Multimodal Language Learning Environment of The Korean Digital Kitchen

'*A Study on the Impact of Physicality and Technological Affordances on Korean Vocabulary Learning*'

JAEUK PARK

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Newcastle University
School of Education, Communication and Language Sciences

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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 foreign/second language teaching and learning (Thomas and Reinders, 2010). While the majority of studies have used the integrated pedagogy inside the classroom context, little attention has been paid to the area outside the classroom (Seedhouse *et al.*, 2013; Seedhouse *et al.*, 2014; Preston *et al.*, 2015). This issue has recently been addressed by the European Digital Kitchen (EDK) project team (Seedhouse, 2017), which has successfully investigated the efficacy of digital technology on foreign language learning out of the classroom. However, as the EDK was designed as a holistic learning environment in which many different environmental factors would contribute to learning, there was a need to disaggregate some of these factors and discover which factors were more or less significant. In order to determine one of the environmental factors to learning, this study attempted to use the technological components of a previous project to create Korean pedagogical materials. This formed the Korean Digital Kitchen (KDK), a real-world environment of a kitchen where students can simultaneously learn Korean language and culture by carrying out the real-world task of cooking. Korean is one of the important global languages to be taught, according to an *Ethnologue* report (Lewis *et al.*, 2016).

Based on the literature on vocabulary learning, especially Nattinger's (1988) claim that touching and manipulating real objects, as opposed to seeing them, increases learnability, this study explored whether kinesthetic mode adds extra value to foreign language learning processes. Would there be any significant difference between vocabulary learning which involves *seeing* the learning items only in a classroom and learning which also involves *touching* the items in the KDK? Thus, this study examined the power of physicality. Furthermore, the salience of real-world and pedagogical tasks has been investigated as factors to different level of vocabulary learning.

To this end, a quasi-experimental design was employed for users to conduct two cooking sessions, one in a digital kitchen by using real objects and the other in a classroom by looking at pictures/photos in the textbook. Participants were 48 adults of both British and international origins, living in Newcastle, UK, coming from 20 different countries. To determine which environment between a digital kitchen and a classroom is more conducive to vocabulary learning, users needed to carry out two

different recipes in the two locations in order to control a practice effect. Subjects went through the real-life cooking activities in three stages of TBLT in both settings using two different recipes with two different set of vocabularies. There were tests before and after cooking to compare their scores to examine the results of learning. Ten vocabulary noun items were targeted in this research.

In addition to test score data, three more data sources were employed, namely questionnaires, semi-structured interviews and video-observations for triangulation, revealing the outcomes and processes of learning in two different learning environments. A series of data sets clearly demonstrated which of the two learning settings was more effective to learn foreign language vocabulary and culture in and what their attitudes towards a digitalized learning environment were.

Findings suggest that physicality in the KDK makes students link the word and cultural aspects to their memory better than simply looking at photos of objects in the classroom. The learning differences reached statistical significance. Other environmental factors such as technology and its affordances may have contributed to different learning outcomes, playing a role in learners taking positive attitudes (Stricker *et al.*, 2004). In contrast, users in the conventional setting demonstrated relatively less learning, due to fewer senses and its typical features such as the relationship with a teacher, less interaction with peers (Shen *et al.*, 2008) and boredom. It is these differences that contributed to the different results and processes of learning in two settings.

From these findings, it could be concluded that the digital kitchen can provide a motivating learning environment which is multi-modal, multi-sensory, multi-interactional, multi-experiential and multi-layered. It is physicality, meaningful tasks and computer technology that foster learning in vocabulary and cultural aspects. This project contributes to building up one more dimension of psycholinguistic factor in language learning, and supports the development of innovative ICT for foreign language learning across the world.

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Dedication

This thesis is dedicated to the memory of my late father, my proud country South Korea, and the Sarang Community Church.

Declarations

I declare that this thesis contain some materials which has already been published collaboratively with Prof. Paul Seedhouse, Dr. Robert Comber, and Prof. Jieun Kiaer, and that it also includes some materials of pedagogical and technological design from the European Digital Kitchen project.

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Park, J-U. and Seedhouse, P. (2017). Sight and Touch in Vocabulary Learning: The Korean Digital Kitchen, In P, Seedhouse (Eds.), T*ask-based Language Learning in a Real-World Digital Environment: The European Digital Kitchen*, 233-259, London: Bloomsbury.

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Chapter 1. Introduction

1.1 Introduction

The first part of this chapter explains the background of this study in relation to its research field. This is followed by the rationale and purpose of the study, including an introduction to the research questions and methodology. This chapter finishes with an overview of the thesis.

1.2 Prologue

Globalisation in the 21st century continues to progress at a rapid pace and influence every single aspect of people's lives around the world. This has made the world more interconnected and interdependent in terms of politics, economy, society, culture, and education. Rapid technological innovation has also occurred, and, in ways that have been surprisingly sustainable. Since the 1990s, with the advent of the Internet and the World Wide Web, a wide variety of learning technologies have emerged and provided the infrastructures to enable foreign language and culture learners to interact and communicate with one another, employing integrated forms of multimodal learning tools such as text, image, and video from a distance (Levy, 2007). Typical examples include high-tech tools such as Skype, Google Talk, and Facebook allowing for communication on a global level. This development has continued to the point where an increasingly large number of features are combined in more sophisticated manners, shaping and changing our way of life.

As the new technology evolves, a number of countries are waking up to global-language learning; a good command of speaking English and one or more other languages is an essential skill for social, economic, and political purposes (Brecht and Ingold, 1998). World languages other than English include Spanish, French, German, Chinese, Japanese and Korean, all of which have more than 50 million native speakers, according to the *Ethnologue* report by Lewis *et al.* (2016). New methods and technologies have opened up incredible opportunities for learning these popular languages, giving access to real connection in real-world environments. This development motivates users to acquire a set of skills necessary in our lives, including language and culture knowledge: "if we want to teach language and culture and access layers of culture which are particularly difficult to access, we need the right tools" (Levet and Waryn, 2006, p. 95).

At the forefront of this is Newcastle University, UK, which has a world-class reputation for research excellence, and is spearheading major societal challenges, that have a significant impact on global society. The university is responsive to large-scale societal needs and demands, which have been met by a range of internal school bodies. One of the leading organizations is *iLab:Learn*, a laboratory for developing appropriate educational applications of digital technology. It is a conceptual as well as a physical space for people in Newcastle University, working closely with a number of partners from both local and international collaborators who share a passion for digital technology and learning in all forms. The aims of this practice-based research lab are twofold in general: (a) combining expertise in pedagogy with the School of Computer Science's expertise in web-based technologies, pervasive computing, and situated interaction, and (b) developing and motivating a program of technology enhanced learning research. Thus, the university has been taking the lead in tackling world-class research in both education and computer science.

Among the latest initiatives in the *iLab:Learn* is the Digital Kitchen for language learning, an innovative learning platform created by an outstanding applied linguist and computer technicians. It is a 'pervasive', and 'real-world' digital environment where foreign language and culture can be learned via the daily activity of cooking (Seedhouse, 2017). The digital environment offers proper help to people in need just as a satellite navigation system installed in a car helps a driver. The digital device aided by satellite signal data keeps track of the progress and provides timely prompt feedback while the driver carries out the task of driving a car to the destination. This ubiquitous computing (Ubicomp) technology has significantly changed our everyday life since its inception. Using this technology, Seedhouse and his team have created an innovative learning platform called the 'European Digital Kitchen (EDK)'. However, the technology has yet to reach its full potential in the field of modern foreign language and culture learning. Therefore, this study extends the previous project to achieve part of the potential by applying the modern technology to an uncharted territory. The current study uses the existing technological component called the 'Authoring tool', which helped produce pedagogical materials to create a learning environment called the 'Korean Digital Kitchen (KDK)[1]' where students can learn

[1] A short video-clip explains what the KDK is and involves. Please follow the link at http://europeandigitalkitchen.com. Watching this video helps you understand most of what will be covered in the coming chapters.

Korean language, culture and cuisine simultaneously through cooking. Thus the main contribution is the creation of Korean materials. By using an Oriental language, this study now shifts the applicability of the approach from European to Asian languages and cultures.

1.3 Why cooking in the kitchen for learning?

This study uses a kitchen as a learning environment for various reasons. The kitchen provides a tangible connection to what Skehan referred to as 'real world activities' (1998, p. 95) where learners use authentic language for a communicative purpose. The kitchen specifically provides learners with a chance to carry out cooking, 'a task which has considerable resonance with both language and culture' (Seedhouse, 2017, p. 7). Furthermore, the kitchen allows learners to engage in cooking and eating food, which is one of the only things in the world that draws on all five senses to engage people. This multi-sensory nature of cooking enables Trubek and Belliveau (2009) to see cooking as an ideal framework for learning. Considering the nature of the kitchen and its relevance to learning, it is important to understand the impact of the kitchen environment as a learning platform.

1.4 Why Korean languages, culture and foods?

Korean language learning has become increasingly popular across the globe due to a combination of factors. It is over the last four decades that Korea's economy has started to grow and gain attention from the global community. Spurred on by this momentum, the Korean government began its support of Korean study programs abroad. The US government started to promote Korean language proficiency. As a result, it has been reported that students in the USA increasingly choose Korean as an option for their SATs (Scholastic Aptitude Test), and Korean was the 4th most popular foreign language chosen by SAT students in 2008 (Kiaer, 2018). According to the British Council's 'Languages for the Future' report by Tinsley and Board (2013), Korean is ranked 14th in languages for the future in Britain. The number of educational institutions for Korean stands at almost 2,000 in 116 countries all over the world, according to a report by the Overseas Koreans Foundation (2014). Finally, the economic boom gained momentum because of the ever-increasing Korean population around the world. The Korean 'diaspora' amounts to roughly 7 million people across the world as shown in Figure 1 (Shin *et al.*, 2013). Korean is now the 12th most widely spoken among the world languages, according to the latest *Ethnologue* report by Lewis *et al.* (2016).

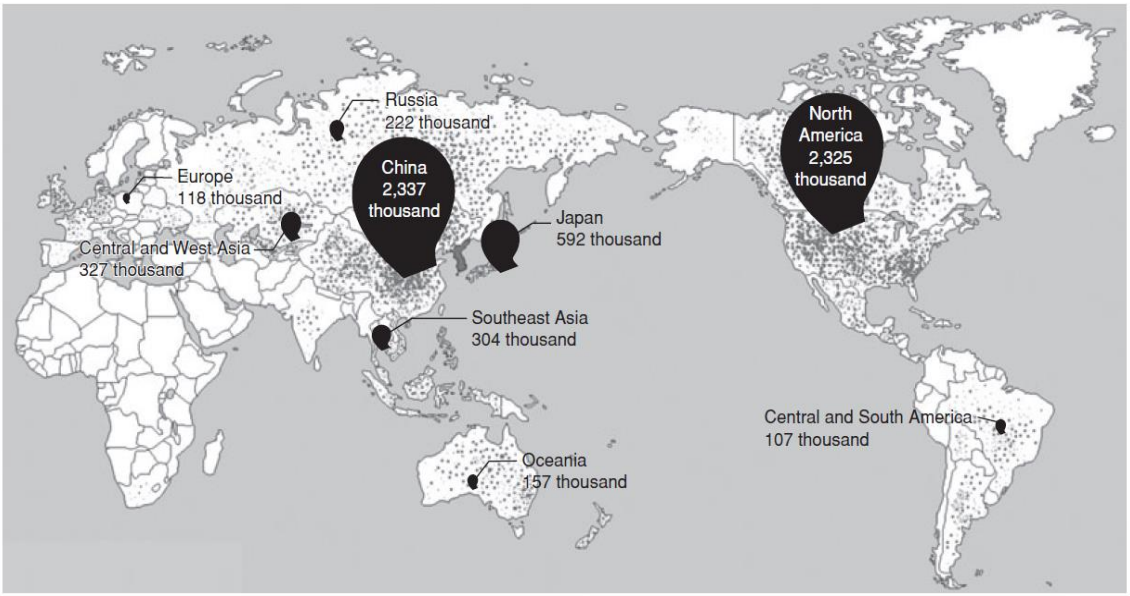

Figure 1 Korean as a global language

In recent years, however, a new wave has given the Korean language boom even greater force. The Korean Wave (*Hallyu*) is a pop-culture media blitz that has taken most of Asia by storm and has even made inroads in parts of Europe, the Middle East, North America, and South America. Korean music (K-Pop) and Dramas (K-Drama) are being exported to various parts of the world at an unprecedented rate. As a result of the widespread interest in Korean popular culture, interest in the Korean language has expanded as well. More recently, Korean foods have also emerged as one of the most influential products to spread Korean culture. According to a report on the Korean Wave conducted by KOFICE (Korea Foundation for International Culture Exchange), Korean cuisine was picked as the most popular aspect of the Korean Wave (46%). Furthermore, a report by the Institute of Management Research of Seoul National University (Kim, 2012) (commissioned by the Ministry of Agriculture, Food and Rural Affairs) ranked Korean cuisine 7th out of 12 on the globalization index for ethnic cuisines. The number of overseas Korean restaurants is also increasing. One estimate reports about 12,000 restaurants in 2014 and very likely to see a substantial increase as the surveying method has recently been improved. Thus, it seems that there has been a massive increase in interest by consumers all over the world to discover Korean language, culture and cuisines.

A global survey conducted by the QS World University Rankings in 2014 has confirmed Newcastle University as the top 1% of world universities. As one of the leading universities, the university has recently reopened up Korean language programs to satisfy the demands of global language learning. Since the EDK deals only with 7

European languages, the present KDK project makes the contribution of confirming the academic status of the university by helping people in and out of the university learn Korean.

1.5 Rationale of the Study

This study employs the real world digital environment of a kitchen as an innovative learning environment for several reasons. Firstly, various well-known problems relating to classroom-based foreign language learning can be addressed. The pedagogy of Task-Based Language Learning and Teaching (TBLT) has contributed to the development of pedagogical activities in the classroom, which have helped students rehearse the language in question. This study attempts to take one step further to give them an opportunity to use the target language to perform real world activities. The Korean Digital Kitchen (KDK) allowed learners to be engaged in a real world task of physically making the dish. Secondly, this study brings the foreign culture to life in the classroom. Learners in the KDK are required to produce the local cuisine, which offers a window into the culture by manipulating real objects involving five senses: "The relationship among language, food and culture in a society is an inextricable one" (Ayeomoni, 2011, p. 51). Thirdly, motivation is activated, enhancing learning in this study. Many people find state-of-the-art technology an interesting and motivating tool for learning, as it can be seen in a number of learning platforms. In Korea, for example, digitalization for education allows for more active access to interactive digital devices, making students motivated and boosting learning effects (Severin and Capota, 2011). Sensor-based Nintendo Wii ™ involves multimodal technology-based activity, and its popularity and motivation is evident according to users' feedback: "'Wonderful technology'; 'The sensors were cool'; 'I said that it was fun to do and that it's great that you can do something practical whilst learning languages and different recipes and I really like the idea and the technology'" (Seedhouse, 2017, p. 6). Also, cookery plays an important part in increasing motivation. Not only South Korea and other East Asian countries but also countries across the world have seen an increasing number of cooking programs on TV and a growing range of cookbooks. These reflect people's interest in and enjoyment of cooking. In other words, motivation from technology and cuisines is stimulated in the KDK. Fourthly, language learning can be normalised into an everyday activity. This study employs a well-established pedagogical approach of Task-Based Learning and Teaching (TBLT) in combination with the technology for learners to gain linguistic and non-linguistic skills at the same time. Paterson and Willis's (2008)

English through Music, for example, is designed to help children to learn English naturally as they are engaged in making music together. Their study is similar to the current research as it combined language learning with non-linguistic skills. However, so far research has been centred on tasks performed only inside the classroom, and little attention has been paid to a real world activity in a naturalistic environment outside the classroom. The KDK uses our kitchen as a learning platform because the act of cooking is an authentic task with a clear goal and end product. In other words, by combining the digital technology and a real world task in an out-of-the-classroom context, this study aims to construct a learning environment in which language learning, in line with technological development, can be immersed into our everyday activities.

This study also has a motivation in relation to engaging with challenges at an international level. With globalization strongly underway in all parts of the globe, countries are increasingly involved in the movement of goods, services, ideas and technology across national borders. As the phenomenon seems to demand a comprehensive transformation of a society, the impact on language and culture is inevitably detected not just in Western, but also in Oriental regions. There have been a wide range of projects that promote understanding of foreign languages and raise awareness of other cultures. The American government has funded the implementation of innovative teaching methods in Korean language programs, by establishing the Korean Language Flagship Centre (KLFC) in the University of Hawaii at Manoa. The centre has contributed to the development of the Korean educational curriculum. Also, the Korean Education Centre of Embassy of Republic of Korea in the UK has recently launched a program in cities including London and Bristol to promote the study of Korean language and culture in the UK. This reflects the ongoing process of globalization and rising demand for Korean language and culture education.

Almost all of these problems and challenges have been addressed using up-to-date technology in combination with the real world task of cooking (Seedhouse *et al.*, 2013; Seedhouse *et al.*, 2014; Preston *et al.*, 2015; Seedhouse, 2017). The EDK project has also shown significant advancements in vocabulary learning. However, since the previous EDK project was designed as a holistic environment in which many environmental factors contribute to language learning, there was a need to disaggregate some of these factors and discover which factors were more or less significant. Did the EDK learners learn the vocabulary effectively because they could see the objects and ingredients, or because they could touch the objects, or because they could use them as part of a meaningful task, or because they were using the latest technology?

The Korean Digital Kitchen (KDK) was therefore designed to address these limitations as an extension of previous research. Since the KDK also uses a different language and culture from the ones used in the EDK project, it opens up an opportunity to expand the horizons of technological application to other geographical areas.

1.6 Purpose of the Study

The purpose of this study is to disaggregate 'seeing' the objects and ingredients from the other factors in the KDK environment. So, this study takes two parallel groups in a quasi-experimental design. One group would carry out the standard digital kitchen cooking task as described in this thesis, whereas the other group would carry out a parallel task in the classroom, learning the same items by looking at photographs of the objects only. This project aims to see whether there is any significant difference between vocabulary learning which involves *seeing* the learning items only, and learning which also involves *touching* and using the items in a meaningful task in the KDK environment. Of course, participants in the classroom were able to only see, touch, manipulate pictures of objects as resources for task completion. However, they were not able to touch real objects to cook. This is what the author of the current study means by *seeing* and *touching*. In other words, KDK learners used real objects for a real cooking task, while classroom ones employed pictures of objects for a 'pretend' cooking task. The research would determine whether the importance of the element of sight and touch would be disaggregated from the overall picture, by finding out whether the other environmental elements add value to the vocabulary learning at a significant level. The motivation for this is to test whether the literature on vocabulary learning (Nattinger, 1988, p. 67) is correct in suggesting that the ability to touch and manipulate objects (as opposed to just seeing them) increases learnability. In designing the test, the following three research questions were formulated:

1. Do participants learn vocabulary more effectively in the digital kitchen by touching and manipulating real objects to complete a real-world task than in the classroom using pictures of objects to complete a pedagogical task? If so, to what extent and how?
2. What are learners' attitudes to learning in the two different settings?
3. Does using real objects to cook in the digital kitchen help students learn Korean cultural aspects more effectively than looking at photos of the objects in the classroom? If so, to what extent and how?

