Vocabulary learning through a daily task of cooking in the Digital Kitchen

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Abstract

Task-Based Language Learning and Teaching (TBLT) has been integrated with Computer-Assisted Language Learning (CALL), contributing to pedagogical developments in the field of SLA. While the majority of studies have used the integrated pedagogy inside the classroom context, little attention has been paid to the area outside of the classroom. Drawing on a recently developed learning environment called ‘Digital Kitchen’, this study examines how learning in a technology-enhanced real-world environment benefits foreign vocabulary acquisition. In particular, the multimodal effect of physicality is investigated using a mixed methods and quasi-experimental research design. Forty-eight adult participants performed two cooking sessions: one in a kitchen using real objects and the other in a classroom looking at photos. Statistical data demonstrated that the digital kitchen users registered significantly higher scores on vocabulary learning compared to classroom participants. The findings show that engaging all senses in a technology-enhanced environment is more powerful for vocabulary learning than using only a few senses. These findings have implications for those planning to design and implement a similar real-world learning environment.

Keywords: CALL, TBLT, Digital Kitchen, Vocabulary Learning

Language(s) Learned in This Study: Korean


Introduction

Computer technology has allowed for a wide range of educational platforms for language teaching and learning, one of which is CALL in combination with Task-Based Learning and Teaching (TBLT) (Hinkelman & Gruba, 2012; Salmon, 2011). The integration of pedagogical and technological approaches has enabled multimodality, where language learners can interact with people using more than one channel of communication (Hampel & Hauck, 2009; Kress, 2000; Kress & van Leeuwen, 2001). It is, for example, argued by Thomas and Reinders (2010) that new technological development has created a learning space where multimodal resources such as images, sound, and text can be used all together through computer devices. That is, these multiple modes have the potential to affect the way in which students engage in learning activities to achieve pedagogical goals.

CALL literature has shown a range of significant benefits for dual modes, that is visual and aural modes in a classroom and virtual worlds to enhance L2 vocabulary learning (Cardenas-Claros & Gruba, 2013; Cárdenas-Claros & Gruba, 2014; Grgurovi & Hegelheimer, 2007; Mohsen, 2016b). Multimedia annotations, for example, have been made available to provide learners with not just textual but also pictorial clarification of foreign words, as a tool of supporting vocabulary learning (Akbulut, 2007; Yeh & Wang, 2003; Yoshii & Flaitz, 2002). However, the technology has yet to reach its full potential in the field of modern foreign language learning; research to date has not yet addressed whether being able to use all five senses through actual objects in a real world learning setting aids in foreign language acquisition. Nevertheless, recent technological affordances, such as the one at the centre of the current study, have
opened up previously unexplored opportunities in foreign vocabulary learning by way of giving language learners access to task-based learning in real-world environments. A real-world learning environment refers to the one in which people do ordinary tasks from their daily life, such as making meals (Seedhouse, 2017). The real-world digital learning environment explored in this study is called the digital kitchen\(^1\).

The application of this unique digital kitchen environment (Figure 1) differs from usual TBLT activities in various ways. First, the digital kitchen is a naturalistic kitchen setting outside the classroom, whereas TBLT has been adopted primarily in classroom and virtual settings. Whereas classroom-based and virtual-based tasks may engage the students’ senses such as sight, sound, and touch, the digital kitchen task of cooking can engage the senses of smell and taste as well, delivering a vivid learning experience. This is why the digital kitchen environment used in this research is different from classroom and virtual environments used for educational purposes. By using a real-world learning environment, this study, therefore, aims to examine the power of using all senses to facilitate L2 vocabulary learning via a cooking activity.

**Figure 1**

*The Digital Kitchen*

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**Literature Review**

**Computer-Mediated TBLT**

As CALL has gone through many stages of development, the evolving computer technology precipitated the development of a wide range of platforms for language learning, teaching, and education. One of which includes Computer-Mediated Communication (CMC) in combination with Task-Based Learning and Teaching (TBLT). As TBLT is a well-known approach to language learning and teaching, both teachers and researchers have paid keen attention to how they can find “tasks that work best for learning” (Ellis, 2003, p. 34). In order to maximise the synergy of the methods, attempts have been made to combine the language pedagogy of tasks, TBLT, and second language acquisition (SLA) (Ellis, 2003; Samuda & Bygate, 2008). Taking advantage of computer-based tools, learners are offered well-organised lessons, which are “highly purposeful and have planned goals, outcomes, and directions” (Salmon, 2011, p. 12). This has led the conventional face-to-face lessons in the classroom to combine with new types of learning, which is called “blended learning” (Hinkelman & Gruba, 2012, p. 46).

