu, Japan. All subjects were non-native speakers, but all had reached at least high school standard level in vocabulary. A total of 63 first-year students, who were enrolled in a university in Japan, participated in this study for the evaluation experiment. All 63 students played ItoScramble on Ito Campus for one hour. All subjects owned smartphones.

3-2: Procedure

After receiving instruction on how to play “ItoScramble,” installation of the game application, and a pre-test to evaluate their current English vocabulary competency, the subjects moved from within the classroom to outside of the classroom to play “ItoScramble” freely. The subjects were asked to play the game for one hour.



Fig. 1 Sample Interface of ItoScramble

The game required the subjects to be divided into two teams and to compete for real spots embedded in the virtual environment. Before beginning the game, the players had to take a rank test to determine their level. The game then began with their level, which was determined by their scores. When a player accessed a spot, the system would give the player 10 questions based on his or her level. Whether the player could occupy the spot depended on the accuracy of the answers given and the time taken to solve the questions. Figure 1 shows a sample interface from “ItoScramble.” After the game, all subjects returned to the classroom and took a post-test to evaluate their current English vocabulary competency.

3-3: Data Collection

The aim of this study was to ascertain the effectiveness of “ItoScramble,” which was designed and developed to support English vocabulary learning at university level by investigating students’ perceived learning motivation and learning performance in English vocabulary. Data were collected from an online pre-test, an online post-test, and a questionnaire concerning students’ attitudes towards game applications and learning motivation. The questionnaire was rated on a Likert scale from one to five: 1) strongly disagree, 2) slightly disagree, 3) neither, 4) slightly agree, 5) strongly agree. Free description space was also provided to collect suggestions or questions from students.

4: Results

4-1: Subjects’ learning performance in English vocabulary

To compare students’ performances before and after the session, we analyzed the results from online pre-test and post-tests via a t-test. The study aimed to specifically deal with the following question: Did any development occur between the pre-test and post-test after students had played the game application? Table 2 shows the results of the t-test on the scores of the online pre-test and post-test.

As can be observed from the table, although the mean of the post-test (28.21) was slightly higher than that of the pre-test (27.76), there was no significant difference. The results of the t-test ($t=1.53$; $df=62$; $p<.1$) revealed a marginal difference between the scores on the pre-test and post-test, which was possibly due to the fact that the gameplay time only lasted for one hour.

Table 2. T-test results for pre-test and post-test

Test	Mean	SD	SE	t value
Pre test	27.76	4.08	0.51	
Post test	28.21	4.27	0.54	1.53

N=63; $p < .1$

4-2: Perceived learning motivation and attitude towards “ItoScramble”

To ascertain students’ attitudes towards the game application and perceived motivation, we also conducted a questionnaire survey. Table 3 shows the results of the questionnaire survey after the students had played ItoScramble. The data were collected from 69 students, including 6 students who did not play the game application for various reasons (such as equipment failure or arriving late for the session). Items 3, 4, 5, 6, 7, 8, 20, and 21 from the 23 items concerned the ARCS model, which we adapted from Keller’s(2009) CIS (Course Interest Survey) and IMMS (Instructional Material Motivation Scale), partly changing the expressions used to better fit our study. These determined whether or not this game application improved students’ motivation.

Table 3. Results of questionnaire survey on game application and perceived motivation

Items	Mean	SD
1. I was interested in the settings of this game	3.52	1.06
2. I would like to play this game in this context in the future	3.34	1.16
3. There is something interesting in this story that got my attention	3.06	1.05
4. The rules of the game helped keep my attention	3.53	0.98
5. It is clear to me how the settings of the game are related to myself	3.26	0.98
6. The settings of the game are related to my interests	3.06	1.11
7. After playing the game, I felt it was easy for me	2.76	0.98
8. After playing the game, I felt confident that I knew what I was supposed to learn from this game	3.29	1.01

9. I think this is a game that needs cooperation between players	2.79	1.22
10. I think this is a competitive game	4.11	1.00
11. I received proper feedback from the game	2.98	1.07
12. The questions presented when accessing a spot were easy	2.48	0.89
13. English vocabulary learning using real maps from my daily life is effective	3.45	0.99
14. English vocabulary learning environments that use real maps from my daily life can be a new possibility for English vocabulary learning	3.48	1.12
15. I felt that the learning contents were related to me, due to the English vocabulary learning environment that used a real map from my daily life	3.26	1.09
16. I felt that my learning motivation was enhanced due to the English vocabulary learning environment that used a real map from my daily life	3.35	1.14
17. I used the location-based English vocabulary game intuitively	3.61	1.10
18. The location-based English vocabulary game was easy to use	3.21	1.06
19. I had a good time playing the location-based English vocabulary game	3.64	1.03
20. The location-based English vocabulary game gave me a satisfying feeling of accomplishment	3.32	1.06
21. I would like to play the location-based English vocabulary game more	3.29	1.08
22. I would like to play the location-based game for other subjects	3.69	1.13
23. I think it is necessary to learn English vocabulary in university	4.65	0.67