To explore the outcomes and processes of users' learning in two different settings, this study takes a mixed methods approach using a range of data – test scores, observational data and interviews for analysis. Throughout this study, the main arguments are:

- Physicality can enhance vocabulary learning significantly.
- Using real objects in the KDK helps students learn Korean vocabulary significantly better than looking at photos in a classroom.
- Using real objects helps students learn Korean cultural aspects in a technology-enhanced environment better than looking at photos in a classroom.
- The technology-embedded environment is more enriching for learning in various ways than a classroom: physicality, hands-on experience, multi-sensory experiential learning, autonomy and increased motivation.
- The majority of learners prefer to learn foreign languages in the technology-enhanced setting rather than in a classroom.
- The digital kitchen is as effective a learning environment for Korean vocabulary, culture and cuisine as for European languages, cultures and cuisines.

This study aims to contribute to the field of applied linguistics by widening the scope of tasks beyond the classroom, and modelling a new methodological approach, which models both learning *outcomes* and learning *processes*. Moreover, this study provides evidence to support one more dimension to vocabulary learning: that physicality aids language learners in vocabulary learning. Finally, the study also contributes to the field in understanding the effect of digital technology on Korean language learning. In particular, the study holds significance by applying sensor technology to an Oriental language, thus expanding the horizons of TBLT and CALL.

1.7 Thesis Outline

This chapter has introduced the background, rationale, and the objective of this study. Chapter 2 then positions the current study within the relevant literature in order to outline the foundations of the study and to identify research gaps that will be addressed. More specifically, studies of a real world environment for foreign language learning and physicality are reviewed. Based on this review, it is clear that little research has been done on vocabulary learning in the field of TBLT and CALL. This chapter also reviews

how learning occurs in a technology-enhanced real-world environment and the recent developments in research in this area.

In Chapter 3, the technology behind the KDK project is explained in greater detail. The chapter looks at how this study uses the previous technology to produce the new pedagogical materials and how the technological component supports learning in combination with the TBLT framework.

Chapter 4 discusses the methodological approach adopted in this project. It includes a detailed account of philosophical underpinnings, research design, a mixed methods approach, a quasi-experiment, the study procedure, data collection tools and data analysis procedures. The chapter explains the framework for analysing vocabulary learning.

The data collected is then presented and analysed in Chapter 5. By using a mixed methods approach, this chapter not just displays the extent of learning in two different settings with a quantitative investigation, but also illustrates the different processes of learning with detailed qualitative analyses. Chapter 6 deepens the interpretation of these data findings by relating them to the research question and literature reviewed. The chapter also presents the findings and their implications to foreign language learning in relation to TBLT and CALL.

Chapter 7 summarizes the findings, and answers the research questions. It offers a brief summary of the contributions to the field as well as reflections on the methodological and pedagogical model of this study. The chapter then presents the limitations of the study and recommendations for further study.

Chapter 2. Literature Review

2.1 Introduction

This chapter positions the current study within the relevant literature. It presents the argument that vocabulary and culture learning can be improved when up-to-date computer technology is combined with an everyday activity in a real life environment, where a learner can use their physical senses of touch, in particular, rather than simply seeing photos in the classroom. To this end, this chapter outlines the key concepts in relation to learning, pedagogical design and computer technology.

2.2 History of Language Learning and Teaching Approaches

Language is one of the most important parts of our being and is essential for communication and interaction. Researchers in Second Language Acquisition (SLA) have therefore made sustained efforts to develop theories and approaches of how best to teach and learn second languages. According to different theoretical perspectives (e.g. cognitive, interactional), a wide range of language learning and teaching approaches (e.g. Grammar-translation, Audio-lingual, Communicative Language Teaching) have been proposed (Cook, 2008; Hall, 2011; Larsen- Freeman and Anderson, 2011). The range of approaches reflects the progressions of language learning (Richards and Rodgers, 2014). They have also encouraged second language educators and researchers to combine theoretical and pedagogical principles from different methods and areas of disciplines to improve SLA. Therefore, the next two sub-sections explain these approaches and the key pedagogy of this study in detail.

2.2.1 Overview of Language Learning and Teaching Methods and Approaches

There is no convincing evidence that there is any one best way to teach a second language (Gebhard *et al.*, 1987). So, attempts to improve the effectiveness of language learning and teaching have long been made and have often focused on changing their methods throughout the history (Cook, 2008; Hall, 2011; Cutrim Schmid and Whyte, 2014; Richards and Rodgers, 2014).

With approaches and methods to second language learning and teaching being underpinned by structural and behavioural tendencies from the 1840s to 1940s, the methodological basis of Grammar-Translation and the Direct Method was developed. The focus of the former was on studying grammatical rules and morphology, written exercises, vocabulary and L1/L2 translation, whereas the latter was on improving oral

communication skills, grammar and vocabulary. These practices were aimed to help language learners aspire to a mastery of the foreign language, but the criticism levelled at this stage was a lack of insight into the reality of the classroom situation for most learners. In the 1950s, the Audio-Lingual Method appeared and the approach focused on memorization through oral drilling of certain patterns. The approach was still based on a structural syllabus, which prompted a reaction in the 1960s with the emergence of the Oral-Situational Approach. This emphasised not just the forms, but also the meaning expressed by linguistic structures. However, since these methods were preoccupied with grammatical accuracy, they failed to promote language learners' communicative ability. Subsequently, there was a need for educators to help students use their linguistic knowledge to improve communication skills. This explains why both approaches were superseded by the Communicative Approach in the 1970s. The approach in this era changed the focus toward fluency over accuracy, with an emphasis on interaction, as both the means and the ultimate goal of learning a language. Communication was seen as more important than simple linguistic knowledge. In this regard, SLA was theoretically related to how people learn their mother tongue: engaged in an authentic environment where language input is obtained naturally. This approach has long dominated academic discourse and emerged as one of the influential constructs to recreate real communication contexts in second language learning and teaching.

Communicative Language Teaching (CLT) has since taken its place as the norm in second language and immersion teaching. This approach emphasises language as a means of communication (Richards and Rodgers, 2014), and attempts to ensure the authenticity of teaching/learning materials and meaningful tasks in the classroom. It has a number of characteristics, as listed below (Brown, 2007; Richards and Rodgers, 2014, p. 105):

- Learners learn a language through using it to communicate.
- The pragmatic, authentic and functional use of language for meaningful purpose should be the goal of classroom activities.
- Fluency is an important dimension of communication.
- Learners should ultimately use the language both productively and receptively in unrehearsed contexts outside the classroom.
- Students are offered opportunities to focus on their own learning process through an understanding of their own styles of learning and through the development of appropriate strategies for autonomous learning.

- The role of the teacher is that of facilitator and guide, not an all-knowing bestower of knowledge. Students are therefore encouraged to construct meaning through genuine linguistic interaction with others.

Thus, CLT reflects a communicative view of language and language learning. Since its inception, the approach has shifted through a number of different phases in its syllabus, procedures for identifying learners' needs, and classroom activities to apply its principles to different dimensions of the second language learning and teaching process. This is how a further refinement of the CLT approach was developed: Task-Based Learning and Teaching (TBLT).

TBLT has long been used due to its pedagogical benefits, and its methodological flexibility has recently led to its application in combination with other L2 teaching and learning approaches and materials. In particular, the combination of task and technology has opened many lines of research, which has improved SLA. In terms of Korean as a foreign language and its education across the globe, Yeon (2015) has foresight and insight, seeing the integrated pedagogy as 'desirable' to maximise students' learning effects (p. 9).

Taking a number of pedagogical and technological advancements into consideration, the KDK is able to construct an authentic learning environment where natural language is used to communicate to achieve the goal in an autonomous manner through technology. It is the pedagogy of TBLT in particular that has made this possible.

2.2.2 Task-Based Language Teaching & Learning (TBLT)

Task-Based Learning and Teaching (TBLT) is one of the major approaches to language teaching and learning worldwide (Ellis, 2003; Nunan, 2004; Van den Branden, 2006; Samuda and Bygate, 2008). TBLT is a well-established approach to language learning which allows learners to achieve a goal via task implementation (Ellis, 2003; Skehan, 2003). Tasks serve as a mediator for learners to pragmatically use the target language with the aim of learning language. It is this pedagogical design that the Korean Digital Kitchen (KDK) draws on.

Samuda and Bygate (2008) see TBLT as involving "holistic activity" (p. 7) in that all sub-areas of language, including vocabulary, are employed to make meaning. They argue that such holistic language work plays an instrumental role in foreign language learning and reveals the language learning processes. In other words, TBLT not only allows learners to relate language to meaning and purposes whilst they

interactively engage in tasks, but also involves learners in getting feedback from interlocutors on whether their comprehension is accurate. Through this, learners enhance their understanding of new language, with the task providing a constant context for new language to be encountered. Moreover, Bygate (2015) proposes that "tasks can be designed and deployed to engage learners in using language interactively" (p. 6). According to Ellis (2003), "there is a clear psycholinguistic rationale (and substantial empirical support) for choosing 'task' as the basis for language pedagogy" (p. 320). That is, tasks provide learners with an opportunity to get involved in activities, which in turn sharpens their grasp of the language, serving as powerful mediators of language learning.

What has been discussed above constitutes a 'strong' version of TBLT with primary emphasis on meaning in a task. However, many scholars argue that if there is no focus on form, learners will attain a low level of language proficiency (Widdowson, 1998; Skehan, 2003; Nunan, 2004). Long and Robinson (1998) also argue that there needs to be a focus on form, even though learners may carry out tasks with meaning as primary. This is the 'weak' version of TBLT approach (Skehan, 1996). The weak version sees tasks as a way of providing communicative practice for language items that have been introduced in a more traditional way. According this view, tasks are comparable to the production stage of the procedure called 3Ps (present-practise-produce) instructional cycle. The language item is first presented and then practised in a controlled manner. Finally, opportunities for using the item are offered. Thus, the traditional approach views language as a series of 'product' that can be acquired sequentially. There are many issues on which aspects should be prioritised in language pedagogy. Nevertheless, Ellis (2003) sees task-based pedagogy that provides a way for vocabulary learning, proposing that "L2 acquisition is a 'process' that is incompatible with teaching seen as the presentation and practice of a series of 'products'" (p. 29).

Tasks are normally defined as a means which systematically help language learners improve their receptive and productive skills (Willis and Willis, 2001; Nunan, 2004; Long, 2014). Within task-based instruction, TBLT has five main features: a task is a work-plan; a task places a primary focus on meaning rather than form; there is a communication problem to solve; a task is related to real-world activities; a task requires participants to use linguistic resources to complete the task; a task has a clearly defined outcome (Skehan, 1998; Ellis, 2003). One distinct feature of most of task definitions by many researchers is that tasks lead to outcomes, which refers to what the learner achieve when they complete the task. The actual outcome of a task may be not

related to the pedagogic purpose of the lesson. However, the task completion involves their cognitive and linguistic mechanism. It is these processes for language learning that matter. Even though there are various options in the case of social organization, tasks are generally transacted in pairs or small groups in order to maximise interaction and autonomy (Ellis, 2003, p. 263). In the KDK, learners (in pairs) use language to complete a culinary task in a holistic manner. The cooking task is an authentic real world context and involves the production of a dish.

TBLT has two types of tasks: 'real-world' tasks and 'pedagogic' ones (see Ellis 2003, 2009). The real-world tasks are taken from the outside world and learners have to accomplish them after completing the course. On the other hand, the pedagogic tasks resemble real-world ones in some way, but are specifically invented for use in the classroom. Recently, it has been highlighted in TBLT that learners need to do tasks in real life and real situations, which allows them to be exposed to authentic language through authentic tasks. Considering the emphasis on the authenticity in TBLT, the kitchen environment can be used as a learning context because the act of cooking a meal is a real task in real life and a real-world situation with a clear goal. This explains why it was thought possible that the main hypothesis of the Korean Digital Kitchen's study could be tested: manipulating real objects in a real environment produces more successful learning than simply using photos in a classroom.

2.2.2.1 Three Phases of Tasks

As a pedagogy, TBLT has been understood in several distinct ways in terms of overall approaches and elements. In order to operationalize TBLT, the present study draws on Skehan's (1998) framework in which tasks are divided into three phases: *pre-task*, *during-task* (or *on-task*), and *post-task*, as the procedure provides a clear design structure for learning materials.

The *pre-task* phase functions as a preparation stage for the task. The preparation explains general purpose and introduces the task, with a clear indication of what students should achieve by the end of the task. This phase aims to direct attention to the language itself through their engagement with the task. This stage involves the mobilization of previous language knowledge and clarification of the knowledge that would be required (Skehan, 1998, p. 138). The *during-task* phase involves students' engagement in the task. It is in this phase of the task that Skehan claimed learners' attention could be manipulated through a range of features such as time pressure, support, surprise and control. That is, this phase helps deal with potential difficulties

among students, and, ensures that everyone is right on track with task outcomes. The KDK plays a supplementary role as a scaffolding to provide support and clarification, checking that students are addressing the key issue and that they are moving in the right direction. Finally, the *post-task* phase is designed to reflect on and evaluate task transactions as students complete tasks and taste the dish. Through the outcome of the task, students produce the use of the target language, which can be reshaped and consolidated via their self-correction or computer feedback. Furthermore, students are given a chance to practise and reformulate the language form they found hard during *tasks*. It is in such a way that the task is pedagogically used as they perform tasks in an effective and meaningful way in relation to language learning.

2.2.2.2 Learning Process in Tasks

The tasks themselves are integrated into the students' learning process. Tasks can be seen as a learning mediator from theoretical perspectives. One such perspective is John Dewey's theory of experiential learning (Dewey, 1938). He thought that the meaning of a given experience comes from interaction between what individuals bring to the situation and what happens there. The learners are able to relate their new experience to their previous knowledge 'by doing and experiencing' rather than by observing. This is also supported by TBLT principles, including learning by doing. As Doughty and Long (2003) argue, "new knowledge is better combined into long-term memory and more easily retrieved if tied to real-world events and activities" (p. 58) . Realistic hands-on experience with real-world tasks in a real life environment brings abstract concepts to life and makes the concepts more understandable. In this regard, it will be argued that the learning setting of the KDK is a motivating space where learners are able to experience a real world task by using real life materials. Learners encounter a direct experience of cooking, which allows them to echo what they have done and work it out again. Learners can take a practical and experiential approach as they carry out the task of cooking. They are also able to formulate their knowledge by doing and feeling, given the nature of the kitchen setting. This style is '*hands-on*', and relies on intuition rather than logic. Indeed, this learning style is prevalent within the general population (ibid.).

As well as experiential learning, learners' autonomous learning is embodied in the KDK. The task of cooking involves them in the learning process and promotes social activities such as collaboration, meaningful communication, and cooperation (Lynch, 2010). This learner-centred learning creates an opportunity for students to use

the target language in order to negotiate meaning with their colleagues in task-based interactions (Adams, 2007). The digital kitchen setting thus offers a space not only for experiential learning, but also for autonomous learning.

2.2.2.3 Tasks and SLA Theories

There are three major perspectives involving tasks in relation to Second Language Acquisition (SLA): a psycholinguistic approach to interaction; a cognitive perspective; and a social interactive approach. The first one concerns the way learners encounter communicational breakdowns on tasks and how they address the difficulties. The second focuses on their psychological processes engaged in when learners implement tasks. This perspective has three main interests: analyses how attentional resources are used during task completion, the influence of task features and the impact of different conditions under which tasks are completed (Skehan, 1998).

The final perspective explores how learners co-construct meaning while in interaction. According to a sociocultural perspective, tasks are seen as a learning mediator allowing for mutual collaboration and interaction, which functions as a vehicle to enhance a deeper level of learning. As Ellis (2003) puts it, a primary means of mediation in sociocultural theories is verbal interaction. This interaction allows one interactant to shape the context in which another person can take part in their own learning and in which, the speaker helps support the person. This dialogic process according to sociocultural theories is called scaffolding, which is the support students are offered for their needs during the learning process with the intention of achieving their learning goals (Sawyer, 2006). It is tasks that allow learners not only to interact with others to use new linguistic knowledge, but to independently apply what they have internalized in less demanding situations, before using that language information. Two learners in pairs in two different settings, for example, interact with each other to cook the dish. When they carry out a certain task and face the individual needs and interests, one speaker might be able to draw upon his or her knowledge and experience of communicating with other interactants to reduce the demand of the task and to scaffold the interaction so that a successful outcome is achieved. Thus, tasks can help build a stage for establishing interaction and collaboration, all of which mediate learning.

As this study employs a quasi-experimental design in which two different conditions are compared in task completion, it mainly takes cognitive perspectives. A socio-cultural perspective is also taken in part, given the nature of tasks in which two learners have to work together.

2.2.2.4 Issues in TBLT

Of course, TBLT is not without issues. This language learning and teaching approach has been subject to criticism in terms of its implementation in different instructional settings (Widdowson, 1993; Li, 1998; Carless, 2004b; Butler, 2005). The criticisms include using the mother tongue during pair- or group-activities, dealing with classroom management challenges, and the production of the target language. For example, as the main purpose of the pedagogy is to use the target language as much as possible, one might think that using the mother tongue can be a barrier to their learning. Nikolov (1999) found that Hungarian young learners use their mother tongue more frequently than English during tasks, and this practice keeps teachers from achieving pedagogic goal of teaching English. Additionally, they raise a question as to how practical TBLT can be in EFL contexts in many European and Asian countries where teachers comply with a philosophy of teaching that is different to that underlying TBLT, and where learners do not have many communicative opportunities. That is, TBLT is viewed as implying a particular cultural context and desirable only in the West. Although this is an issue about EFL contexts rather than Asian language education, this study attempts to counter the criticism by using Korean and 87.5% of participants from a culturally communication-deficient context (see Section 7.5).