Taking part in CMC for language-learning contexts through multiple modes of communication, such as texting, tweeting, Snapchat, e-mail, FaceTime, social media, or video-conferencing, is unavoidable in the 21st century (Sherblom, 2019). Sherblom argues CMC has played a role as a means for learners not just to engage in authentic interaction with others, but also to be monitored easily and non-intrusively by practitioners. Attention has been paid to multiple modes of CMC-based communication tasks and the concept of multimodality has gained momentum. This is where participants are able to interact using more
than one form of communication (Hampel & Hauck, 2009; York et al., 2021). Jewitt (2014) suggests that learners are able to perceive the meaning of a word not just through the word itself but also through non-verbal communication cues such as gestures, postures, and other body movements. Several studies examined how multimodal methods of CMC tasks led language learners to use various channels in interactions (Satar, 2016) and produce better speaking proficiency (Satar & Özdener, 2008). Wigham (2017) demonstrates how multimodal communication strategies in webconferencing-supported pedagogy enhance vocabulary teaching. These studies show a significant difference in favour of multimodality. Thus, improved accessibility to technologies has allowed communication to occur between teachers and learners in multiple modes, which has had the potential to affect the way in which learners engage in learning activities. These multimodal aspects are well embodied in this study as the digital kitchen environment not only provides several modes for learning (e.g., audio-visual images and tangible objects) but also addresses the challenges that virtual contexts and CMC resources pose by integrating face-to-face collaboration between learners.

In addition to the wide range of studies above, researchers have advanced the design, development, and application of task-based approaches for learners with different levels of language proficiency and skills. CALL studies provide a wealth of accessible examples of authentic language use at various levels of complexity via media such as blogs and social networking as well as CALL-TBLT applications in real language learning situations, reproducing the positive impact of TBLT (Thomas & Reinders, 2010). These developments are significant as such realistic language production materials are an important resource for students. Thus, various technology-oriented platforms have been put into practice and made a big difference in language learning and teaching all around the world.

In spite of the huge body of studies above, research on CALL and TBLT has been “rather limited” (Motteram & Thomas, 2010, p. 218). Most studies have used TBLT principles to focus on pedagogical tasks carried out only in the classroom for vocabulary learning and language skills. This does not help address the issues of well-known class-related problems: boredom and lack of motivation. This underlines the need for research in which those technologies are applied to the real-world learning environment. Therefore, the present study attempts to adopt a real, motivational environment and investigates its effect on vocabulary learning by comparing it to learning in a classroom.

From Daily Space to Learning Environment

This study used a kitchen as a learning platform because the space provides learners with a chance to carry out a real-world activity: cooking. The kitchen also provides a tangible connection to what Nattinger claims as a “situational set” of cooking items, by which learners can employ physical objects for learning (1988, p. 72), and what Skehan refers to as “real world activities,” during which learners use authentic language for communicative purposes (1998, p. 95). Cooking in kitchens is an important part of daily life for many and an activity with a clear goal, providing helpful tasks in relation to learning. Trubek and Belliveau (2009) suggest that “cooking engages students at an almost instinctive level; the smells, sounds, sights, textures, and tastes excite senses and intellect” (p. 16). Considering the nature of the kitchen and its relevance to learning, it is significant to understand the impact of cooking on vocabulary learning by using kitchen environments as learning platforms.

The technology-enhanced kitchen was originally developed to help people in the early stages of dementia through multi-tasks in daily life, such as making a cup of coffee (Olivier et al., 2009; Wherton & Monk, 2008). The research team found that an autonomous environment was important for people with dementia, which led to advances in pervasive computing technology for educational use in the kitchen. In previous studies by Seedhouse (2017) and Seedhouse et al (2013), computer experts and applied linguists integrated this digital technology and pedagogical design into a situated language learning environment where language and culture could be learned simultaneously, showing that the kitchen space as a real-world environment has aided language learning. These studies have attempted to take Task-Based Language Teaching (TBLT) principles out of the classroom and into the real-world environment to investigate how the situated environment helps language learning. Thus, the domain of the kitchen has begun to play a role
as a learning environment for a wider audience. Nevertheless, the research has been limited from a theoretical point of view in that they failed to reveal clearly what factors have contributed to learning. Those factors may include a kinaesthetic task-based experience in a specific real-world context in which students learn a foreign language by physically manipulating objects. It is the gap that this study attempts to fill.