Items 3 and 4 received 3.06 and 3.53 points, respectively, indicating that the story slightly attracted students' attention, and the rules attracted students' attention. Items 5 and 6 received 3.26 and 3.06 points, respectively, indicating that, to some extent, students were able to understand the relevance of the game to themselves. Item 8 received 3.29 points, which indicated that, to some extent, most of the students were able to understand the purpose of the game. However, item 7 received 2.76 points, which means some of the students felt the game was too difficult for them. As this is an item about "confidence" from the ARCS model, it might influence students' motivation. As for items 20 and 21, 3.32 and 3.29 points, respectively, indicated that students were slightly satisfied with their experience of this game, including accomplishment.

4-3: Opinions and suggestions from subjects

4-3-1: Opinions regarding "ItoScramble"

Some subjects commented on the positive and negative aspects of "ItoScramble." Many of the subjects commented positively on the game elements of "ItoScramble," level up, and the location-based educational environment. Regarding the negative aspects of "ItoScramble," some of the subjects found it difficult to play due to the gap in location information. Some subjects also wanted to know the correct answers to the questions when the results were presented.

- Comment 1: I think the best part of the game was that I could learn English vocabulary in a mood of playing rather than learning.
- Comment 2: As a player can level up through collecting points, I can clearly see my improvement.
- Comment 3: It's such a great idea to learn English vocabulary while walking around in a place with which I'm familiar.
- Comment 4: The location information shown on the screen was different from my position, which made it difficult to play.
- Comment 5: I wanted to know what the correct answers were rather than just my accuracy.

4-3-2: Suggestions for "ItoScramble"

Most suggestions for improving "ItoScramble" regarded functions concerning English vocabulary learning rather than game elements, such as the review function or wanting to see the correct answers. However, comments about vocabulary selection and a game manual were also mentioned by some subjects.

- Comment 1: I was hoping for a review function that I could use to review incorrect words.

Comment 2: I didn't know what was wrong even if the system told me I was wrong. If the system won't show us the correct answers, I think I would have to take a dictionary with me while playing.

Comment 3: Since you adopted GPS technology in your game, why don't you fit more related words to different places?

Comment 4: I found it difficult to play without a manual that I could check at any time.

5: Discussion

5-1: Subjects' learning performance concerning English vocabulary

In this study, we found that the location-based English vocabulary learning game called "ItoScramble," which adopted Krashen's (1982) input hypothesis, was effective at improving subjects' learning performances in English vocabulary. The results of the t-test demonstrated a marginal difference between the pre-test and post-test scores, but not a significant difference. This may have been due to the short playtime that did not give subjects sufficient time in which to remember the vocabulary they had learned from the game. The subjects' feedback regarding "ItoScramble" demonstrated that the provision of questions according to their current English vocabulary competency enabled subjects to learn better.

5-2: Perceived learning motivation and attitude towards "ItoScramble"

Many of the questionnaire items were highly rated by the subjects. Despite the areas evaluated as potentially lacking and in need of improvement, such as the cooperative elements of the game and question difficulty, the majority of students who completed the questionnaire either "slightly agree" or "strongly agree" that "a learning environment that uses a real map from my daily life can be a new possibility for English vocabulary learning" and "is effective in enhancing learning motivation." As the results demonstrated, not only would most of the students like to play the location-based English vocabulary game more, but they would also like to play location-based games for other subjects, which indicates that they had a positive attitude towards the potential of this game.

Appreciation of the game elements is also embedded in the location, based on the psychological structural framework of the game from its free description parts, indicating that students in fact want educational games that have more game elements.

Although there was only a marginal difference between the scores on the pre-test and post-test, a possible reason may have been the lack of playing time. Furthermore, according to the free description responses, the instability of the internet environment and game system might also be a possible reason. Nevertheless, the results indicated that Krashen's (1982) input hypothesis, which helped the students to immerse themselves in learning activities that are most suitable for them, is effective at enhancing students' learning motivation and performance.