2.2.2.5 Empirical studies

TBLT has become a mainstream approach, as the top-down curriculum mandate at a national or regional level in many countries such as Hong Kong, Malaysia, China, and Belgium (Zhang, 2007; Carless, 2008; Mustafa, 2008; Van den Branden, 2009). A number of studies have presented applications of TBLT and its learning outcomes in various classroom environments. Cho (2015) applied the approach to writing lessons for high school students in South Korea, showing that task complexity made students pay more attention to fluency rather than accuracy in L2 written performance. This study suggested pedagogical implications for L2 writing curriculum in such a way as to enable a more balanced language development for students. Leaver and Kaplan (2004) studied students in a TBLT-based learning environment at the Defence Language Institute in America. They noticed that the approach raised learners' awareness of learning skills. Ruso (2007) conducted research with university students, revealing that the implementation of TBLT brought positive effects into the classroom, such as increased participation and enhanced rapport between students and teachers. Similar findings came from Mao's (2012) study showing that a TBLT-based curriculum helped

Chinese students improve reading skills and linguistic competence under authentic learning circumstances, compared to that of the traditional classroom. A quasi-experimental classroom study in an Iranian school provided further evidence of the advantageous ripple effects of TBLT on language learning outcomes (Rahimpour, 2008). Propelled by such findings, studies have recently examined how the previous research impacted teachers' practices in the classroom in relation to students' language learning. They found that prior academic results can help instructors implement the recommended TBLT programs in the classroom (Carless, 2004a; Van den Branden, 2009; East, 2012). As an innovative attempt to integrate language learning with non-linguistic skills, TBLT has recently taken a further step by using daily activities in the current research. Paterson and Willis's (2008) English through Music attempted to use a TBLT pedagogy in the classroom to help children acquire English naturally by making them enjoy music, showing positive results for learning. Likewise, a large body of literature exists, showing how the TBLT approach positively impacts learning.

However, most of this research has focused only on tasks carried out in the classroom setting. Although TBLT has contributed to bringing real-world tasks into the classroom, very few attempts have been made to use TBLT in naturalistic settings outside the classroom. This is why more research is needed to examine real-world tasks beyond the classroom and their impact on learning. To fill this gap and develop more sophisticated methods, this study has examined the effect of tasks undertaken outside the classroom on learning in combination with other resources, in particular the modern technology of Computer-Assisted Language Learning (CALL).

2.3 Computer-Assisted Language Learning (CALL)

Computer technology has influenced human activities, as well as education, to an astonishing extent. Up until two decades ago, only a small number of specialists had been concerned with the use of computers. However, with the increasing availability of multimedia computing and the Internet, the role of computer technology in foreign language learning has become an important issue. Applying state-of-the-art technology to education in a particular context has challenged language researchers to maximize the students' learning effects. The field of computer-assisted language learning (CALL) studies the role and use of Information and Communication Technologies (ICT) in second/foreign language learning and teaching, including an array of activities spanning different materials and pedagogical practices. Levy (1997) defines CALL as "the search for and study of applications of the computer in language teaching and learning" (p. 1).

Computer technology has brought major advances in second/foreign language learning in several ways; in allowing for multimedia applications, this capacity enables learners to interact with both program and other learners (Felix, 1998); through offering time flexibility for class scheduling and pacing of individual learning; and by choosing activities and content to suit individual learning styles. That is, optimal use of learning time is given to students, so that they repeatedly review what they have learned (Oxford *et al.*, 1998; Ikeda, 1999); providing great assistance to the learner even without the presence of teachers, which leaves students room for autonomy (Pennington and Stevens, 1992). This allows students dynamic ways to learn languages through games, graphics, and problem-solving techniques, which can give students the great joy of learning (Ravichandran, 2000); giving students immediate feedback, which help them keep track of their learning. It allows students to work at their own pace, causing less frustration (Brown, 1997). Thus, a wide variety of features have all contributed to the development of CALL programs.

CALL research and applications, however, have been confined to ESL or European languages (Nagata, 2002). While a wide range of Asian languages including Chinese and Japanese has recently seen the integration of CALL in their education system (ibid.), little attention has been paid to Korean education overseas. In this regard, the Korean Digital Kitchen is one of the greatest advancements of the human-computer interaction-based learning platform.

2.3.1 A brief history of CALL

As in other fields of education, the methods and approaches to language learning and teaching are strongly influenced by changes in theories of foreign language learning. Chomsky's attack on behaviourists is a case in point. It brought about a major shift in approaches to language learning and teaching. According to Rüschoff (2002), language learning theory has transformed from a teacher-centred to a learner-oriented paradigm as a result of constructivism (i.e., knowledge is firstly constructed in a social context and then is appropriated by individuals), instead of following the conventional trends of behaviourist approach. The emergence of this new paradigm gave rise to new approaches and methods in the field, and these in turn have evolved.

In a similar way to other language teaching theories, CALL has experienced evolution. This development is shown in Table 1 (Warschauer, 2000, cited by Yang, 2010) below. The researchers have divided the history of CALL into three phases: behaviouristic, communicative and integrative CALL (Warschauer, 1996; Lee, 2000;

Warschauer and Kern, 2000; Al-Shehri, 2004; Braul, 2006). The first wave of 'Behaviouristic CALL' was dominant in the 1970s and 1980s and was informed by the behaviourist model of learning. Kim (2004), found that the first wave of computer use focused on repetitive drills. The computers were nothing more than a replacement of grammar worksheets with computer based systems. The students often felt as demotivated to use computers as to do grammar exercises. Salaberry (2001) suggested that computers just "amount to little more than electronic textbooks" (p. 45). Gaining momentum with the help of World Wide Web in the 1980s and 1990s, the second wave of 'Communicative CALL' has given computers more capabilities through internet searching where students found themselves engaged in more meaningful tasks (Kim, 2004). Computer-based activities from this wave have allowed students to learn grammar implicitly rather than explicitly, and generate original utterances rather than manipulate prefabricated language (Jones and Fortescue, 1987; Phillips, 1987). The computer with the help of internet has provided students with a host of opportunities that were never achievable before, such as communicating with native speakers all over the world and searching for authentic materials (Xing, 2003). These benefits have continued in the next wave: 'Integrative CALL' in the 21st century. However, what made the third wave different from the previous wave was the shift to a viewpoint that not only combines four language skills (e.g., listening, speaking, reading, and writing), but also integrates up-to-date technology more comprehensively into the language learning process, rather than just focusing simply on one language skill based on computer software. This creates the combination of language skills with joint activities. Warschauer (1996), for example, suggested that hypermedia helps create real-life simulations, where hearing and seeing are combined. Students use a range of instruments to solve potential problems innate to language learning (e.g. communication, authentic materials, tasks, etc.). Furthermore, the learning environment can be flexible to help learners to progress individually along their learning paths. He goes on to add that "a major advantage of hypermedia is that it facilitates a principal focus on the content, without sacrificing a secondary focus on language form or learning strategies" (p. 3). Students can freely explore other contents that help them without losing focus on the main course material. The third wave has thus allowed CALL to be transformed into a range of technological tools as an ongoing process of language learning, rather than visiting the computer lab once a week for isolated exercises. Learning tools have kept evolving to support learners.

Table 1 Nature and Developments of CALL

Stage	1970s-1980s: Behaviouristic CALL	1980s-1990s: Behaviouristic CALL	21st Century: Integrative CALL
Technology	Mainframe	PCs	Multimedia and Internet
English-Teaching paradigm	Grammar-Translation& Audio-Lingual	Communicative Language Teaching	Content-Based, ESP/EAP
View of Language	Structural (a formal structural system)	Cognitive (a mentally-constructed system)	Socio-cognitive (developed in social interaction)
Principal Use of Computers	Drill & Practice	Communicative Exercises	Authentic Discourse
Principal Objective	Accuracy	And Fluency	And Agency

The way that the interaction of teaching and learning is shaped has also changed due to the role of computers. The earliest CALL programs in the first and second wave aimed to enhance learners' accuracy and fluency: by providing drill, practice, explanation and feedback in the 'Structural Approach'; or by offering language input and inferential tasks in the 'Cognitive Approach'. This was made possible through the interaction with the computer. However, the third wave moves the focus from learners' interactions with computers to interactions with other humans via the computer. It emphasises a range of roles including providing alternative contexts for social interactions, facilitating access to existing discourse communities, and the creation of new ones. At a theoretical level, the emphasis is on meaningful interaction within authentic discourse communities, whereas at a technological level, the computer is used as a vehicle for interactive human communication. That is, the computer plays the role of a mediator, shaping the ways we interact with the world in the 'Socio-Cognitive Approach'. What started as a tutor that delivers language drills or skill practice has both created a learning space, and served as a medium of a global communication and a source of authentic materials.

Recently, CALL has gone the extra mile, creating video and virtual environments such as Moodle and Blackboard for language learning (Hampel and Stickler, 2012) and mobile technology (Kondo *et al.*, 2012). The potential of up-to-date technology has opened the door for novel forms of CALL-based pedagogy and applications to emerge. The internet has made teachers and learners all over the world communicate with one another, and allowed people to take modules on offer from the other side of the world. It has even spread beyond mobile technology enabling anyone

to speak to their friends in the street, to language learning SNS (Social Network Services), making today's L2 learners one click away from meeting people from all over the world.

The internet era has allowed learners to take advantage of the resources to suit their needs, and has been used as a tool to carry out learning courses in a range of learning and teaching contexts (Stickler, 2011; Barrs, 2012; Diez-Bedmar, 2012). For example, Busuu, a popular Web 2.0 language learning society in the marketplace has more than 50 million registered users (Busuu, 2015). This third wave of CALL has allowed for meaningful spaces where real-world activities are involved, learners can make friends online and sharing personal opinions through social media channels such as blogs and twitter. Considering the popularity of this technology, it is not surprising that most schools try to equip themselves with technology-enhanced devices available for teachers and students to use for learning. Thus, the wired learning platforms help to open doors that others could not, enhancing the quality of autonomous and interactive learning. It is therefore worth investigating whether technology-assisted programs in a wide range of studies have been helpful for teaching and learning. However, even the third wave has faced limitations to learning programs: yet to include a real world activity in a real-world environment, which forms the key facet of TBLT. It is this gap that this study tries to fill.

2.3.2 Developments in CALL

Computer technology has precipitated the development of a wide range of platforms for language learning, teaching and education as CALL has gone through many stages of development, 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). 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 and 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 and Gruba, 2012, p. 46).

CMC in learner-based CALL has been identified by researchers as having a number of potential advantages and drawbacks. The use of text in real-time text-based CMC as an environment of language learning has been proved to be beneficial although simultaneous feedback was reduced (Hudson and Bruckman, 2002). The use of CMC-based pseudonyms in the classroom enabled learners to get involved in identity and language play in a low stress environment, revealing beneficial forms of interaction that were not found in non-CMC classrooms (Warner, 2004). These have all shown that CMC can represent valuable tools serving as an environment with the potential for language learning, while it also contains possible limitations such as reduced paralinguistic cues and a barrier to the formation of interpersonal relationships (Peterson, 2010). These drawbacks led to another development, which is multimodality.

CMC in language-learning contexts most commonly takes place through a single mode of communication, such as audio-conferencing, email, and chat. In recent years, CMC has played a role as a means for learners not just to get engaged in authentic interaction with others, but also to be monitored easily and non-intrusively by teachers and researchers alike (Levy and Stockwell, 2006). So, attention has been paid to multiple modes of CMC-based communication tasks. The concept of multimodality has gained momentum. This is where participants are able to interact using more than one form of communication (Kress, 2000; Kress and van Leeuwen, 2001; Hampel and Hauck, 2004). Norris (2004) suggests that learners are able to perceive the meaning not just through the word itself, but also through non-verbal communication cues such as gestures, postures, and other body movements. Luisa (2003) investigated the effect of multimodality on Spanish learners' vocabulary learning, revealing that they produced more language when using multiple modes of communication than just one. Similar finding comes from several studies (2003) that examined how multimodal methods of CMC tasks led language learners to use various channels in interactions (Satar, 2016) and produce better speaking proficiency (Satar and ÖZdener, 2008). (Wigham, 2017) demonstrates how multimodal communication strategies in webconferencing-supported pedagogy enhance vocabulary teaching. The three studies show a significant difference in favour of multimodality. Thus, improved accessibility to technologies have 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 activity. These multimodal aspects are well embodied in the KDK as the kitchen environment not only provides several modes for learning (e.g. subtitles, audio-visual images, tangible objects), but also addresses the challenges that virtual contexts and CMC resources pose

by integrating face-to-face collaboration between learners. This development has also made CALL practitioners take several elements of the technology into consideration to achieve their pedagogical goals.

In addition to the wide range of studies above, researchers have advanced the design, development and application of task-based approaches for learners from different levels of language proficiency and skills. CALL studies provide a wealth of accessible examples of authentic language use 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. 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. The present study, therefore, attempts to create a real and motivating environment and investigates the effect of it on vocabulary learning by comparing it to learning in a classroom.

2.3.3 Vocabulary Learning

L2 meaning expression is limited by insufficient knowledge of words (Schmitt and McCarthy, 1997), and while little can be delivered if one does not know any grammar, nothing can be conveyed without vocabulary (Wilkins, 1972). It is therefore important to learn vocabulary in foreign language learning. Vocabulary acquisition is defined as the knowledge of form and meaning (Kersten, 2010). However, this is very complex as knowing a word involves not just the ability to recognize it when it is heard and seen: receptive knowledge ; but being able to use the word in a communicative way in the context of purposeful interaction: productive knowledge (Nation, 2001). Thus, understanding a lexical item involves knowing information related to its form, meaning, receptive and productive knowledge. Incidental learning is the process of learning something without the intention of doing so, whereas intentional learning comes when learners intend to learn one thing (Richards and Schmidt, 2002). As this study design

asks students to learn vocabulary items during tasks with communication as the primary objective and with no intention to learn the word, it is incidental that vocabulary learning occurs (Schmidt, 1994; Laufer and Hulstijn, 2001).

Research has also been conducted in the context of Korean as Foreign Language (KFL) in order to develop the strategies of vocabulary learning. Studies show positive results by way of diverse pedagogies (Jeon, 2006) and effective mnemonic approaches with non-heritage Korean language students (Kim, 2000).

A specialized lexical set related to cooking was chosen to test learners' acquisition of vocabulary: a "situational set" (Nattinger, 1988, p. 72) of ten items of cooking utensils and ingredients. All vocabulary items were nouns for several reasons. First, it is because nouns are the most common component of speech in everyday communication (Webb, 2005). It is also because "nouns are the easiest word class to learn, and particularly concrete nouns are learnt more easily than abstract nouns, and because the concrete noun items are learnt more quickly and effectively if objects are nonverbally referred and used as stimuli" (Ellis and Beaton, 1993, cited by Seedhouse, 2017, p. 210). De Groot (2006) also shows that concrete words are learned more effectively than abstract ones. The cooking-related vocabularies used in the KDK are very concrete and involve physical movements on tasks. So, these principles of vocabulary learning are employed in the design of the kitchen environment.

2.3.3.1 Vocabulary learning process

There is a process for learning new words. Nation (2001) proposes that three psychological processes lead to remembering a word: noticing, retrieval, and creative use. The task and test procedures as a whole require learners to "…notice the word, and be aware of it as a useful language item…" (Nation, 2001, p. 63), that is, to retrieve the vocabulary multiple times. When carrying out the cooking tasks, learners had the chance to use the item creatively. *Noticing* occurs when learners have a word explained to them, and it is affected by several factors such as decontextualisation through negotiation; learners pay attention to a word by a range of ways such as listening, reading, explanation, and negotiation. Interestingly, motivation and interest in various layers affect language learning. As Laufer and Hulstijn (2001) put it, motivation as a determining factor influences the retention of unfamiliar words in incidental learning tasks. *Retrieval* happens after comprehension, and subsequent retrieval of a word during the task strengthens the word memory (Nation, 2001). Repetition in the *retrieval* phase also plays an integral role in incidental vocabulary learning. It is because "it is not

simply repetition which is important but the repeated opportunity to retrieve the item which is to be learned" (Badderley 1990, cited by Nation, 2001, p. 67). Kurhila and Kotilainen (2017) also propose that repetition has tremendously powerful consequences for the learning process and for the interaction between peers. *Creative* and *generative processing* happen when previously met words are subsequently met and used in a different ways whilst performing the main cooking task. The new encounter with the word helps learners to reconceptualise their knowledge of the word. For example, if a learner has met the word chopstick used as a noun as in "Please use chopsticks" and then meets "The model in a picture is chopsticking", the learner will need to rethink the meaning and uses of chopstick and this process will allow the learner to firmly establish the memory of the word. Generative process is not restricted to metaphorical extension of word meaning. It can apply to a wide range of variations from inflection through collocation and grammatical context to reference and meaning.

In the present study, two learning settings enable learners to obtain a variety of instructions throughout the test and task cycle that involves three cognitive conditions. However, the levels of the three psychological processes vary due to the obvious difference in affordances between the two environments. The kitchen users can employ real objects, which enhance all learning processes, whereas the classroom learners use only photos, hindering 'creative and generative' use of the words. The task involves the same teaching material for the learner activity in both settings, but the actual activity that occurs is different. It is because contrasting materials (i.e., real objects in a digital kitchen, but photos of the objects in a classroom) make learners experience different cognitive processes in evaluating linguistic and culture information during the work-plan: a real-world task is in process in the KDK, whereas a pedagogical task is in process in a classroom.

In relation to the involvement of the task in incidental vocabulary learning, Laufer and Hulstijn (2001) introduce three dimensions of *Need*, *Search* and *Evaluation* as follows. *Need* gets stronger when learners are required to learn a word. The two settings of the current study do not force them to learn vocabulary items. Rather, the pre-test makes them aware of any items they will need to use in order to make the dish that they do not know the names of, thus raising awareness of a need. *Search* involves attempting to figure out the unknown forms or meanings by consultation, e.g. a dictionary or teacher. Learners in two separate settings alike may request help by interacting with the system, a teacher, or peers. *Evaluation* is a mental process in which learners use a word to link it to another word on tasks. Learners may then ask the

computer, teacher or partner for a help to search and use the word throughout the during- and post-task phase to communicate with one another. Considering learners' inclination, the first two elements are strong, but *Evaluation* is variable because it is dependent on the learners' inclinations rather than on the task or system. Likewise, the construct of task-induced involvement (ibid.) is employed to track down the learning processes in two locations.

2.3.3.2 Vocabulary Learning Modes

There are many ways of communicating and learning the meaning of a word, one of which is showing pictures (Nation, 2001). This is often seen as the most effective way. This is because the accompaniment of a text by a picture can lead to a form of mental elaboration that enriches the level of word processing (Baddeley, 1990, pp. 160-177) 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 of Paivio's 'dual coding' (Paivio and Desrochers, 1981). Chapelle (2003) also suggests 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. This is necessary because pictures contain essential features of the concept involved.