Vocabulary Learning Modes

There are many ways of communicating and learning the meaning of a word, one of which is by using pictures (Nation, 2001). This is often seen as the most valid and effective way because the accompaniment of a text with a picture can lead to a form of mental elaboration that enriches the level of processing of a word (Baddeley et al., 2009) and thus enhances learning. Two dimensions work together, creating synergetic effects for learning. If the learning process combines a verbal and non-verbal definition, there is a chance that Paivio’s dual coding will occur (Paivio & Desrochers, 1981). According to Paivio and Desrochers, human memory consists of two separate channels that deal with verbal and visual stimuli. While it stores them independently, words are images are linked. These linked memories make retrieval much easier. Chapelle (2003) also suggests the beneficial effects of audio-visual inputs on L2 vocabulary acquisition in the context of CALL tasks. That is, word knowledge is stored both verbally and visually. It is necessary because pictures contain essential features of the concept involved. A picture is undoubtedly worth a thousand words.

Many studies find dual-modality presentation (auditory and visual) to be effective for incidental vocabulary learning, illustrating that dual modalities through multimedia help options significantly improved L2 vocabulary learning (Al-Seghayer, 2001; Aldera & Mohsen, 2013; Baltova, 1999; Chun & Plass, 1996; Jones & Plass, 2002; Kost et al., 1999; Plass et al., 1998; Plass et al., 2003; Stewart & Pertusa, 2004; Sydorenko, 2010; Winke et al., 2010; Yoshii & Flaitz, 2002). For example, Aldera and Mohsen (2013) explored the impact of different modes (picture/texts/keywords, picture/texts, and picture alone) by giving students a multimedia-enhanced task; results indicated that vocabulary acquisition was significantly facilitated when pictorial and textual help was offered. Similarly, Yoshii and Flaitz (2002) examined the impact of different types of modes (text alone, picture alone, and a combination of the two). Results revealed that students with the two modes altogether performed better than the other groups. Other than this, a number of researchers have extensively investigated multimedia glosses in CALL literature to aid L2 vocabulary acquisition (See Mohsen and Balakumar, 2011; Xu, 2010 for reviews), clearly indicating how a dual-coded approach using computer-mediated education tools can have a positive influence on vocabulary acquisition.

However, very little attention has been paid to using all senses (i.e., more senses such as touching, smelling, and tasting) in L2 vocabulary learning. Nattinger (1988) suggests that “associations of vocabulary with physical actions have a dramatic effect on memory because students must commit themselves to the learning task by performing appropriate actions” (p. 67). Motivated by this idea, this study establishes a space in which interactional associations between real objects and learning are forged in a digital kitchen in such a way that the real world task allows for users’ vivid experience, enabling powerful, integrated verbal and nonverbal memory links. A physical object can create multiple coding, in which the meaning is coded verbally, visually, and kinaesthetically. A physical object is thus worth a thousand pictures.

Methodology

Participants

The participants were adults of both British and international origins, living in Newcastle, UK, and from a wide variety of backgrounds. Forty-eight participants whose ages ranged from 19 to 49 years were chosen for each group, with 16 males and 32 females. They were from 20 different nationalities. All subjects were at an absolute beginner level in Korean, which means that L2 proficiency was not a confounding variable. This study assigned participants in a non-random manner.
Quasi-Experimental Design

This research draws on a quasi-experiment, which lacks one of the true experimental design elements (Shapley et al., 2010). This quasi-experimental study assigned subjects to the treatment and control groups in a non-random way. By implementing a quasi-experimental design, this study’s aim was to determine whether the intervention had the intended effect on participants’ vocabulary learning by examining the difference in learners’ pre-test and post-test outcomes from two different learning environments. This study adapted a diagram by Nation and Webb (2011) and created a new design—Latin Square and its experimental design, as in Figure 2 below—to carry out the research.

Figure 2

Latin Square and Experimental Design

Each group carried out two different cooking sessions with two different sets of vocabulary items, one in a classroom and the other in a digital kitchen. The quasi-experiment was designed in such a way that the ordering and practise effect of the task did not compromise their vocabulary learning. For example, Group A makes the dish using Recipe 1 in the classroom and then Recipe 2 in the digital kitchen, while Group D uses Recipe 2 in the digital kitchen and then Recipe 1 in the classroom. Similarly, Group C performs the task using Recipe 2 in the classroom and Recipe 1 in the digital kitchen, while Group B carried out tasks using Recipe 1 in a digital kitchen and then Recipe 2 in a classroom. Participants were given delayed post-
tests two weeks after taking the initial post-tests. It is thus possible to compare the four groups. The two recipes have different sets of vocabulary and the same level of difficulty (see Appendix).

**Different Experiences in Two Settings**

As this study compares the learning between a digital kitchen and a classroom, this section shows what is involved in the two settings. Every condition, including the procedures of tasks and tests, was controlled so that potential confounding variables could be minimised.