6 Conclusion

In this study, we designed and developed a location-based game to support English vocabulary learning in university, based on Krashen's (1982) input hypothesis, and applied it in an actual class to support students with their English vocabulary learning. The effectiveness of this game was assessed by t-test and a questionnaire that was partly adopted from Keller's (2009) CIS (Course Interest Survey) and IMMS (Instructional Material Motivation Scale). The results indicated that the location-based game to support English vocabulary learning, based on Krashen's (1982) input hypothesis tended to be effective at improving university students' English vocabulary learning performance, and, in fact, could enhance students' learning motivation. However, due to the instability of the internet environment and game system, and without sufficient time to play, there was only slight growth in students' English vocabulary competence.

The research findings demonstrated positive results for the location-based English vocabulary game. However, there remain several limitations. Although there were many positive views of this game, students also submitted suggestions for improvement, such as enhancing the degree of relevance between the English vocabulary and spots. In future research, we need to improve the game system and carry out a long-term study to ensure the effectiveness of this game.

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References

- Alnuaim, A., Caleb-Solly, P., & Perry, C. (2014). A mobile location-based situated learning framework for supporting critical thinking: A requirements analysis study. In *Digital Systems for Open Access to Formal and Informal Learning* (pp. 139-158). Springer International Publishing.
- Brown, E., Börner, D., Sharples, M., Glahn, C., De Jong, T., & Specht, M. (2010). Location-based and contextual mobile learning. A STELLAR Small-Scale Study. 1-30.
- Chen, N. S., & Hwang, G. J. (2014). Transforming the classrooms: Innovative digital game-based learning designs and applications. *Educational Technology, Research and Development*, 62(2), 125-128.
- Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education*, 59(2): 661-686.
- Connolly, T. M., Stansfield, M., & Hainey, T. (2011). An alternate reality game for language learning: Arguing for multilingual motivation. *Computers & Education*, 57(1), 1389-1415.
- Gilmore, A. (2011). "I Prefer Not Text": Developing Japanese learners' communicative competence with authentic materials. *Language Learning*, 61(3): 786-819.
- Huizenga, J., Admiraal, W., Akkerman, S., & Dam, G. T. (2009). Mobile game-based learning in secondary education: Engagement, motivation and learning in a mobile city game. *Journal of Computer Assisted Learning*, 25(4), 332-344.
- Keller, J. M. (2009). *Motivational design for learning and performance: The ARCS model approach*. Springer Science & Business Media.
- Keller, J. M., & Suzuki, K. (1988). *Use of the ARCS Motivation Model in courseware design*. Lawrence Erlbaum Associates, Inc., Publishers, NJ.
- Krashen, S. (1982). *Principles and practice in second language acquisition* (pp. 1982-1982). Pergamon: Oxford.
- Liu, T. Y. & Chu, Y. L. (2010). Using ubiquitous games in an English listening and speaking course: Impact on learning outcomes and motivation. *Computers & Education*, 55(2), 630-643.
- Melero, J., Hernández-Leo, D., Sun, J., Santos, P., & Blat, J. (2015). How was the activity? A visualization support for a case of location-based learning design. *British Journal of Educational Technology*, 46(2), 317-329.
- Peacock, M. (1997). The effect of authentic materials on the motivation of EFL learners. *ELT journal*, 51(2): 144-156.
- Schilit, B., Adams, N., & Want, R. (1994, December). Context-aware computing applications. In *Mobile Computing Systems and Applications, 1994. WMCSA 1994. First Workshop on* (pp. 85-90). IEEE.
- Squire, K. D. & Jan, M. (2007). Mad City Mystery: Developing scientific argumentation skills with a place-based augmented reality game on handheld computers. *Journal of Science Education and Technology*, 16(1), 5-29.
- Wang, B., Tang, F., Kaneko, K., Yamada, M., & Okada, Y. (in press). Game-based educational application for informal learning of English using FLEG, T-T, Wu et al. (Eds.), *Lecture Notes in Computer Science*, Springer.
- Waratani, I., Ohta, T., Raindl, M., & Kurabayashi, S. (2012). An experience-oriented language learning environment supporting informal learning abroad, *Japan Journal of Educational Technology*, 36(2), 91-101.
- Wood, R. T., Griffiths, M. D., Chappell, D., & Davies, M. N. (2004). The structural characteristics of video games: A psycho-structural analysis. *Cyber Psychology & Behavior*, 7(1), 1-10.
- Yip, F. W., & Kwan, A. C. (2006). Online vocabulary games as a tool for teaching and learning English vocabulary. *Educational Media International*, 43(3), 233-249.