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 (Chun and Plass, 1996; Plass *et al.*, 1998; Baltova, 1999; Kost *et al.*, 1999; Al-Seghayer, 2001; Jones and Plass, 2002; Yoshii and Flaitz, 2002; Plass *et al.*, 2003; Stewart and Pertusa, 2004; Sydorenko, 2010; Winke *et al.*, 2010; Aldera and Mohsen, 2013). For example, Aldera and Mohsen (2013) explored the impact of different modes (picture/texts/keywords, picture/texts, and picture alone) by giving students the multimedia-enhanced task, and it turned out that vocabulary acquisition was significantly facilitated when pictorial and textual helps were offered. Similarly, Yoshii and Flaitz (2002) examined the impact of different types of modes (text alone, picture alone, and the combination of the two). Results revealed that students with the two modes together performed better than the other groups. This is a replication of Kost *et al.* (1999) who also implemented a study where participants were instructed to read a story with textual, pictorial and both mode. Plass *et al.* (1998) investigated the effects of multimedia glosses on individual learning differences as well as learning styles

(visualizers and verbalizers), showing that participants acquired vocabulary much better when they drew on both visual and verbal cues.

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). These all clearly indicated 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 in the field of vocabulary learning to the effect of one additional dimension (i.e. more senses such as touching, smelling and tasting) on L2 learning but see the recent projects of Seedhouse *et al.* (2013), Seedhouse *et al.* (2014), and Seedhouse (2017). 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, the Korean Digital Kitchen (KDK) establishes a space in which interactional associations between real objects and learning are forged to allow for users' vivid experience, enabling powerful, integrated verbal and nonverbal memory links. A physical object can create 'triple coding', in which the meaning is coded verbally, visually, and kinaesthetically.

Recent research by Seedhouse and his team has designed and implemented a holistic real-world learning environment where learners perform real world tasks. Their projects have created a learning environment where kinaesthetic value throughout a task of cooking is added to vocabulary learning. In particular, both the English and Italian project teams alike of the EDK project showed statistically significant gains in vocabulary item learning (Pallotti *et al.*, 2017). This has provided a rich and detailed perspective on one single aspect of the overall learning experience. However, it was unclear which features of the environment contributed most to vocabulary learning. Were the visual aspects most important or the kinaesthetic aspects? It is this gap that the Korean Digital Kitchen study attempts to fill by comparing the learning outcomes from the digital kitchen with the ones of a classroom using an experimental design, posing the question of whether or not manipulating concrete physical objects as part of task helps learning better than simply observing pictures. The original element of this study is that it explores the effect of touching real objects on vocabulary acquisition.

2.3.4 Affective factors

In relation to foreign language learning, applied linguists have long paid a great deal of attention to the learners' psychological and emotional state because the level of learning outcomes varies depending on how they feel when learning occurs: "Learners' affective factors are obviously of crucial importance in accounting for individual differences in learning outcomes. Whereas learners' beliefs about language learning are likely to be fairly stable, their affective states tend to be volatile, affecting not only overall progress but responses to particular learning activities on a day-by day and even moment-by-moment basis" (Ellis, 1994, p. 483).

Krashen (1982) claims that affective factors determine to what extent language learners process linguistic information. These factors include emotions, such as motivation, self-confidence, anxiety, and so on in the process of acquiring a foreign language. When they have a high level of motivation and self-confidence and a low level of anxiety, they have low filters so gain more input, and *vice versa*. This theory shows that learners' emotional state affects their learning. Since the current study has used two different learning environments – a digital kitchen and a classroom- it was expected that learners would sense the contrasting atmosphere between the two settings, which might affect the level of information absorbed, thus resulting in different learning outcomes. An attempt has therefore been made in the present study to compare learners' feelings toward two different learning settings. This will be discussed by using both quantitative and qualitative data.

2.3.5 Culture Learning

It has been emphasized that L2 learning is incomplete without learning culture (Thanasoulas, 2001). Bada (2000) claims that "the need for cultural literacy in ELT arises mainly from the fact that most language learners, not exposed to cultural elements of the society in question, seem to encounter significant hardship in communicating meaning to native speakers" (p. 101). This indicates that culture learning is necessary as cultural knowledge plays a part in communication. Therefore, this section describes the definition of culture and the framework of cultural learning for this study.

There is no consensus on the definition and content of culture learning as culture is a multifaceted and complicated topic depending on the context. This study adopts Moran's (2001) definition of culture as an encounter with another way of life. He based his definition of culture on five interrelated dimensions (see Moran, 2001 for a full account). Claiming that the cultural phenomenon includes real structures (products) that

social members of the culture (persons) employ in a range of interactions (practices) in specific social circumstances (communities) in such ways that reflect their values, attitudes and beliefs (perspectives), he sees the way of life itself as the cultural content and proposes that the learning process occurs via the cultural encounter. Applying Moran's explanation, the current research constructs and employs two learning environments for cultural learning: a classroom and a kitchen where students encounter Korean cultural aspects, share their own experiences, and reflect on their perceptions by experiencing the cooking of typical Korean dishes.

Moran's (2001) approach to cultural experience enhances an in-depth understanding of culture through a progressive educational process. He explains that the cultural experience refers to learners' encounter or involvement of any kind with another way of life through learning materials in learning environments, and "these encounters elicit four kinds of culture learning, or cultural knowings: knowing about, knowing how, knowing why, and knowing oneself " (p. 8). Moran's framework for cultural knowings includes four components that are involved in the learning interaction as in Table 2 below.

Table 2 Moran's Cultural Experience

Knowing about	Showing acquisition of general and detailed cultural information about the specific culture.
Knowing how	Obtaining cultural practices such as behaviours, touching, looking, or other forms of "doing" via the use of technological tools and their language to establish relationship with the target culture.
Knowing why	Enriching an understanding of the fundamental cultural perspectives through observations and experiences.
Knowing oneself	Raising self-awareness of the target culture via feelings, reactions, and evaluations.

Learning interactions according to Moran lead to four kinds of cultural knowledge, through which learners transform their intellectual state from unaware to aware as they encounter a new way of life. A wide range of factors exerts influences on culture learning: learners' characteristics, the relationship between the learners' culture and the target culture, the instructional context, the teacher-student relationship, and cultural comparisons (Moran, 2001). Likewise, this framework underpins the design of learning tasks and shows the process of cultural learning, which is why this scheme is applied to the current project.

Learning cultural aspects can be realised via cooking because the mundane activity provides a window into culture (Seedhouse, 2017). As Kurlansky (2004) puts it, "food is a central activity of mankind and one of the single most significant trademarks of a culture" (p. 11). Furthermore, Trubek and Belliveau (2009) see the notion of cooking as pedagogy with an activity involving 'multisensory experiential learning' because cooking itself "engages students at an almost instinctive level; the smells, sounds, sights, textures and tastes excite senses and intellects" (ibid., p. 16). Indeed, cooking and eating food is one of the only things in the world that draws on all five senses to engage people. Thus, cultural knowledge and learning can be obtained through foods and cuisine.

The KDK provides users with the opportunity not merely to be exposed to cultural aspects, but also to experience the target culture themselves via cooking and tasting. Specifically, Korean cooking equipment and ingredients are offered and seen by learners throughout the tasks. In particular, one step in the cooking task shows how to use chopsticks the Korean way, what is involved in making the most popular dish of *kimchi*, and other relevant information. Most importantly, an evaluation on how the dish tastes at the end of the tasks enriches learners' cultural understanding. Being able to learn cultural aspects in a kitchen setting has positive impacts on learning, thereby helping learners not only to enrich their Korean vocabulary repertoire, but also to use their newly acquired words. In this way, the KDK has the potential to be an innovative and effective learning environment, assisting in not simply language and culture, but also cuisine. Of course, learners in a classroom have the same condition in terms of culture learning. The difference is that while some senses are activated in a classroom, all senses are employed by learners in a digital kitchen.

2.4 Human Computer Interaction (HCI)

Undoubtedly, computer technology has been making and is going to make a huge difference in the future of CALL. Among the rapid changes in learning platforms is the Human Computer Interaction (HCI).

Research in HCI has been spectacularly successful and has fundamentally changed computing (Brad, 1998). One example is the remarkable growth of the World Wide Web, which applies hypertext technology to browsers, allowing one via links to traverse the world with a click of the mouse. It has contributed to language teaching and learning. HCI researchers have recently investigated the design and use of computer technology, putting more emphasis on the interface between users and computers

(Hewett *et al.*, 2004). So, researchers in this field both observe how humans interact with computes and design technologies that allow humans to interact with computers in novel ways. Humans usually interact with computers in various ways, and the interface between humans and the computers they use is crucial to facilitating this interaction. The Digital Kitchen research is one of the new forms of HCI technology. The next section introduces its origin and development, followed by its technological design.

2.4.1 The Digital Kitchens

Domestic kitchen spaces are important sites of everyday life. Kitchens are places of social interaction, where family memories reside, communication happens, culinary traditions are created, and emotions are shared. The kitchen is also a physical and functional space where people work, cook, and clean. This daily space has been developed over time through the adoption and installation of a range of technologies, appliances, and devices into a digital kitchen. It is only recently that this communal area for social interaction has come to the fore as a pedagogical platform for language learning.

The design of the digital kitchen was motivated by taking people in the early stages of dementia through multi-tasks in daily life, such as making a cup of tea or coffee (Wherton and Monk, 2008). In the study, researchers found out that it was important for people with dementia to develop a sense of autonomy when preparing meals in the kitchen, thus encouraging advances in pervasive computing technology for use in the kitchen. This led to the further development of technology that incorporated a fully integrated set of sensors and displays in the Ambient Kitchen to help people with dementia (Olivier *et al.*, 2009). The Ambient Kitchen, as originally developed at Newcastle University, employed state-of-the-art digital technology, namely activity recognition and sensor technology, and was designed to provide people engaged in a kitchen activity with situated supports in the form of written and audio prompting.

This study has allowed computer experts (Patrick Olivier and his team) and applied linguists (Paul Seedhouse and his team) to make a greater contribution to the kitchen project by putting the prototype to use as a design tool, and hence push the boundaries of knowledge in the field. The development has recently been extended to the realm of language teaching and learning; **Phase I** of the French Digital Kitchen Project (Seedhouse *et al.*, 2013). This study has attempted to integrate the digital technology and pedagogical design into a situated language learning environment where language and culture can be learned simultaneously, showing that the kitchen space as a

real world environment has helped learning. The French Digital Kitchen was made by collaboration between researchers from different disciplines: applied linguists working on the integration of digital technology called the digital Tabletop with a task-based approach to language learning (Seedhouse and Almutairi, 2009) and computer scientists working on the establishment of a pervasive environment called the Ambient Kitchen where the technology helps and supports people with dementia (Olivier *et al.*, 2009). The French project took the principles of Task-Based Language Teaching (TBLT) out of the classroom and into the real-world environment to investigate how the situated environment helps language learning. It was quite a unique and original study in that the kitchen space was pedagogically used in relation to foreign language learning. Thus, the domain of the kitchen has begun to play a role as a learning environment for a wider audience. It subsequently led to **Phase II** of a European wide consortium.

The project team constructed a purpose-built kitchen that communicates and interacts with users in a European language, and gives them step-by step cooking instructions via a Graphic User Interface (GUI). The European Digital Kitchen, an EU-funded language learning project, was developed initially by HCI technologists and applied linguists at Newcastle University. The project is called LanCook, which stands for 'Learning languages, cultures, and cuisines in digital interactive kitchens'. LanCook is a transnational collaboration which engages with major issues such as how to increase foreign language proficiency, and the contribution of language skills and motivation in the European Union, with a purpose of developing language learning materials for European languages and cuisines. This collaboration involves five different partners drawn from a range of language learning and teaching experts throughout Europe: Newcastle University (UK), Università degli Studi di Modena e Reggio Emilia (Italy), Helsingin yliopisto (Finland), Universität Paderborn (Germany), and Universitat Autònoma de Barcelona (Spain). Starting in December 2011, LanCook involved the development of task-based language learning materials for learners using a technology-enhanced digital kitchen to cook dishes linked to 7 different European languages and cultures: English, Italian, Finnish, German, Spanish, Catalan, and French. The aim of producing learning materials is manifold: diversifying a series of activities to develop further materials; trialling the developed materials with a wide range of target learners; exploring the results of these trials; and ensuring that these materials are available to learners and teachers across Europe. To this end, all partners involved are creating and advancing the new materials with a wide range of users at CEFR levels A to C, including adult, higher education and vocational students as well as migrants and

overseas students (Seedhouse *et al.*, 2014). This study was significant because the results validated the fact that the kitchen can be paired together with technology to facilitate learning. The team showed that the kitchen developed a range of language skills (listening, speaking, reading and writing) in a holistic way; for example, English vocabulary was learned to a significant degree. The project had also theoretically established a strong basis for learning by employing a micro-analytic approach.

Nevertheless, the two phases have 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, multimodal, task-based experience in a specific real-world context to learn a foreign language and culture by physically manipulating objects. That is, to determine whether sight or touch was the most important factor in vocabulary learning in this specific environment, this study uses a quasi-experimental research design. Furthermore, the languages used for LanCook were limited to those with the same orthography (Latin form) as research subjects' mother languages were European-based ones. This makes it desirable to explore the synergetic effects of digital technology and a real-world activity in a real-world environment on learners whose native language, culture and cuisine have different orthography from the target language, Korean. All these consideration led to the next development of **Phase II-α**: The Korean Digital Kitchen as shown in Figure 2.

Figure 2 The Korean Digital Kitchen

To reiterate, this study did not create the Korean Digital Kitchen technology. What the present study contributed was to take advantage of previously-made technological and pedagogical design of the **Phase II** to create new materials for international students to learn Korean language and culture using the authoring tool software (see Section 3.2.3).

The Korean Digital Kitchen (KDK) thus follows the trends of language learning and teaching methods and approaches, incorporating principles for second language learning from a range of fields, namely Computer-Assisted Language Learning (CALL), Human-Computer Interaction (HCI), Task-Based Learning and Teaching (TBLT) and anthropology. The KDK is an innovative development in language teaching and learning as it involves cutting-edge features in an interactive, effective, methodologically sound and sustainable framework (Olivier *et al.*, 2009; Seedhouse *et al.*, 2013; Seedhouse *et al.*, 2014; Preston *et al.*, 2015). By building on existing design, implementation and evaluation of the digital kitchen, the KDK expands and develops these to create a new model.

This interdisciplinary combination allows users to learn foreign languages as well as foreign culture in a real world environment by performing the real world activity of cooking. By interacting with the state-of-the-art computer system, users obtain linguistic and non-linguistic knowledge both by themselves and collaboratively. Importantly, learners find the activity itself enjoyable and pleasurable as they actually make the dish, which can be evaluated and eaten at the end. In other words, the innovation is a *multi-modal*, *multi-sensory*, and *multi-learning* (in the sense that language, culture and cuisine can be learned) experience. This unique integration of technological and pedagogical properties has the potential to be a vehicle not only to disseminate a pervasive learning environment, but also to advance our understanding of pragmatic aspects of SLA.

2.5 Chapter summary

This chapter has summarised the history of second language learning and teaching approaches and the research context of this study, followed by the key pedagogy of TBLT playing a role in learning in combination with the computer technology. Since this study is all about technology, it has introduced Computer-Assisted Language Learning (CALL) and its relevance to vocabulary and culture learning, with a range of published works reviewed. The chapter has also reviewed Human-Computer Interaction (HCI) and how the KDK has been developed.

To achieve the research aim, this study will conduct a quasi-experiment in which learning outcomes between experience involving five senses and the other involving fewer senses are compared. It is to see the effect of physicality through a real world task of cooking in the digital kitchen on users' vocabulary and culture learning.

Computer technology has helped keep learning tools evolving in such a way as to support learners. Research has been highly successful, one strand of which is the digital kitchen research with the learning principle of TBLT applied in combination with communication-based tools for learning. It has generally been acknowledged that technology-assisted programs have been helpful compared to the conventional learning environment of the classroom. Nevertheless, the following weaknesses were highlighted in this chapter:

a. Few studies have used tasks outside the classroom context.
b. Researchers have simply created pedagogically designed tasks, rather than using a real work task.
c. Most studies have employed two dimensions (textual and pictorial helps) to see the effect on vocabulary learning, but almost none see the potential impact of all five senses on learning.
d. Not many studies have examined the real world environment outside of the classroom for language and culture learning in combination with technology.
e. No study has applied sensor technology to Oriental language learning.

Therefore, it is invaluable for the field to take all these limitations and issues into consideration and seek to further the scarce research, exploring the effect of physicality on learning by creating a real world environment where students can simultaneously learn linguistic and cultural aspect of Asian, and to uncover how learning occurs. Moreover, I attempt to examine learners' attitudes toward the use of technology-enhanced real world environment in foreign language learning.

This chapter has aimed to situate this thesis within the relevant literature by using a range of different literature strands to formulate an argument for the need to take advantage of digital technology and real world experiences based on TBLT in relation to learning. The next chapter offers more detailed description of the technology behind the KDK. Providing a detailed account of three key technological components, Chapter 3 shows how Korean pedagogical materials were created. This is followed by a description of how the pedagogy of the current study of TBLT fits in the technology.

Chapter 3. The Technology behind the Korean Digital Kitchen for Language Learning

3.1 Introduction

The previous European Digital Kitchen (EDK) project outlines a range of key features of any real-world digital environment for language learning. The features which require some kind of technological support are as follows:

- Participants physically carry out real-world tasks (using real-world equipment) which are embedded in everyday, real-world contexts such as a kitchen, an office, or a shop. The task can be broken down into a series of specifiable physical actions.
- Participants should receive some L2 input from some source and be able to learn some aspects of the L2 by performing the task.
- Participants physically touch and manipulate real-world objects while carrying out the task and have the opportunity to learn the L2 names of these objects.
- The digital system can track how participants are carrying out the actions of the task via a number of digital sensors embedded in the environment.
- The technology is designed to facilitate performance of the task, but is not the focus of the activity – it remains in the background.
- The system provides timely instructions, feedback, help, and tips to users to enable them to perform the task. The feedback facilitates multimodal and multisensory learning by use of audio, photos, and videos.
- The learning environment provides a range of possible supports or scaffolds to cater for a variety of learning styles and L2 proficiency levels, and learners can decide for themselves which to make use of.
- Participants can ask the system for help or for explanations, but are not obliged to.
- It is best practice to develop an authoring tool so that materials can easily be developed for other languages (Seedhouse, 2017. p. 69-70).