The difference between the two settings is that participants in the kitchen used real objects to cook, whereas they simply used photos of objects in the classroom. So, the kitchen users could access all five senses, while classroom learners only accessed a few senses. In the two different settings, learners went through the same test and task procedures in each cooking session; the pre-test assessed 10 noun vocabulary items; the pre-task required users to collect each item; the during-task exercise asked them to manipulate items to cook; the post-task exercise requested evaluation; and the post-tests tested their knowledge. Given the nature of a classroom, learners simulated cooking by interacting with a teacher using the computer, which was not sensor-based, but they were given the same feedback as in the kitchen on their request.

**Figure 3**

*Task Procedures in Two Settings*

A specialised lexical set related to cooking was chosen to be learned to test learners’ acquisition of vocabulary, a “situational set” (Nattinger, 1988, p. 72) of 10 items comprising cooking utensils and ingredients. All vocabulary items were nouns for several reasons. First, nouns are the most common component of speech in everyday communication (Webb, 2005). They are also the easiest word class to learn, and, particularly, concrete nouns are learnt more easily than abstract nouns (De Groot, 2006). Also, the concrete noun items are learnt more “quickly and effectively if objects are nonverbally referred and
used as stimuli” (Ellis & Beaton, 1993, cited by Seedhouse, 2017, p. 210). Cooking-related vocabularies used in the digital kitchen are very concrete and involve physical movements on tasks. So, these principles of vocabulary learning were employed in the design of the kitchen environment.

**Task and Test Procedures in Two Settings**

In order to operationalise TBLT, the present study drew on Skehan’s (1998) framework in which tasks are divided into three phases: pre-task, during-task, and post-task, as the procedure provides a clear design structure for learning materials. Based on the three-phase framework, participants were able to complete the dish-making task. Each task was offered in the sensor-based digital kitchen by a table computer called GUI (Graphical User Interface), whereas in the classroom, a teacher used a tablet computer.

In the pre-task, students were provided with the instruction via audio and visual files to collect each item, such as 밥 (rice) and 그릇 (bowl). If students did not understand, they could make a range of help requests, such as repetition. The during-task required them to manipulate what they had collected, with such instructions as 밥을 그릇에 넣으세요 (put rice into a bowl). The post-task involved tasting the food. Figure 3 demonstrates each task they carried out in two different environments.

**Figure 4**

*Test Procedures in Two Settings*

<table>
<thead>
<tr>
<th>Classroom</th>
<th>Digital Kitchen</th>
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<tbody>
<tr>
<td>Pre-Test</td>
<td>Pre-Test</td>
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<tr>
<td>Post-Test (Productive)</td>
<td>Post-Test (Productive)</td>
</tr>
<tr>
<td>Immediate Test (Receptive)</td>
<td>Immediate Test (Receptive)</td>
</tr>
<tr>
<td>Productive Test (Receptive)</td>
<td>Productive Test (Receptive)</td>
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</table>

Three tests were used: pre-, immediate- and delayed-test. The pre-test was designed to assess the participant’s knowledge of the vocabulary items and serve as a baseline to compare with post-tests. The pre-test was a verbal production test. Each individual was shown 10 real objects and then asked to produce them in Korean one by one, as shown in Figure 4. The researcher held an audio recorder to record his or her performance. Two post-tests consisted of a receptive and productive test. The receptive test consisted of the participants placing 10 pieces of paper with the name of the object on each of the 10 tangible objects within one minute immediately after the cooking session. They were instructed to leave the objects they
were unsure of. The production test was the same as in the pre-test. No receptive test was administered in the pre-test as learners’ random matching may have compromised the actual vocabulary learning. Figure 5 portrays the procedure for tests performed in both learning environments.

Figure 5

Test Procedure in the Digital Kitchen

Data Analysis Tool

This paper employed Statistical Package for Social Sciences (SPSS) to analyse test results data. First, a t-test was used to compare vocabulary gains for two groups, one in a classroom and the other in the digital kitchen. A paired-samples t-test can show whether there is a statistically significant difference in the mean scores for the two groups and the same group on two occasions (Cronk, 2012). Analysis of Covariance (ANCOVA) was then used to see the influence of a classroom and the digital kitchen on vocabulary learning. ANCOVA can be used when there is a two-group pre-test/post-test design (Pallant, 2013). That is, ANCOVA can compare the impact of two different interventions, taking before and after measures for each group. This statistics tool helps explore differences between groups while statistically controlling for an additional variable. The additional variable (called a covariate) is a variable that may impact scores on the dependent variable. Pre-test scores in this study were controlled (i.e., this was the covariate).

To analyse the figures within a data set, several measures were used, such as mean (M), mean difference (MD), standard deviation (SD), F ratio and Cohen’s d (referring to eta squared): p value < .05 indicates a significant difference; F indicates a variability between groups (caused by the independent variable); Cohen’s d or eta squared ( ) represents the proportion of variance in the dependent variable that is explained by the independent variable and ranges from 0 to 1 with .2 = small effect, .5 = medium effect, and .8 = large effect (Cohen, 1988). p value < 0.05 indicates statistical differences but does not always mean that two variables are associated with one another. It is the effect size known as ‘strength of association’ via eta squared that makes it possible to associate the two. These all are basic assumptions made in ANCOVA. The ANCOVA revealed the two groups’ mean vocabulary scores at post- and delayed post-test were significantly different after the initial pre-test scores were controlled for.

Findings

Figure 6 shows that the digital kitchen learners scored better than the classroom learners in both receptive and productive vocabulary knowledge in both immediate and delayed tests. The pre-test scores were 0.14 in the digital kitchen and 0.16 in a classroom, the difference between which showed no statistical significance. So it can be said that the two groups started with little knowledge of Korean, which is to be expected for absolute beginners. However, some participants did nonetheless have some slight knowledge of some Korean cuisine terms from watching popular Korean dramas or movies, for example; however, this had no effect on the pre-test score.
Figure 6

Overall Vocabulary Gains in All Tests

Note. All scores were higher in the kitchen setting than in the classroom (the mean difference on the immediate receptive test scores was $MD = 1.58, p < .001$; immediate productive, $MD = 1.78, p < .001$; delayed receptive, $MD = 0.83, p < .02$; delayed productive, $MD = 2.12, p < .001$).

If the overall mean differences in gains were statistically significant in all cases, it could be claimed that learners were able to learn vocabulary items both receptively and productively for immediate and delayed tests better in a digital kitchen than in a classroom. In order to demonstrate a more detailed analysis of Figure 6, a one-way between-groups analysis of covariance (ANCOVA) was conducted to compare the effectiveness of the two different locations. The independent variable was the intervention (Location), and the dependent variable consisted of scores on vocabulary tests administered after the intervention was completed. The next section presents four ANCOVA results of receptive immediate post- and delayed post-tests and productive immediate post- and delayed post-tests in order (Table 1).

After adjusting for pre-test scores, the digital kitchen ($M = 6.77, SD = 2.44$) saw higher vocabulary scores than that of a classroom ($M = 5.21, SD = 2.10$). There is a significant difference between the two intervention groups’ vocabulary learning on receptive immediate post-test scores, $F (1, 93) = 11.86, p < .001$, partial eta squared = .11. There was a weak relationship between the pre-intervention and post-intervention scores on the immediate post-test, as indicated by a partial eta squared value of .11. That is, a student scoring high on a pre-test will not necessarily score high on a post-test.
Table 1

**ANCOVA 1 (Receptive Immediate Post-Test Scores)**

<table>
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<tr>
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<th>Descriptive Statistics</th>
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<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>Digital Kitchen</td>
<td>6.77</td>
<td>2.44</td>
<td>48</td>
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<tr>
<td>Classroom</td>
<td>5.21</td>
<td>2.10</td>
<td>48</td>
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**Tests of Between-Subjects Effects**

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<tbody>
<tr>
<td>Pre-test</td>
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<td>.03</td>
</tr>
<tr>
<td>Location</td>
<td>11.86</td>
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<td>.11</td>
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Table 2

**ANCOVA 2 (Receptive Delayed Post-Test Scores)**

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<th>Descriptive Statistics</th>
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<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>F</td>
</tr>
<tr>
<td>Digital Kitchen</td>
<td>5.48</td>
<td>2.35</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Classroom</td>
<td>4.50</td>
<td>2.20</td>
<td>48</td>
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**Tests of Between-Subjects Effects**

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<tbody>
<tr>
<td>Pre-test</td>
<td>5.63</td>
<td>.02</td>
<td>.05</td>
</tr>
<tr>
<td>Location</td>
<td>4.94</td>
<td>.02</td>
<td>.05</td>
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The results in Table 2 also show a statistically significant difference in receptive delayed vocabulary scores between the digital kitchen ($M = 5.48, SD = 2.35$) and the classroom ($M = 4.50, SD = 2.20$), $F (1, 93) = 4.94, p = .02$, partial eta squared = .05. There was a weak relationship between the pre-intervention and post-intervention scores on the receptive delayed post-test, as indicated by a partial eta squared value of .05. This means that a student scoring low on a pre-test could score high or low on a delayed post-test as their performance on the pre-test had little link to their performance on the delayed post-test.
Table 3

**ANCOVA 3 (Productive Immediate Post-Test Scores)**

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<th>Descriptive Statistics</th>
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<tr>
<td></td>
<td><strong>M</strong></td>
<td><strong>SD</strong></td>
<td><strong>N</strong></td>
<td><strong>F</strong></td>
<td><strong>p</strong></td>
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<tr>
<td>Digital Kitchen</td>
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<td>1.86</td>
<td>48</td>
<td></td>
<td>.00</td>
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<td>Classroom</td>
<td>3.21</td>
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**Tests of Between-Subjects Effects**