This section explains how the technology has been developed to carry these environmental features for the KDK, and how materials were redesigned using these characteristics to work with the application of the third-generation EDK technology.

The first-generation technologically enhanced kitchen was The Ambient Kitchen, created at Newcastle University, to support those with dementia in their daily kitchen activity (Olivier *et al.*, 2009). The second generation of the technology was The French Digital Kitchen, an innovative development to first take TBLT out of the classroom and into the real-world environment (Seedhouse *et al.*, 2013). The third generation is the mother project of this current study: the European Digital Kitchen (Seedhouse *et al.*, 2014; Seedhouse, 2017).

3.2 How the KDK works

This sub-section examines three essential technological components behind the KDK, namely digital sensors, a tablet computer called the Graphical User Interface (GUI), and an authoring tool (see Seedhouse 2017 for the full account). All of these components have originally been developed by the EDK team. What the present study contributed was to create new pedagogical materials for learning Korean language and culture by using the technological support (see Section 3.2.3).

3.2.1 Digital Sensors

The technological system interacts with users by talking to them, providing them with various assistance including audio-visual files, and instructs them step by step to complete the cooking session. Each sensor in Figure 3 below is attached and inserted into ingredients and equipment, enabling the system to recognize the activity and transmit the information back to the system as users progress throughout the task.

Figure 3 Digital Sensors

The KDK tracks users' movement by employing sensors called 'wireless accelerometers (WAXs)', which measure acceleration, weight, and vibration. These are similar to the ones used in applications such as Nintendo Wii™, which uses a handheld pointing device and detects movement in three dimensions, so that the sensors send the information to the system.

These sensors had to be attached to each item, so users do not find any difference or inconvenience from when they use normal kitchen objects. To this end, this study made the most of ready-made casts from previous studies (as in Figure 3). The third generation addressed the issue of durability of sensors used in the second generation by placing casts. How could sensors be attached to utensils and ingredients? They can be integrated into the handles of cooking utensils. In cases where the sensors were difficult to attach, various attempts had been made; recesses in the sensors allowed them to be inserted into a whisk and a turner; a knife needed a 3-D printed design to fit the sensor inside the handle; a spoon, scissors, and chopsticks contained a ring which could be hooked into the hole in the handle; watery foodstuffs were placed in plastic or metal containers, so sensors could be attached by Velcro, or a cradle with a magnet. Stickers worked well in some cases as in Figure 4.

Figure 4 Sensor Attachment

Figure 5 below shows how all food ingredients and equipment have sensors attached (e.g. a spoon, a bowl, a pan, tofu on a bowl, a pack of dry spices, and so forth).

Figure 5 Sensor-attached Ingredients & Equipment

Likewise, various devices commercially available were used to attach sensors to virtually any object used in the KDK.

3.2.2 Graphical User Interface (GUI)

One might think that a recipe book is needed to complete the meal. However, technological advancement has enabled users to no longer carry around books to inform their tasks (Bonanni and Chia-Hsun, 2004). The tablet computer with a wireless signal receiver enabled users to complete the cooking task. This is the next element of the KDK, called Graphical User-Interface (GUI), which plays a key role in bridging a gap for interaction between human and computer (Fig.6).

Figure 6 Graphical User Interface (GUI)

Without this tool, users are not able to accomplish their cooking mission. It contains every single step of the recipe in the form of written and audio-visual prompts (Figure 13) based on 3 stages of TBLT. Users can manually request audio and textual help along the way by way of repetition, and the system provides support (as in Fig.7).

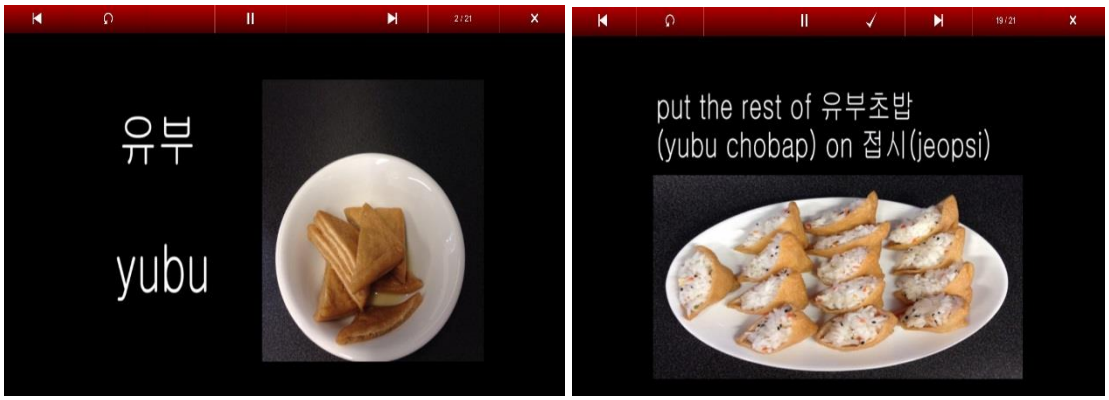

Figure 7 Images of Photo & Video Help

The GUI display as in Figure 8 shows several buttons such as '≤ ≥ ◌ √ ? ‖', each of which has its own function. This way, it allows users enough time to complete each step and be able to move to the next stage gradually. A detailed account for the function in relation to learning is made on the figure below.

	NAVIGATION BACK	This allows user to go backward to listen to or watch again.
	REPEAT THE LAST ACTION	This allows users to repeat the step. Users might want this for repetitions of spoken or written words.
?	HELP REQUEST	This automatically appears in a few seconds when no movement is detected. This allows users to request the help such as visual aids.
	PAUSE	This allows uses to pause the system in order to focus on the step in progress.
	ACTION COMPLETION	This allows users to indicate to the system that they complete the step and are ready to move onto the next step. This can be also used when they carry out an action which does not need sensor recognition. (for example, using chopsticks and eating dishes)
	NAVIGATION FORWARD	This allows the user to go forward to the next step.
3 / 48	STEP COUNTER	This shows the current step out of steps left to be done.
	CLOSE PLAYER	This closes the window, which users do not need to use.

Figure 8 GUI Buttons and Functions

3.2.2.1 Technical Design Modules

Having digital sensors attached to ingredients and equipment necessary for cooking allowed learners and the technical system to communicate with each other through a tablet computer of the GUI. It is important to understand the technical modules, so this sub-section examines overall how the system is organized.

Seedhouse (2017) displays three key parts of the digital kitchen system as in the figure below: ‘a sensing and a recognition module (S&R) for tracking the learners’ activities and the state of the system; an inference module (INF), which infers what progress users are making through the stages of the recipe; and a prompting and

interaction system (P&I) for providing situated support related to the language learning task' (p. 76) as in Figure 9.

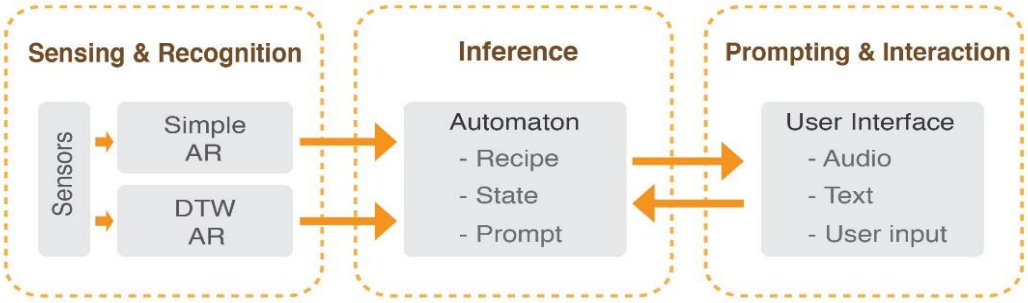

Figure 9 Overview of the System

As in the EDK, digital sensors were attached to each ingredient and appliance. Once there is movement, a sensor begins transmitting the raw acceleration data to the receiver, which is housed in the case of the GUI.

In order to provide timely prompts and instructions to the users, the system must keep track of where they are in terms of the steps of the recipe they are cooking. Since recipes are normally consecutive, a simple automaton was used. The automaton consists of a sequence of three major states, each of which specifies the overall task being carried out. One or more actions in each major state must be completed to move onto the next stage. The actions can be completed in three conditions; when the movement is recognized; when the fixed time period (e.g. 5, 10, 15 seconds) is reached; or when there is no movement for a certain length of time. If a certain action is not met within a defined interval, the next prompt for that action is given by the system. So, the system is designed to read signals showing the engagement of learners in any step of the recipe. The same system has been applied to tasks in the KDK study, so that users have enough time to properly complete the action at that stage. For example, once the instruction of '숟가락으로 잘 섞어 주세요 mix ingredients properly with a spoon' is given, the system would wait for three things to happen before moving onto the next step: sensor data shows movement of the spoon; sensor data shows use of a bowl containing the ingredients; and then a subsequent lack of activity means that the users had finished the action. As well as communication through automated prompts by the system, interaction can be made by learners themselves through the GUI, as they are able to press various buttons on the display to suit their needs at the point of each step.

3.2.3 The Authoring Tool

The 'Authoring Tool' is the final component of the KDK, and was designed in the LanCook project to allow language researchers to upload the task materials to the

kitchen system, such as audio-visual files, and to allow recipes on each cooking instruction to the player to be integrated easily into the software programme for playback. This tool not only enhances work within the project at present, but also offers a long-term opportunity for creating materials for further languages and cuisines as well as raising the possibilities for exploitation and sustainability. Thus, an authoring tool helps create continuous and cost-effective materials. It is by using this previously-designed authoring tool that the researcher of the present study could produce two recipes for two Korean cuisines. The invention of these Korean materials is what this study contributed.

The best way to understand how the KDK system interacts with users is by figuring out how the tool is organized and what can be uploaded. It is for these reasons that specific and brief explanations on the authoring tool are given below.

3.2.3.1 The Basic Structure of the Authoring Tool

There are five main parts, each allowing any researcher to author the relevant materials (see Seedhouse, 2017 for the full account). *Part 1 (Pre-intro)* allows for recipe selection where the researcher can record and upload an audio message. *Part 2 (optional Pre-intro)* enables video for the background film about the recipe. This introduction video was not used in the KDK. *Part 3 (Intro)* involves an authoring pre-task where each ingredient needs to be collected. Every single audio-visual material necessary to help users complete the pre-task as well as feedback on their move can be uploaded. *Part 4 (Main)* helps author the main task of during-task, where learners manipulate all the items that they collected in the pre-task phase. As the during-task phase demands more delicate skills to cook, this part consists of more sophisticated structure where more pictures/videos with voice-over and written text of ingredients or equipment can be uploaded. The final *Part 5 (End)* is for the post-task phase. In this part, individual recordings of ingredients and equipment, and success statement or sound are uploaded. Thus, the individual recipe content is specified by the basic structure of the authoring tool.

3.2.3.2 Each Tab on the authoring tool

Each tab in order in Figure 10 below is shown on the authoring tool for proper materials to be uploaded. Explanations on how the tool was adapted to the current study where necessary are given.

Figure 10 Tabs in Authoring Tool

In the **SETUP** tab, basic elements can be uploaded: the recipe title and its image, as well as any video media to show as preparation for the dish, i.e. short background film about the cuisine and culture. In its inner tab called 'Global content settings', a few prompts can be uploaded.

In the next **SENSORS** tab, each sensor attached to the corresponding object can be named. To help users, an image of the object to which the sensor is attached can be uploaded. Also, correction phrases can be used to guide users to the final stage. The inner tab *Add sensor* can be selected to create and name as many sensors as necessary for the recipe.

In the following **PRE-TASK** tab, each step can be described and an audio-recording of the instruction associated with the object lined to the step can be uploaded. The *Add step* option can be used as much as necessary. If, after adding a number of steps, modification is needed either to change the order or to insert a new step, *Up/ Down/ Delete step* tab can help it.

The ensuing **TASK** tab is almost the same to the previous stage in how it works. The only difference is that this stage has more options in which users can request *Help 1*, *Help 2*, and *Help 3* by using an audio-recording, an image and a video. The time period, e.g. 5 seconds or 10 seconds can be selected to make this help available in the three helps. There is one thing to pay attention to; for the digital technology to be able to see if the step goes successfully, the sensor should be associated with the step.

Once the TASK tab for each step has been completed, the authoring tool allows the researcher to move on the next step. The **POST-TASK** tab includes the same operations. In the final **PUBLISH** tab, whether or not each tab and step has been properly finished can be checked off. If there are errors in the recipe, a list of issues is given to resolve under each tab.

It is these three components of digital sensors, GUI, and the authoring tool that are behind the KDK. This overview of the technology system has shown how materials can be created and how the users are intended to interact with the system.

3.2.4 Technological Design Principles

The principles underlying the technological design of the KDK are based on pervasive technology, interaction design, and IP (Information Processing) theory.

This study draws on activity recognition and sensor technology. The technology is a form of *pervasive* or *ambient technology*, which is defined by Mousa (2013), as the "third wave in computing" and "roughly the opposite of virtual reality" (p. 276). He proposes that the third wave (ubiquitous computing) allows the computer to live out here in the world with people, whereas virtual reality puts people inside a computer-generated world. That is, pervasive technology enables people and computers to interact with one another everywhere. In the latest study, the technology has been more advanced by Seedhouse's (2017) team, with the term 'pervasive' meaning an application of digital technology to learning platforms in diverse contexts and "providing timely prompt, help and feedback when necessary to enable users to perform a task" (p. 4).

One of the key facets of a ubiquitous computing system is activity recognition and sensing technology of everyday activities in an everyday environment. Ubiquitous computing technologies in HCI have attempted to provide objects and the environment with sensing capabilities to enable them to respond appropriately to the needs of the individuals in the environment. The Ubicomp system is also known to extend the learning experience by embedding technology in a daily activity as sensing technology enables tracking of learners' progress in any given practical activity. The system is characterised by a range of affordances of HCI, such as responding with timely, situated, and language-appropriate conversation and feedback. This means that the system can provide linguistic input for language learning. Indeed, these pervasive learning settings offer "contextualised and situated learning experiences in everyday settings where users are guided and supported through learning tasks by ambient intelligence" (Seedhouse, 2017, p. 85).

Therefore, it is important to see the shift in the relationship between human and computer. While the technology previously served as a mediator for learning in approaches to CALL, the ambient technology goes one step further. It is now seen as another speaker and directly communicates with humans, shaping the interaction. In HCI, human-computer interaction can be characterised as 'conversations' by denoting the sequencing of 'give and take' involved in the use of expert systems as 'turns' (Abras *et al*., 2004, p. 1080). These affordances of HCI that support face-to-face interaction between human and computer imply that the Ubicomp technology can play an instrumental role in pedagogy.

The next technical and pedagogical design is *interactionality*. The previous EDK team has gradually improved the technology system, so the system can be used not only

as a collaborator but also as a source of assistance by learners via a range of support offered during the cooking session. Taking the point of how to help learners most into account, the team has optimized the relationship between the technology and users. That consideration enhances learners' partnership with the digital kitchen – the notion of "accompaniment" and "interaction design" (Seedhouse, 2017, p. 86). This means that learners are given control over the system, which is an important aspect of the digital kitchen system, promoting autonomous learning processes. In the KDK, this is embodied through the GUI, which creates a space for learners' engagements by providing a range of support at a timely manner and their disposal.

As well as pervasive technology and interaction design, IP theory (Preston *et al*., 2015) underlies the KDK. The previous team bridged the gap between technological implementation and pedagogical framework of TBLT by taking the IP perspective. This allowed information regarding the cooking task completion to be more communicative for learners, helping maximising learning opportunities on tasks.

It is these technical design principles that are embedded in the current research. The next section explains how materials for Korean were designed.

3.3 Birth of Korean Pedagogical Materials

Producing pedagogical materials fit for the current study required a lot of intensive work not just because the quasi-experimental design itself demanded two sets of separate materials to be used in two different learning environments, but because the authoring tool has never been used for an Oriental language. Mainly, six steps needed to be taken: inventing manual recipes, dividing steps in accordance with the three-phrase framework of TBLT, recording audio instructions, taking photos of visual objects, encoding audio-visual materials and then uploading all materials via an authoring tool.

Firstly, two recipes needed to be manually generated by googling online and consulting Korean chefs. Out of the various recipes possible for each dish, only one for each was chosen and adapted for the research, taking into consideration what ingredients and equipment needed to be used. This led me to choosing the 10 target vocabulary items. To increase the applicability, the recipes were as simplified as possible, so users and a computer could implement one step at a time. The instruction, for example, was transformed originally from '초밥 소스를 그릇에 있는 밥에 넣고 숟가락으로 잘 섞어 주세요 add the vinegar-based sauce to the warm rice in a bowl, and mix it well with a wooden spoon' to '밥을 그릇에 넣어 주세요 put rice into a bowl' and '숟가락으로 잘 섞어 주세요 mix them properly with a spoon'. Then, the recipes were divided and remade to fit into

TBLT scheme of: pre-task, during-task and post-task. As these steps involve audio instructions to be uploaded, proper voice recordings for every single step had to be made. This was possible by using a studio exclusive for the Audio Recording at Newcastle University enabling sound recordings of high quality. For visual instructions, all ingredients and equipment used for two recipes, and manipulation of them in cooking processes according to TBLT were photographed to make them look as real as possible. The specific processes of these four steps are clearly displayed in Appendix A and Appendix B.

The fifth step was to encode all of the audio-video materials to upload into the GUI. However, the authoring tool needed technical control. Since the authoring tool was programmed originally for European languages, computer technicians had to examine whether the tool could also work with Oriental languages. Their reprogramming and technical manipulation enabled the tool compatibility with Korean. Then, the researcher of this study spent a whole month encoding Korean learning materials for two different recipes with a different set of vocabulary. In order to produce high quality audio-visual slides fit for this study, I collaborated with a multimedia specialist, Chris Falzon. His support allowed me to invent high quality audio-visual slides by using timeline-based video editing software, Adobe Premiere Pro CS4, shown as below (Fig. 11).

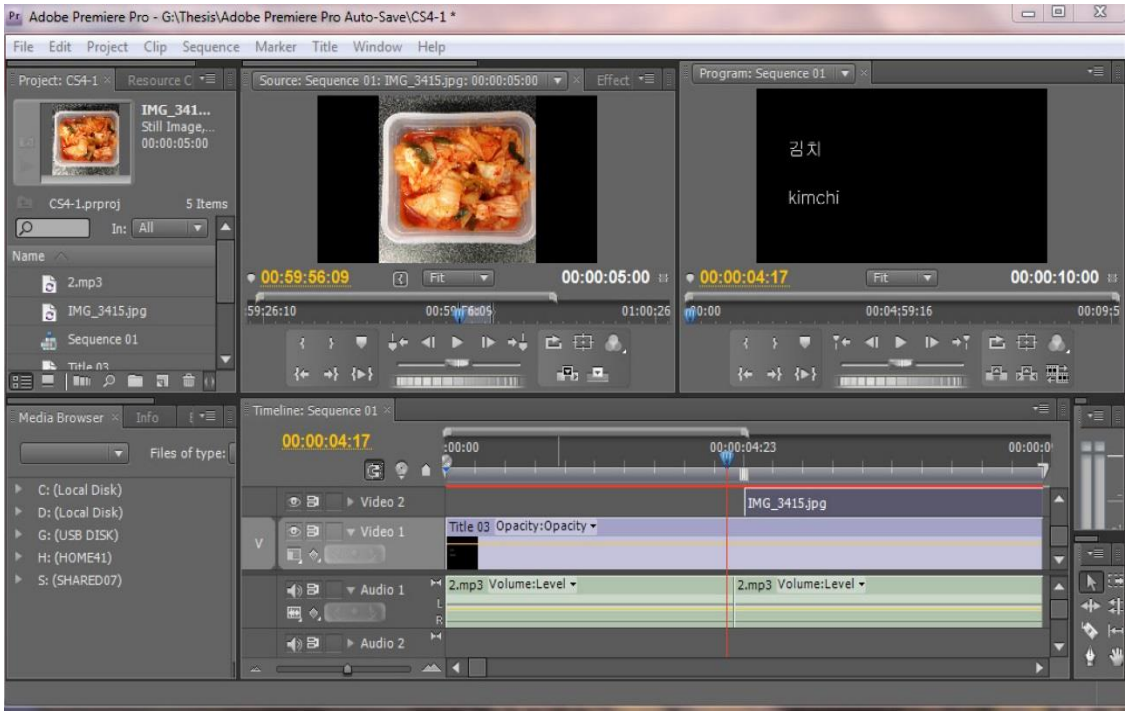

Figure 11 Adobe Premier Pro CS4

The final step involved uploading ready-made instructions using an authoring tool. The section below shows how the materials including feedback were put in each tab of the authoring tool.

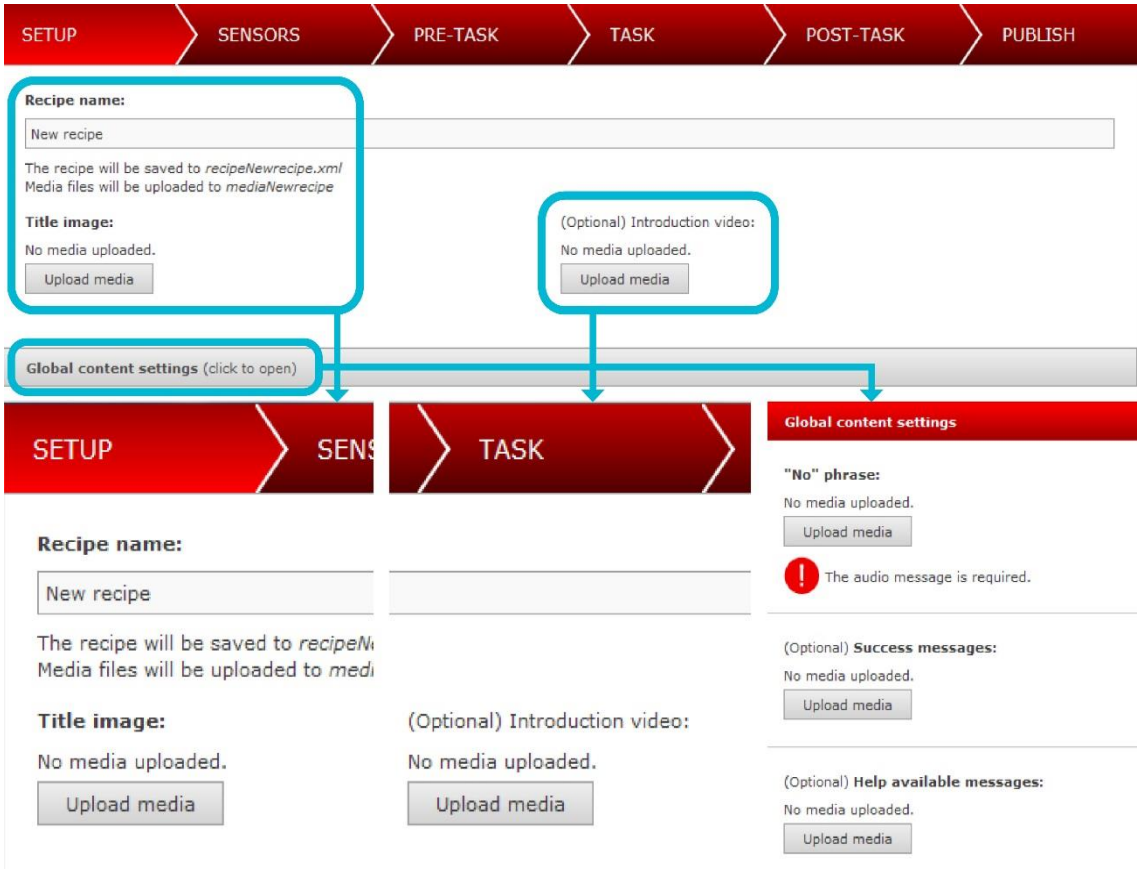

Figure 12 SETUP tab and Korean materials

In the **SETUP** tab, two recipes names of *kimchijeon* and *yubuchobap* were inserted. In the Global content settings tab, a few prompts were uploaded: the word 'no' 아, 아니었어요 in the language of the recipe in case participants do not follow the instruction properly and need to repeat the process again; success messages such as 'great or well done!' 너무 잘 하셨어요 when users complete a required step; Help available messages, i.e. Do you need help? (Figure 12)

In the **SENSORS** tab as in Figure 13, 10 sensors were made for each recipe, so 20 sensors in total were named for two recipes by using the inner tab *Add sensor*. The examples include 유부 (*yubu*), 김치 (*kimchi*), 가위 (*gawi*) etc.

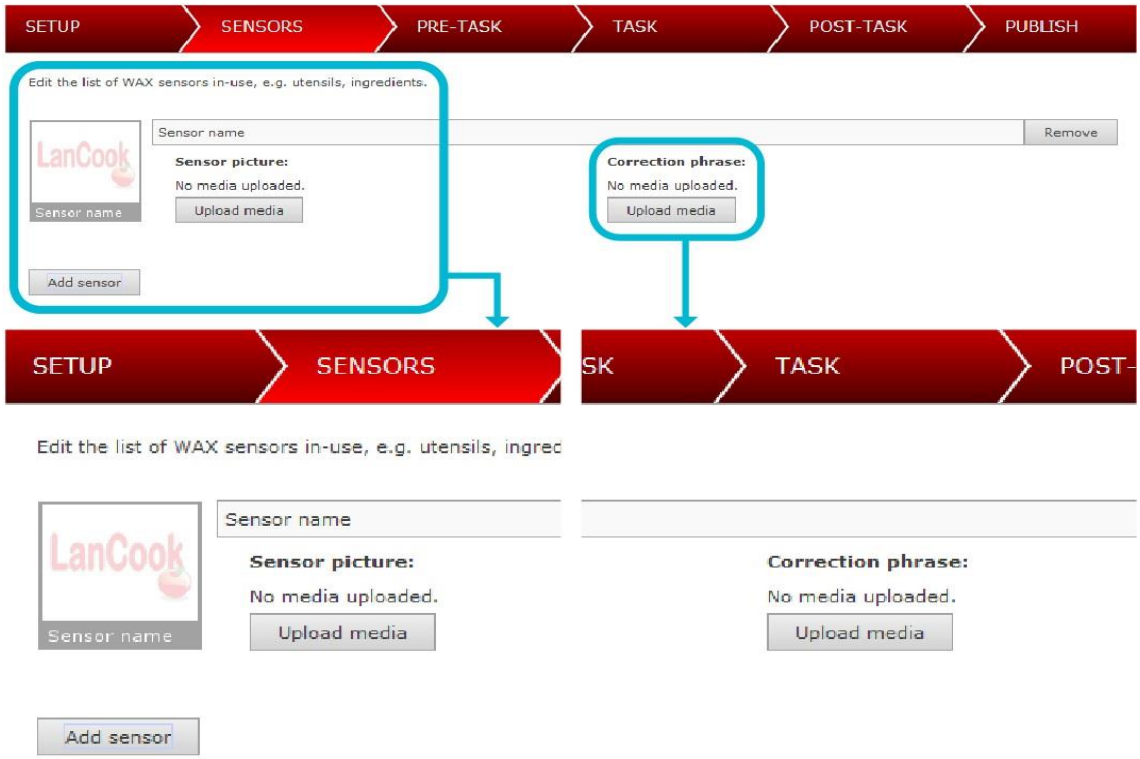

Figure 13 SENSOR tab and Korean materials

In the following **PRE-TASK** tab (Fig. 14), Korean descriptions for each ingredient and equipment were uploaded (e.g. 유부를 가져오세요 please collect *yubu* and 김치를 가져오세요 please bring *kimchi*).

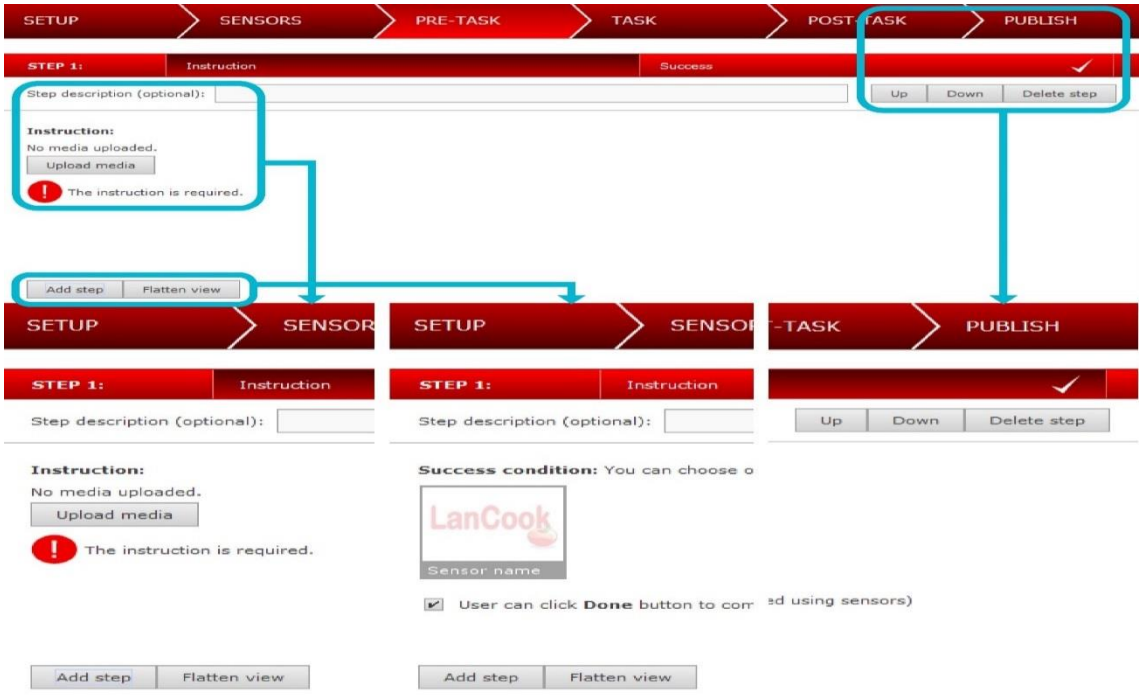

Figure 14 PRE-TASK and Korean materials

In the **TASK** tab, longer instructions were given, so the tool was designed to offer three prompts such as emphasis, image and video on request as indicated below (Figure 15). However, due to the nature of the step involved, it was not always possible to attach the sensor to measure the condition, e.g. 숟가락으로 밥을 유부에 넣고 접시에 담으세요 using a spoon put the mixture into *yubu* and then onto the plate. In this case, users need to select the success condition to move onto the next step and also make sure there is a √ in the box. This implies that users interact with the digital technology to indicate when they have completed a particular action. If the step is associated with a sensor, there is no need to tick the box. All steps of this phase in the KDK were designed to be ticked off.

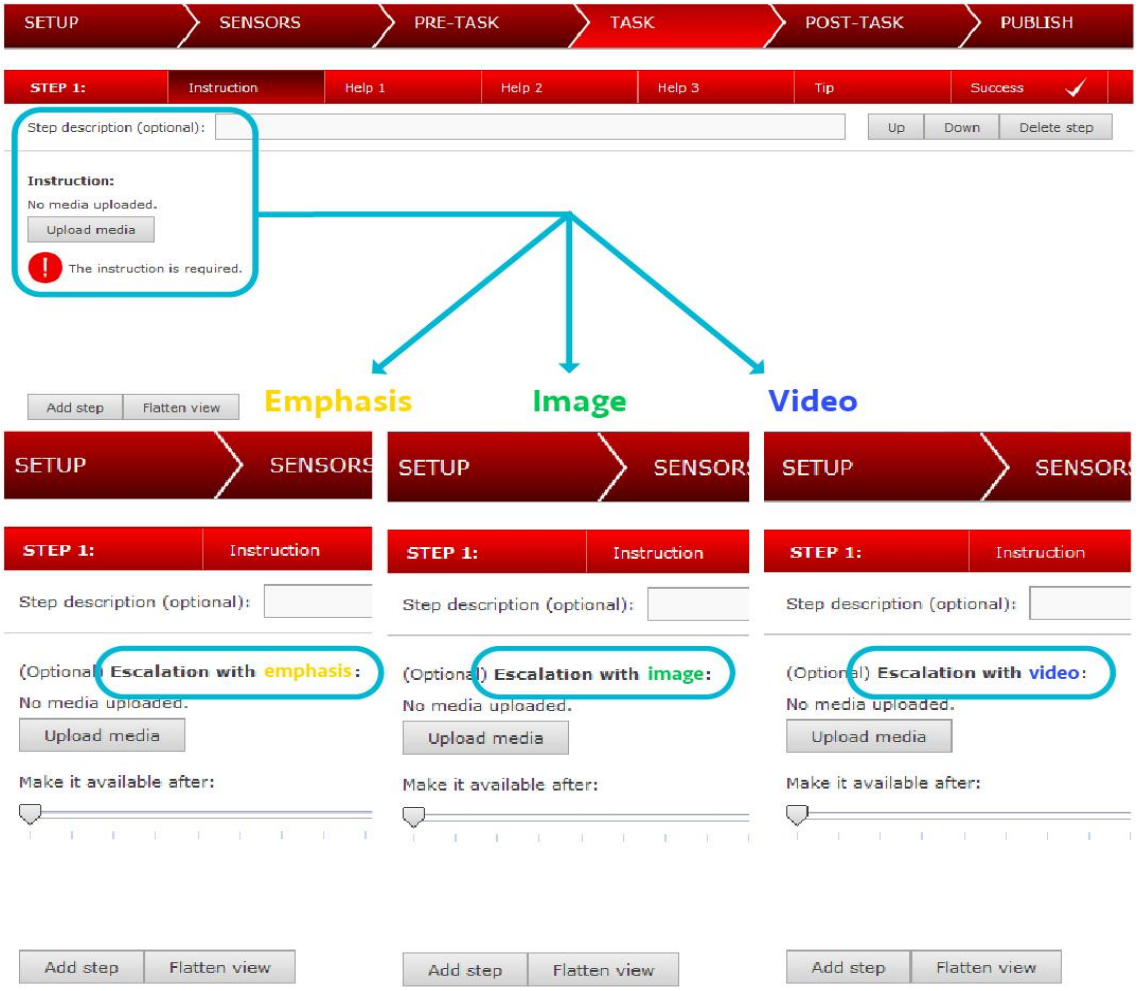

Figure 15 TASK tab and Korean materials

Once the TASK tab for each step has been completed, the authoring tool looks like the Figure 16 below.

Figure 16 Completed TASK tab

The POST-TASK tab (as in Fig. 17) has one instruction since they are done with their cooking task at this point. The description was what students really wanted to hear: 자, 이제 맛있게 먹어봅시다! Now, enjoy the dish as you like.

Figure 17 POST-TASK tab and Korean materials

As previous steps have been properly manipulated, the PUBLISH tab show no errors as in Figure 18.

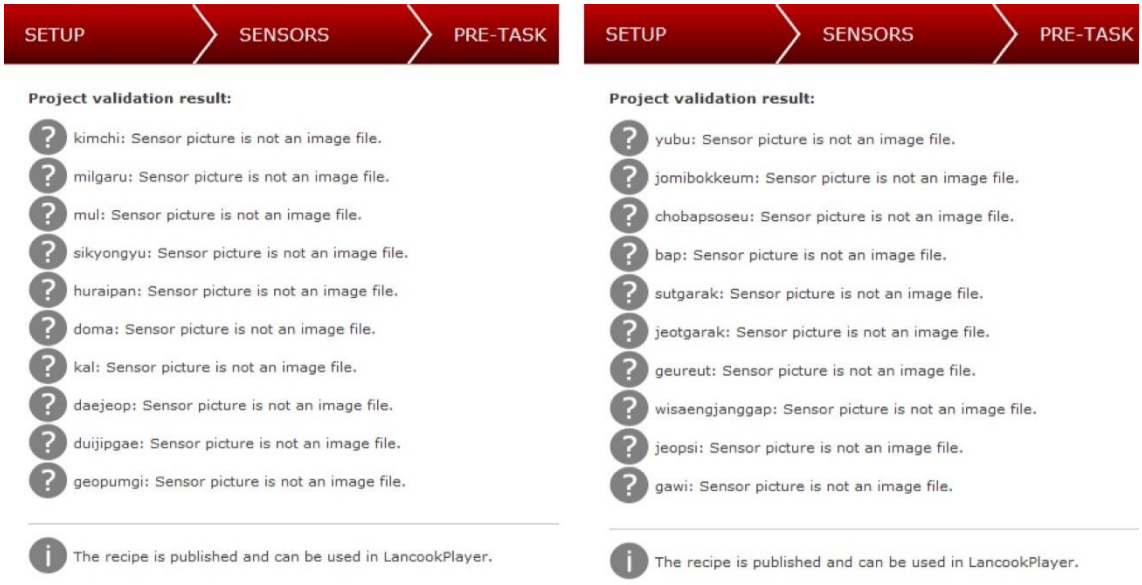

Figure 18 PUBLISH tab and Korean materials

Thus, these six processes made Korean pedagogical materials possible. In the following section, how the pedagogical materials are created and how the pedagogy of TBLT fits into the technology of a bespoke graphical user interface (GUI) are explained.