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<tbody>
<tr>
<td>Pre-test</td>
<td>8.03</td>
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<td>.08</td>
</tr>
<tr>
<td>Location</td>
<td>25.29</td>
<td>.00</td>
<td>.21</td>
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</table>

Productive post-tests in the digital kitchen registered higher vocabulary scores ($M = 4.97, SD = 1.86$) than the classroom ($M = 3.21, SD = 1.74$) in Table 3. The scores were statistically significant, $p < .001$, $F (1, 93) = 25.29, p = .001$, partial eta squared = .21. Even though there was a medium relationship between the pre-intervention and post-intervention scores on the productive immediate post-test, the eta squared statistic (.21) displayed a negligible effect size. This indicates a small magnitude on the means in the two learning environments.

The productive delayed post-test in Table 4 has shown a similar orientation, but its score difference between the two settings is statistically significant, $p < .001$. Learners’ vocabulary scores from the digital kitchen ($M = 4.36, SD = 1.90$) are higher than that of the classroom ($M = 2.26, SD = 1.70$), $F (1, 93) = 37.31$. The eta squared statistic (.29) demonstrated a medium effect size. This shows a medium magnitude of the means in the two learning environments.

Table 4

**ANCOVA 4 (Productive Delayed Post-Test Scores)**

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<td></td>
<td><strong>M</strong></td>
<td><strong>SD</strong></td>
<td><strong>N</strong></td>
<td><strong>F</strong></td>
<td><strong>p</strong></td>
</tr>
<tr>
<td>Digital Kitchen</td>
<td>4.36</td>
<td>1.89</td>
<td>48</td>
<td></td>
<td>.00</td>
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<tr>
<td>Classroom</td>
<td>2.26</td>
<td>1.70</td>
<td>48</td>
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**Tests of Between-Subjects Effects**

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<tbody>
<tr>
<td>Pre-test</td>
<td>11.56</td>
<td>.00</td>
<td>.11</td>
</tr>
<tr>
<td>Location</td>
<td>37.31</td>
<td>.00</td>
<td>.29</td>
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</table>

The data of the combined test results clearly indicate that the receptive score is higher than the productive one. It seems that participants needed to not only know the meaning but the pronunciation or spelling as well. Crow (1986) claims that there are differences between what it takes to know a word receptively or productively, and “a much larger body of knowledge is required” for the productive (p. 242).
In terms of immediate and delayed post-tests, learners’ performance in immediate tests was better than in delayed ones, as would be expected given the time difference between the two tests. It was seen that they learned more words during their initial performance, but after two weeks, they had forgotten some words and could not retain the target vocabulary in the same way as for immediate tests. This is in contrast with the test results drawn from Italian and English Digital Kitchens, which showed a gradual increase from pre- even to delayed post-test (Pallotti et al., 2017). It turned out that since they were in an environment where English is spoken, participants used their strategies to encounter vocabulary items repeatedly by seeing, looking at, and looking up the target words, hence promoting their learning. However, learners in the Korean digital kitchen were not in the same condition. They rarely had an opportunity to be exposed to Korean in Newcastle unless they intentionally looked it up in the dictionary or the Internet.

**Discussion**

Statistical analyses showed a clear distinction between the two different learning environments. Being able to actually perform a real-world task in a digital kitchen played an instrumental role in linking linguistic knowledge to their memory. Digital kitchen learners were able to use all five senses, including smell and taste, whereas in a classroom, participants had relatively fewer senses when carrying out a cooking task: simply sight, sound, and touch. According to actual gains on the target vocabulary items, the digital kitchen users scored significantly higher than those in the classroom.

These findings are similar to a range of studies that investigated the effects of CALL. Computer-mediated learning has been combined with task-based learning, and the new trend has allowed for well-established lessons and outcomes (Hinkelmann & Gruba, 2012; Salmon, 2011). In particular, due to technological development, multiple modes of learning were made possible in which learners learn through more than one form of interaction (Hampel & Hauck, 2004; Norris, 2004). These developments created better outcomes in vocabulary learning (Perez, 2003). Computer technology could help learners link the form and meaning of vocabulary items to their memory more effectively when exposed to not just a written but also a visual mode pedagogically displayed on a computer screen, thus influencing the way students are engaged in the learning activity (Abrams, 2003). However, there was one more mode that helped learning in this study: the kinaesthetic mode. Touching real objects not only motivated students but helped them make connections to their memory. These findings also mirror those of recent projects by applied linguists taking advantage of the trend to create a daily learning platform (Preston et al., 2015; Seedhouse, 2017; Seedhouse et al., 2013; Seedhouse et al., 2014). Since the project teams reported significant positive effects of the digital technology on vocabulary learning but did not compare with a classroom, this study strengthened the research findings of physicality on vocabulary learning by implementing a quasi-experiment.