3.4 How TBLT fits in with the Graphical User Interface (GUI)

The GUI was specifically designed to reinforce learning processes (Fig. 19). It therefore guides learners through the cooking process and allows the users to manually request situated support. The support includes "on-demand, on-screen transcriptions of the audible prompts or their translation to English; self-determined adjustment of progression speed by manually pausing and resuming the automation; and manually moving backwards and forwards to skip or repeat certain steps" (Hooper, *et al*., 2012, p. 5). In this way, the GUI can support on-task learners in several ways in each stage of a standard TBLT framework as explained in detail below. Throughout the tasks in the KDK, learners had the real items in front of them.

In the *pre-task* phase, the GUI offered four types of scaffolding: an audio and audio-visual help for the object, with Korean and Roman letterings written to use, feedback, a repetition request, and the option of moving backwards and forwards through the list of ingredients for users to double check.

Figure 19 The GUI

The *pre-task* phase had a dual focus of cooking preparation and Korean language skills, and presented the display and preparation of language and cooking. Basically, learners were asked to prepare the food ingredients and equipment. As an introduction, learners could listen to the initial greeting and be instructed on what to do to cook with a picture of the target Korean dishes *kimchijeon* and *yubuchobap* on GUI display (Figure 20).

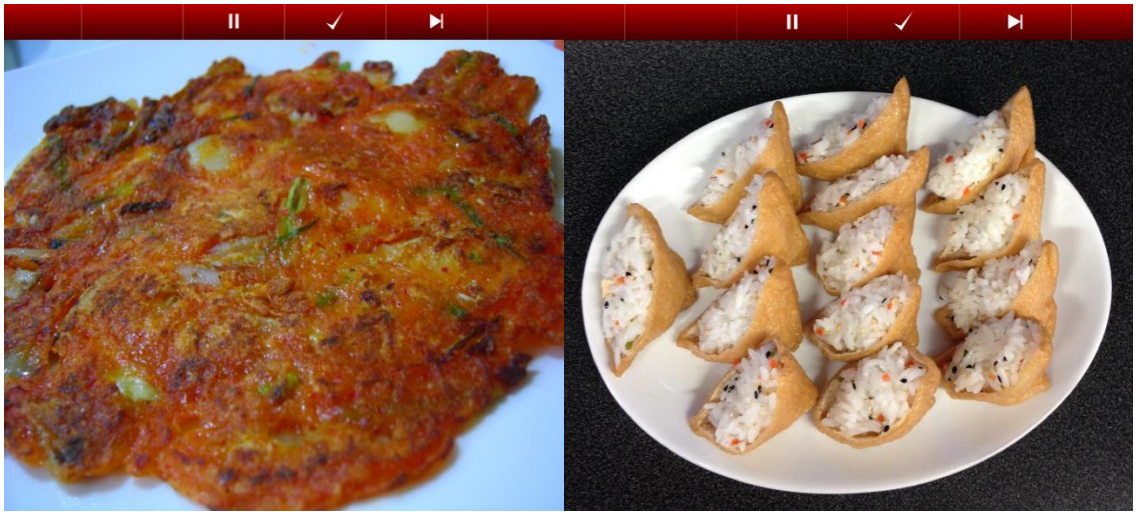

Figure 20 The target Korean dishes

When ready, they pressed the button to move onto the next slide. First, learners could have access only to the audio and written form of the designated object (top-left in Figure 21 below). The written form of vocabulary items are shown in two ways, one in Korean on the left of the display and the other in Roman right under the Korean lettering. This helped expose them to the Korean sound and language to be employed. They could take a guess out of ten items. If the right one was chosen, GUI said 와 참 잘하셨어요! (Wow, good job!) and moved onto the next step for another item. Learners took a right guess once in a while, which invoked higher level of motivation, but usually learners got the wrong item and the GUI said 아, 아니었어요. 다시 한번 해보시겠어요? (Oh sorry, you've got the wrong item. Would you try that again?), making them take it back to where it was. They would then try the same prompt again now with a picture gradually fading in together (bottom-right as in Figure 21). Learners could watch an audio-visual slideshow of the different utensils and ingredients they would need to make the dish, which were designed to give learners one more chance to be exposed to the authentic Korean in addition to making it easier to find the target item.

Figure 21 Outlook of Audio-visual slides

To this end, the photo slowly fades in before it gets fully clear because this is how one more learning mode of visual materials is provided via the GUI. The two bottom pictures in Figure 21 show how each slide contained a photo of the kitchen utensil or ingredient, the corresponding word written in both Korean and Latin scripts, and the option to listen to an audio file of the word being spoken. Learners pressed the forward arrow button every time when they were ready to move on until the end of the first stage. Likewise, the learners had the opportunity to use the interactive screen to have access to a range of scaffolding.

Throughout the pre-task, the scaffolding is provided. As two learners in pairs work together with each other to collect the right item, they show an orientation to collaboration on the ongoing activity. It is the affordances of the GUI that enables this mutual activation by offering an 'interactional space' (Seedhouse, 2017. p. 53). The pre-task phase thus allows learners to notice and process specific vocabulary items in the input. The linguistic input supported is salient as the GUI allows for unlimited repetitions in both spoken and written forms.

The procedure is the same in the *during-task* phase. The GUI provided learners with similar types of scaffolding given to the pre-task phase, but included a video with non-linguistic content and cultural knowledge. This phase involved step-by-step instructions on how to manipulate ingredients and equipment to cook the dish. The audio-visual slide along with written words in Korean showed what to use and how to mix them (top-left in Figure 21). These cooking task instructions were devised in such a way as to contain cooking-specific vocabulary to which learners would be expected to

pay keen attention. One specially-designed audio-visual slide aimed to give learners information and knowledge about specific items and foods so they could be exposed to Korean culture (bottom photos in Figure 22).

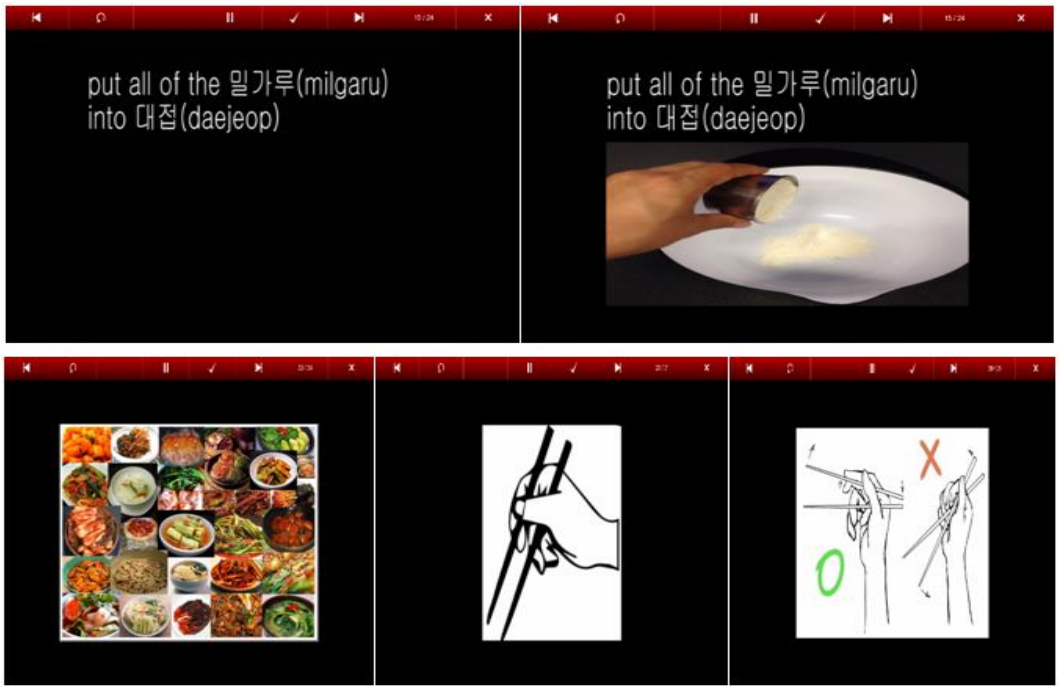

Figure 22 The process of During-task

Here in this stage of the during-task, learners are provided with a range of possible supports or scaffolds to cater to various learning styles and L2 proficiency levels to understand linguistic and cultural inputs. They can use the GUI interface for translation and audio-visual repetition, as well as drawing on real objects in the physical context. What is more, learners can decide for themselves what to make use of through collaboration. This supports the autonomous learning process engaged in by the learners. The KDK is thus a multi-modal, multi-sensory and multi-layered learning environment where learners can choose to use the resources which most suit their own learning style and strategy.

Finally, in the *post-task* phase, the GUI offered an opportunity to evaluate and reflect on their performance. This phase involved tasting the food, which was formulated to evaluate what participants experienced and learned. They were shown one single audio-visual slide asking them to try the food. This enabled learners a chance to use the target vocabulary and utensils that they had learned. Figure 23 shows what users are required to do, and the duo transacting the final task.

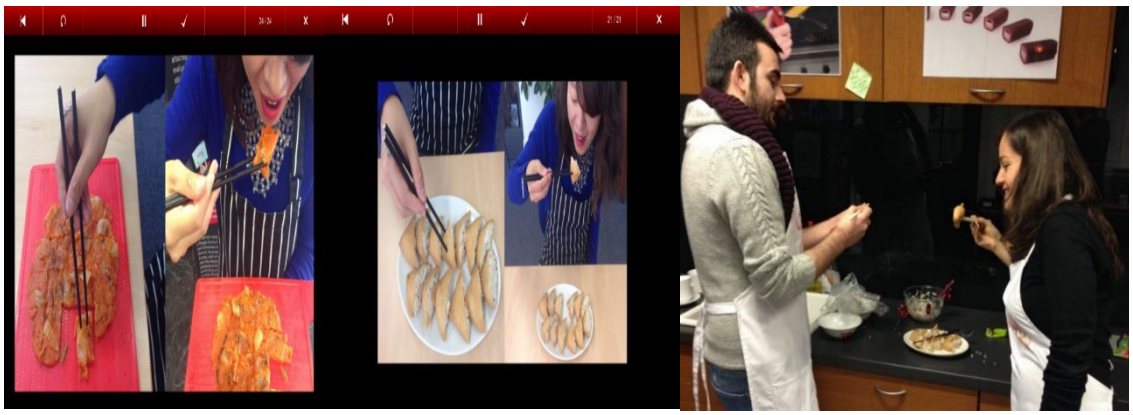

Figure 23 The post-task & task-takers

In this stage, whilst two users evaluate what they made, they reflect on what they have learned in terms of language and culture. Some of them might want to move back to a couple of slides where linguistic information is provided via tab functions of the GUI interface, which provides learning supports such as repetition and translation. In particular, this stage is where learning peaks as users apply their knowledge of language and culture by drawing on physical products such as chopsticks and foods, which give them the sensory moment to link to their memory.

It is not only the GUI, but also activity recognition sensor technology that supported learning. The technology was designed to provide the different steps of the cooking instruction on a timely manner. The sensor was attached to each ingredient and appliance, and read by the main computer system to see whether or not the chosen movement is correct. This allowed for learners' proactive communication with the digital technology, namely human-computer interaction.

Thus, a range of types of scaffoldings by the computer were made available for learners to use throughout the tasks, and sensor technology strengthened the relationship between three interactants of two learners and the GUI, thereby creating an interactional space that fosters learning. This is how ubiquitous computing in HCI bolstered the pedagogical framework of the current TBLT research.

3.5 Chapter summary

This chapter has examined how the technology to deliver the KDK learning environment works and how pedagogical materials for Korean language were created using the technical components of the EDK. The three key components include digital sensors, GUI, and an authoring tool. It is the final element that helped the researcher of the present study not just to be able to author the materials for Korean language and culture, but also to meet the criteria of the final features stated at the outset of this chapter; 'it is best practice to develop an authoring tool so that materials can easily be

developed for other languages'. The chapter has also explained how the pedagogy meets technology in relation to learning supports.

Now that this technology behind the KDK is understood, the next chapter moves on to describe the methods by which the issues mentioned above regarding vocabulary learning research in the field of CALL will be addressed. It includes a detailed account of philosophical underpinnings, research design and its rationale, the study procedure, data collection tools and data analysis procedures. This is followed by a description of reliability, validity, ethical issues and limitations of this study.

Chapter 4. Research Methodology

4.1 Introduction

Having presented the theoretical and empirical background of this study in the previous chapter, Chapter 4 outlines the methodology. Methodology is an overarching concept, and it comprises choices which researchers make in "study, methods of data gathering, forms of data analysis etc. in planning and executing a research study" (Silverman, 2013, p. 15). Since the choice of methodology depends on the research questions asked and the philosophical positions of the researcher, the purpose of this chapter is to provide an overview of and justification for the research design.

Richards *et al.* (2012) specify twelve areas that should be covered in methodology chapter in the field of SLA as below:

- focus of the study
- research questions and sub-questions
- overall research paradigm and epistemology
- overall methodological approach and justification
- data collection instruments including rationale, justification and design principles
- data collection procedures, including sampling issues, how access was obtained, and pilot study where applicable
- relevant information on the context in which the study was undertaken
- data analysis procedures
- discussion of validity and reliability in relation to your study and how you have tried to maximise these
- ethics
- discussion of methodological issues and problems which have arisen
- reflections on the research process, including reflexivity, and limitations of the study

This chapter will therefore follow these guidelines, adjusted to this study. In addition to these elements, it describes specifically how three components of the technology work and fit into this study since it employs the latest technology, unique to learning.

4.2 Focus of the study and Research Questions

This research focuses on seeing the effect on learning of a technologically-enhanced situated language learning environment where learners can simultaneously learn linguistic and cultural skills: a real life kitchen setting that embeds a range of elements such as TBLT, digital computer technology of HCI (Human–Computer Interaction), and cooking. To achieve this goal, the present study contrasts two learning settings for an experiment: the KDK where learners use all five senses in combination with the digital technology in learning activities, and a classroom where they use fewer senses. Specifically, it hypothesizes that subjects cooking in a digital kitchen will outperform participants in a classroom in learning vocabulary items and cultural aspects. Based on the research gap outlined in Chapter 2, the following research questions were set:

1. Do participants learn vocabulary more effectively in the digital kitchen by touching and manipulating real objects to complete a real-world task than in the classroom using pictures of objects to complete a pedagogical task? If so, to what extent and how?
2. What are learners' attitudes to learning in two different settings?
3. Does using real objects to cook in the digital kitchen help students learn Korean cultural aspects more effectively than looking at photos of the objects in the classroom? If so, to what extent and how?

In order to answer those questions, a number of data types will be collected and analysed. The first question relates to their vocabulary learning. Learners' pre- and post-test scores from each cooking session will be compared to show their learning outcomes. Moreover, the observational and interview data will be used to understand their learning processes. The second question focuses on participants' attitudes, so their interviews and questionnaire responses will be examined in great detail. The third question relates to culture learning. As it is hard to measure students' learning of cultural knowledge, questionnaire responses are used, which will be justified below. In order to demonstrate the process of culture learning, observation and interview data will be analysed to answer this question. All questions are discussed thoroughly in Chapter 6.

4.3 Considerations of philosophical underpinnings

The research paradigm of this study is based on both quantitative and qualitative perspectives. The paradigm might be best explained as a "worldview", and "a basic set of beliefs or assumptions that guide a researcher's inquiry" (Creswell, 2009, p. 74). Social researchers make certain assumptions about the nature of the social phenomena and the basics of knowledge by choosing a specific paradigm for research (Cohen *et al.*, 2011; Denzin and Lincoln, 2012). In other words, social researcher's assumptions about the nature of the social world determine how they explore it. There are a wide range of methodological approaches for social researchers to collect data and generate knowledge. However, the method adopted within any study depends on two key conceptualizations concerning the nature of the social world: ontology and epistemology: the former covers issues about what can be known about the world, whereas the latter relates to how knowledge is generated (Bryman, 2012).

As the current study takes both philosophical stances as stated above, it draws on a mixed methods approach. To begin with, taking a social constructivist position in social sciences research, this research sees social phenomena not as external facts that are beyond our reach, but as constructed through social interaction, and in a constant state of revision. Indeed, reality is accessible by means of socially constructed meanings (Richards, 2003; Snape and Spencer, 2003). As Burton and Bartlett (2009) put, "there is no one objective reality that exists outside of the actor's explanations, just different versions of events" (p. 21). In other words, what underlies the researcher's opinion on educational settings is more an inter-subjective co-construction of an individual and society, rather than an objective undertaking, independent of the knower. This study, thus, adheres to 'constructivism'. However, a certain aspect in social reality cannot be explained enough only by subjective insights. It needs another perspective taken from another research angle to make the results more credible. This is objectivism. The stance is "an ontological position that asserts that social phenomena and their meanings have an existence that is independent of social actors" (Bryman, 2012, p. 33). To put it simply, a social organization has its rules and regulations, and people follow the standardized procedures. The same can be said of educational settings. The settings serve as a place where people learn and internalize knowledge. This social entity functions as something external to the actor. It has features of "an object and hence of having an objective reality" (ibid.). According to Somekth and Lewin (2005), quantitative research studies are based on the notion that social phenomena in reality can be measured objectively, and deal with causes/effects through hypotheses

(Lichtman, 2010). Therefore, these two stances are taken together. In this study, cooking is a real social activity, although each participant may have a range of perceptions and attitudes towards this event. As the activity allows students to experience multi-sensory learning, it is interesting to examine learner's attitudes toward learning by seeing how they construct their views of the real life activity through interaction with the digital technology, and whether they find it useful to learn both foreign language and culture, and to what extent cooking in fact makes a difference in learning in specific contexts. The investigation of participants' experience, attitudes, and level of learning helps determine both subjective and objective meanings from educational actions. Thus, the present study uses both qualitative and quantitative approaches in an attempt to offer complementary views on the social world. Researchers who value the possibilities that come from combining two paradigms "need to promote a worldview that encourages others to share our beliefs. One part of that work involves inspiring others about the practical value of research designs that combine different methods" (Morgan, 2007, p. 73-74).