In contrast, in a classroom, learners were found to be less successful in their learning outcome. This might be explained by the ‘actual’ versus ‘abstracted’ nature of the task posed by the learning setting itself. They were only able to use photos to complete the task, which allowed them to employ two types of communication tools available to learn vocabulary: verbal (written and spoken) and non-verbal (image) cues delivered by a teacher. Findings from the classroom are in line with previous research, which has found the link between texts and pictures, and point to the synergetic effects of the combination for vocabulary learning. Words are remembered more effectively when they are associated with images (Underwood, 1989), and the integration of pictures and texts enables learners to engage larger parts of the brain, thereby leading to a greater depth of knowledge processing (Mohsen, 2016a; Oxford & Crookall, 1990). Thus, the synthesis of imagery and verbal information played a role in enhancing information processing for learning, lending support to many previous studies (Aldera & Mohsen, 2013; Montero Perez et al., 2014; Paivio, 1986, 1991, 2007; Paivio & Desrochers, 1981; Sydorenko, 2010; Winke et al., 2010). However, the classroom missed one important learning mode: ‘touching.’ This resulted in different learning outcomes.

Such findings suggest a few implications for those planning to design and implement a similar real-world learning environment. Firstly, this study addressed the issues of traditional versus technology-enhanced
learning environments by showing that a technology-enhanced space where realia can be used was beneficial in terms of language learning. Whereas the majority of CALL research has focused on tasks, contexts, and resources occurring in imagined learning settings (Hampel & Stickler, 2012; Ho, 2013), the current study allowed learners to perform a real-world task with tangible resources in a real-life context. Specifically, the actual environment of the digital kitchen turned out to be more enriching for vocabulary learning. This is probably because the level of motivation via the real-world task of cooking is more meaningful and engaging. Therefore, it may be helpful if the degree of resemblance to the real-world is taken into consideration when choosing a main learning environment for second and foreign language learning and teaching.

The fact that very few pedagogical applications of TBLT have been designed for use outside of the classroom was one of the main factors that prompted this study. From the research done here, it is clear that TBLT is robust and sound enough to be used outside of the classroom for foreign language teaching and learning. So, while preliminary, the findings suggest that naturalistic settings can be useful for TBLT; they provide an authentic and motivating environment for learning. Increasingly, schools are sending students on field trips to places such as museums or factories for educational purposes. This is most likely because direct engagement in a real-life activity aids their learning more than merely looking at textbooks in a classroom, which the digital kitchen experiment also confirms.

Many vocabulary-learning studies have argued that technological affordances such as pictorial and textual aids enhance students’ task-based learning (e.g., Mohsen, 2016b). In addition to such aids, by accepting that physical objects help to internalise linguistic and non-linguistic information more permanently within our mental lexicon, we may gain a deeper understanding of the process of vocabulary learning. It is hoped that the findings of this study will build on what was ambiguous in previous studies and add to the literature on technology-enhanced TBLT.

Conclusion

The digital kitchen proved to be a more conducive environment for vocabulary learning due to the greater number of senses that the meaningful real-world task of cooking engages. The findings of this study suggest that multimodal experience using real objects in the digital kitchen environment can help students obtain vocabulary knowledge. On a broader level, this study addressed the issues of traditional classroom and technology-enhanced learning environments by showing that a technology-enhanced space was beneficial in terms of language learning. Whereas the majority of CALL research has focused on tasks, contexts, and resources occurring in de-contextualized learning settings (Hampel & Stickler, 2012; Ho, 2013), this study allowed learners to perform a real-world task with tangible resources in an actual context. In this sense, this study broadened the research scope by adopting TBLT with a real-world task in a real-world CALL environment.

TBLT has been subject to criticism in terms of its implementation in different instructional settings (Butler, 2005; Carless, 2004; Li, 1998; Widdowson, 1993). Specifically, they raise the question of how practical TBLT can be in EFL contexts in many European and Asian countries—places where teachers comply with a teaching philosophy that is different from what underlies TBLT, and where learners do not have as many communicative opportunities. As previous kitchen projects have only used Western-based languages, they are not free from criticism. By trialing the Korean Digital Kitchen, this study does not just apply the pervasive digital learning environment from the European consortium to the Asian one; it also starts to expand the horizons of TBLT from its Anglo-American origins to a wider World-Language learning approach. Given that the “new generation of learners appeal for technology-rich, flexible and comfortable learning space” (Huang, 2015, p. 255), such applications to a real-world environment will be a significant step in the right direction for the future learning space, subsequently offering rich opportunities for research in SLA.

However, considering that the digital kitchen is a holistic learning environment with a range of affordances,
there could have been other factors such as self-organisability that caused the contrasting outcome. Therefore, more controlled experiments using other modern languages would be recommended for future research.

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Notes

1. The digital kitchen is a computer-supported pervasive learning environment that interacts and communicates with learners, and provides them with step-by step cooking instructions via a tablet called Graphic User Interface (GUI). The Kitchen tracks users’ movement by employing sensors called ‘wireless accelerometers (WAXs)’, which measure acceleration, weight, and vibration (Seedhouse, 2017).

2. This was first published in a book chapter by Park and Seedhouse (2017). While discussing the same research as described in this study, the chapter does not show detailed statistical analysis. It focuses more on showing interaction and interview data of learners to reveal how they learn vocabulary items.

References


Appendix. Cooking Recipes for Vocabulary Learning

김치전 (kimchijeon, kimchi pancake)

※ Recipe

Ingredients: a cup of kimchi, 250g of flour, a cup of water, oil

Equipment: a frying pan, a chopping board, a knife, a bowl, a spatula, a whisk

Directions

1. In a bowl, place chopped kimchi, flour (all purpose flour), and ¼ cup of water and mix it well with a spoon.
2. Heat up a 12 inch non-stick pan over medium high heat and drizzle about 2 tbs grape seed oil.
3. Place the mixture of kimchi pancake batter on the pan and spread it thinly and evenly with a spoon.
4. Cook it for 2 to 3 minutes until the bottom gets golden brown and crispy.
5. Turn it over with a spatula or flip it.
6. Lower the heat to medium and cook for another 2 minutes.
7. Turn it over one more time and cook for 30 seconds before transferring it to a serving plate.

*tip: Serve it right out of the pan or cool it down and cut it into bite size to serve.
**Target Vocabulary items**: Kimchi (김치), flour (밀가루), water (물), oil (식용유), a frying pan (후라이팬), a chopping board (도마), a knife (칼), a big bowl (대접), a spatula (뒤집개), a whisk (가품기)

**Pre-task**
1. Bring kimchi
2. Bring flour
3. Bring water
4. Bring oil
5. Bring a frying pan
6. Bring a chopping board
7. Bring a knife
8. Bring a big bowl
9. Bring a spatula
10. Bring a ladle
11. Bring a whisk

**During-task**
1. Put oil into a frying pan
2. Heat the frying pan with mid-low fire
3. Put flour into a big bowl
4. Put water into a big bowl
5. Put kimchi into a big bowl
6. Mix them with a whisk
7. Using a spatula, put the mixture into a frying pan, and make it spread out
8. Using a spatula, turn it over in 2 minutes and turn off in 2 minutes
9. Put Kimchi pancake onto a chopping board
10. Using a knife, cut it as you like

**Post-task**
1. Now, enjoy the dish as you like
유부초밥 (yubuchobap, rice covered with fried tofu)

※ Recipe

**Ingredients:** fried tofu, a bowl of rice, tofu sauce, dried seasoning

**Equipment:** chopsticks, a spoon, a bowl, a plate, a vinyl glove, a scissors

**Directions**

8. Put chopped cucumber and carrot into a bowl.
9. Make two cups of rice and put it into a large bowl.
10. Add the vinegar-based sauce to the warm rice, and mix it well with a wooden spoon.
11. Add the prepared vegetables to the rice, and mix it well and cool it down.
12. Open the package of yubu and squeeze it slightly to drain out the extra sauce.
13. Open up each yubu to make a pouch.
14. Fill each tofu pocket with a rice ball.

※ Application of the recipe fit for the current study
Target Vocabulary items: a plate (접시), rice (밥), fried tofu (두부), dried seasoning (조미 양념), sauce (소스), a spoon (술가락), chopsticks (젓가락), a bowl (그릇), a vinyl glove (비닐장갑), a scissors (가위).

Pre-task
1. Bring yubu
2. Bring jomibokkeum
3. Bring chobap sauce
4. Bring rice
5. Bring a spoon
6. Bring chopsticks
7. Bring a bowl
8. Bring a vinyl glove
9. Bring a plate
10. Bring a scissor

During-task
1. put bap into geureut
2. cut chobap soseu with gawi and then put it into geureut
3. cut jomibokkeum with gawi and then put it into geureut
4. mix them properly with sutgarak
5. put wisaeng janggap on both hands
6. using sutgarak put the mixture into yubu and then onto the plate
7. put the rest of yubuchobap on jeopsi
8. Now, let’s learn how to use chopsticks

Post-task
1. Now, enjoy the dish as you like

About the Author

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