The epistemological standpoint of this study is also both that of an 'interpretivist' approach, whereby I have interpreted and explained a social phenomenon (i.e. the effect of using real objects in a real life environment on learning, compared to the traditional classroom setting) as it is, and that of a 'positivist' approach, whereby only empirical evidence generates valid knowledge. Due to the nature of both two approaches, this study used various instruments to collect data. It not only used observations and interviews which offer an element of interpretation to obtain participants' views and more meaningful insights of the phenomenon, but also employed test results and questionnaires, which help predict behaviour and ground claims. Indeed, many researchers support each approach. Johnson (2011) suggests that epistemologically, being empirical gives the study opportunities of prediction, objective results, and transparency from personal prejudices. On the other hand, Matthews and Ross (2010) claim that the approach of 'interpretivism' attempts to explain the immense complexity of the social aspect in social sciences, and that its established research conventions and emphasis on the rigour of inquiry have a significant influence on educational research methodology. The kitchen project formulated research questions in relation to participants' social behaviour and their perspectives, which need to be shown via both empirical evidence for learning products and subjective viewpoints for learning processes. Accordingly, both stances apply to the present study.

In order to examine the social action of learning and generate the knowledge, the current study has adopted a holistic approach where one single paradigm alone cannot answer a research question. More than two strategies for data collection and analysis have been used.

4.4 Research Design

The current study makes the most of a mixed methodology. Integrating both quantitative (QUAN hereafter) and qualitative (QUAL hereafter) research has offered "a powerful third paradigm choice that often provided the most informative, complete, balanced, and useful research result" (Johnson *et al*., 2007, p. 129). In particular, QUAN data help demonstrate students' learning as a product by showing gains in learning via test results and questionnaires, whereas QUAL ones reveal the learning process. Therefore, the two main strategies are taken as equally important in this research. This section explains the features of, and rationale for, adopting a mixed-methods approach to analysing the data, and states how this enhanced the reliability and validity of the present study. It then introduces the nature and design of the quasi-experiment, as well as its advantages and limitations. It is followed by how the design is applied to this current study's quasi-experiment.

4.4.1 Mixed methods approach

A holistic mixed-methods approach was chosen for this study as it can bridge a gap between different ways of seeing, interpreting and knowing (Greene, 2007). The term 'mixed methods research' (MM hereafter), which has gradually become an accepted approach to conducting social research refers to the one that "combines research methods that cross the two research strategies" (Bryman, 2012, p. 629). However, there has been much debate about adopting MM (Newby, 2010), and not all researchers agree that the approach is feasible because most prefer to conduct research either qualitatively or quantitatively (Johnson and Onwuegbuzie, 2004). Nevertheless, the integration of two methods can be regarded as an appropriate strategy to provide general and intuitive insights into the findings from quantitative data, and provide a richer understanding of the phenomenon by adopting qualitative data as well (Bryman, 2012). In other words, various types of data are analysed as a whole to generate knowledge, which can strengthen the reliability and validity of the study. Therefore, the current study employs the mixed approach to expand the breadth and depth of data as much as possible with limited time and resources. In what follows, key considerations

of mixed methods research are introduced in more detail, specifically rationale, design, implementation, weighting and mixing (Richards *et al.*, 2012):

1. Rationale: why MM provides a good flavour
2. Design: how best to approach an MM project
3. The status of the two paradigms: whether both quantitative and qualitative elements should be placed with equal emphasis
4. The timing of the elements
5. Mixing: whether/when integration of the methods should occur

A quantitative paradigm generally conducts research deductively, whereby a researcher collects evidence to generate theory, emphasizing numerical measures. Thus, this approach is effective for assessing relationships between variables and making predictions. It however fails to answer the questions of 'why' and 'how' (Rauscher and Greenfield, 2009). The qualitative paradigm complements the limitations of a quantitative one. This paradigm commonly follows an inductive process, whereby meaning is generated to be interpreted from the perspective of those being studied (ibid.). To specifically explain multiple data sources employed, questionnaires were used to survey all of the participants, and the statistical measurements had the potential for generalizability. Observational data allowed for the establishment of a better understanding of the learning process, and their interviews were designed to elicit their own perspectives on their experiences. Likewise, quantitative data helped validate participants' learning as a product, whereas qualitative ones revealed the learning processes occurring in a specific environment. Therefore, MM was fitting for the present study to elucidate the extent of the environmental effect on learning and learners' attitudes toward the learning settings as shown in Figure 24.

Figure 24 How MM validates Learning

Of the various mixed-method models, the current study relied on 'Explanatory Design' (Creswell and Plano Clark, 2011), which starts with a quantitative phase, followed by a qualitative phase designed to build on the quantitative outcomes of the

first phase. Quantitative data is normally, though not necessarily, prioritized. The design gives both quantitative and qualitative elements equal weight. Typically, qualitative data follows up quantitative data to explore some of the findings in greater depth. The data was collected separately, but then brought together simultaneously to deal with research questions. The next diagram (Fig. 25) is the sequential MM design of this study (ibid.).

Figure 25 Explanatory Design of MM

When it comes to data mixing, decisions should be made about how the data is combined. Out of various approaches to this, Creswell and Plano Clark's (2007) position '*connected/linked*' is adopted in this study. This refers to the connection occurring when one type of data is not enough and needs another type for enriched results. In other words, one set builds on another. The data integration in this study occurred in the data-analysis stage and discussion where findings were presented in great detail. The procedures and products of both data collection sets are shown in a diagram below in Figure 26.

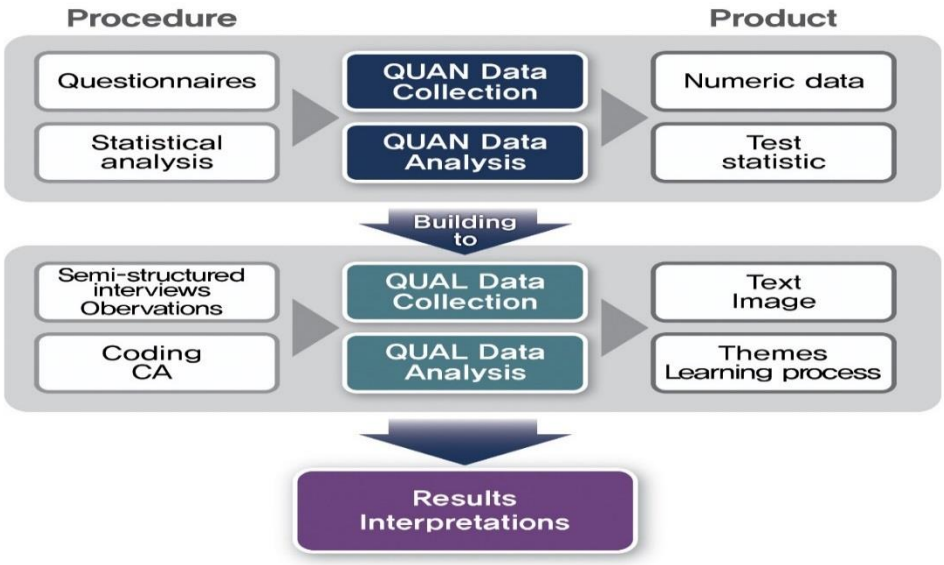

Figure 26 Sequential Explanatory Design

4.4.2 A quasi-experiment

A quasi-experimental study aims to determine whether an intervention has the intended effect on a study's participants, but may be defined as one lacking key components of a true experiment (Bryman, 2012)**.** While a true experimental study includes many features: pre-post test design, a treatment group and a control group, and random assignment of study participants, quasi-experimental studies lack one or more of these design elements (Shapley *et al.*, 2010). The quasi-experimental design is often an impact evaluation that assigns subjects to the treatment and control group by a method other than random assignment.

This type of quasi-experimental design is a pre-post test design that requires the researcher to collect data on participants' level of performance before and after the intervention (Shapley *et al.*, 2010). The design allows an investigator to make inferences on the effect of the intervention by examining the difference in the pre-test and post-test outcomes.

The benefit of a quasi-experimental study lies in its practicality. As mentioned above, the main difference between two designs is that in an experimental one, the participants are randomly assigned to a treatment group or a control group. However, random assignment is not always possible (Bryman, 2012). For example, Newcastle University may want to test the effects of an intervention on adult students' learning. It is impractical to ask a school to divide up students into two separate classes through random assignment. It is also unrealistic to ask a school to do so in the middle of the course. When it is impractical, a pre-post test quasi-experimental design is a practical step to take in the real world.

4.4.3 Applying the design to study

The quasi-experiment was conducted to find out which environment - a classroom or a digital kitchen - is more effective in terms of vocabulary gain, and whether sight or touch is the more important factor in vocabulary learning. The intervention was the addition of the KDK environment. The study is intended to clarify whether there is a significant difference in vocabulary learning between sight of target objects alone (through photos) and touching and manipulating the object. To carry this out, a previous diagram by Nation and Webb (2011) was adapted as in Figure 27.

Figure 27 Original Experimental Design

This typical experimental design for vocabulary learning was adapted for this setting. Treatment 1 indicates Setting A of Classroom, and Treatment 2 refers to Setting B of Digital Kitchen as shown in the figure 28 below.

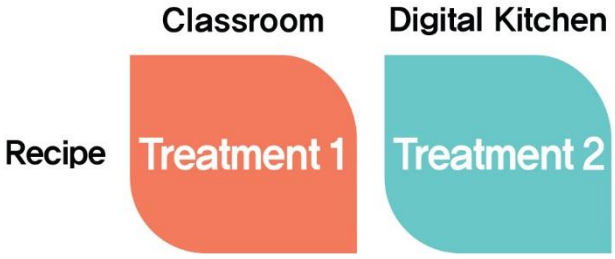

Figure 28 Basic Experiment

To determine which environment is more conducive to vocabulary learning, users need to carry out a recipe in the two locations. Participants in Treatment 1 conduct two cooking sessions: first with a recipe in a classroom, and then with a recipe in a digital kitchen. However, these cannot be the same recipes, as practice may then account for any increase in learning. Therefore, two recipes are necessary in two locations. Subjects in Treatment 2 also go through the same process. However, there may still be practice effects and ordering effects. Therefore, the design requires four groups, using two locations and two different recipes with no overlapping vocabulary between the two. The order of environment and recipe is varied to control practice and ordering effects.

Taking all variables into consideration, the original design is revised, with two settings and two recipes. Each of the four groups goes through two different recipes in two different environments: Recipe 1 of *kimchijeon* (kimchi pancake) and Recipe 2 of *yubuchobap* (rice covered by fried tofu) in the classroom and in the KDK. The interval between two cooking sessions was 15 minutes. That is, each group carries out each recipe at each location, but in different orders. It is thus possible to measure the effect of

the independent variable (using real objects to complete a task in the KDK) between groups. The finalized model of a quasi-experimental design was arrived at, as is shown in Figure 29.

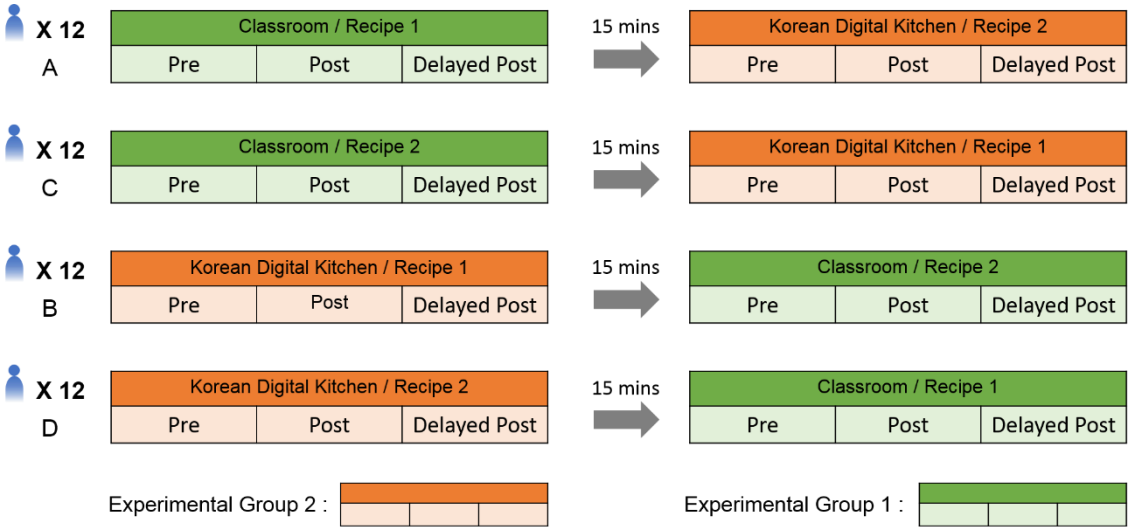

Figure 29 A finalized diagram

The independent variables are the experimental settings of KDK (Korean Digital Kitchen) and CL (Classroom), while the dependent one is how well participants learn Korean vocabulary items (post-test scores and delayed post-test scores) and cultural aspects. Other major variables in the quasi-experiment included participants' L2 proficiency, teaching and testing methodologies, all of which were controlled to measure the effect of treatment. Participants in each of the four groups had the same level of Korean proficiency, namely complete beginners. Given the nature of the different learning environments, it was impossible for participants to have the same amount of time for each recipe in each environment. The same basic design for administering the vocabulary test was followed in all cases, as described later. The same task procedure was followed in both environments. However, the task experiences for users were inevitably very different in the two environments, as explained in the section on the learning experience.

4.5 The Digital Kitchen

4.5.1 Participants

The participants were adults of both British and international origins, living in Newcastle, UK, and from a wide variety of backgrounds, as shown in Tables 3 and 4 below. A total of 24 pairs were chosen for each group with 16 males (33.3 percent) and 32 females (66.7 percent), giving a total of 48 participants, whose ages ranged from 19

to 49 years. Fortunately, all subjects at absolute beginner level in Korean were paired, which means that L2 proficiency was not a confounding variable. This study assigned participants in a non-random manner. Each learner chose their own partner from their friends on the condition that the partner is an absolute beginner in Korean language. It was to minimise the confounding variable.

Table 3 Sex & Age

	Frequency	%
Males	16	33.3
Females	32	66.7
Total	48	100.0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. D
Age	48	19.00	49.00	29.00	7.23

Table 4 The number of International Languages used

Chinese (12)	Urdu (1)	Belarusian (1)	Czech (1)
Indonesian (3)	English (6)	Malayalam (1)	Malay (3)
Japanese (2)	Thai (5)	Taiwanese (1)	
Spanish (1)	French (1)	Turkish (2)	Total: 20 languages (48 participants)
Romanian (1)	Akan (2)	Maltese (1)	
Bulgarian (1)	Tamil (1)	Arabic (2)	

4.6 The Learning Experience in Two settings

As this study compares the learning between a digital kitchen and a classroom, this section shows what is involved in the classroom.

The same basic task procedure was followed in both the KDK and classroom environments. However, the learning experience for users was intended to be very different in the two environments as the key variable in the research design. In the KDK, the learning experience would involve touching and manipulating physical objects as part of the cooking tasks and accessing all supports of the KDK environment, whereas the classroom would involve seeing the same objects as photos and simulating rather than actually performing the cooking task. Since the learners' experience in the KDK is by now well known to readers from the previous chapters, in this section we explain what the learning experience was in the classroom.

In the classroom, participants carried out the same 3-stage task procedures as in the KDK. The significant differences were the location, that photos of objects were used for the task rather than manipulating real objects, and that there was no direct access to the digital technology. The role of digital sensors and GUI was performed by the researcher, who offered the same instructions and help facilities as the system in the KDK. Timely HELP prompts such as 'image help?' were provided 10 seconds after the instructions and repetition was provided as many times as learners wanted. This was to establish a learning environment as similar as possible to the one in the KDK apart from the variable of physicality. Interaction between the researcher and learners was minimized in order to minimize variability in input. Figure 30 below demonstrates how the classroom task was conducted.

Figure 30 Carrying out the Task

Learners encountered the spoken and written form of the vocabulary through a tablet, which gave learners audio-visual 'cooking' instructions. They asked the teacher/researcher for help when necessary, who played exactly the same audio-visual files as in the KDK, but learners could not access the tablet themselves.

In the *pre-task* phase, the tablet provided the instruction using an audio file in the same way as in the KDK. Help 1 repetitions were spoken by the researcher and the Help 2 and 3 audio-visual helps were shown on the tablet with the same slides as in the KDK. Feedback on actions was provided by the researcher using the same language as in the KDK. The photos below demonstrate the way learners carried out the pre-task when the tablet asks them to collect 유부 (tofu) and 가위 (scissor); they move the pictures to complete the step (Fig. 31).

Figure 31 Pre-task in the Classroom

In the *during-task*, the learners follow the instructions, simply putting the photos together or gesturing to complete the task. The two photos in figure 32 show how they reacted when the instructions were given: one for '밥을 그릇에 넣으세요 put rice into the bowl' and another for '숟가락으로 잘 저어주세요 stir the mixture properly with a spoon'

Figure 32 The During-task in Classroom (Pretending to stir the mixture by hand)

The *post-task* phase involved tasting the food. Learners in the KDK were shown one single audio-visual slide asking them to try the food (left photo in Fig. 33). We however see in the right photo that classroom learners are carrying out a simple simulation, using their hands to pretend to eat what they 'made'.

Figure 33 Post-task in Classroom

Thus, in the classroom, learners perform a classroom task which simulates the real-world task which learners in the KDK perform. They do not have real ingredients or equipment to achieve the goal, nor are they in control of their own learning. They simply use photos to complete the task. Although they receive help on request, a teacher/researcher controls the tablet computer. That is, the task is pedagogical, not real-world, and interaction is with a conventional teacher.

4.7 Vocabulary Test procedures

This research tests learners' partial vocabulary knowledge at beginners' level via two different tests: receptive and productive ones. A receptive test is needed to examine learners' ability to understand a word when it is heard or seen, while a productive one is necessary to examine their ability to produce a word when it is written or spoken (Nation, 2001). Receptive and productive tests were used as the former can measure learner's accuracy and the latter makes the test much more sensitive to partial knowledge (ibid.). These tests were administered throughout pre- and post-tests. All subjects also carried out the delayed post-test after two weeks to check retention as it was possible to record granular evidence on how individual users showed changes in active production of the vocabulary items over a period of two weeks. The period of two weeks was seen appropriate as the 'Forgetting Curve' sees a week as a boundary between short-term memory and relative long-term memory (Baddeley *et al.*, 2009). Given the nature of different level of physicality of objects in both settings, the times spent cooking were different. The digital kitchen users spent 7 minutes on average more than classroom ones on cooking. It would be ideal to control the variable of time for a precise experiment. However, as each pair controlled their own paces for task completion in two settings on their side, I was able to minimise the effect of the time variable on learning.

The way learners are tested on their word knowledge is twofold: matching spoken form to meaning for concrete objects, and oral reproduction of the phonological form. Schmitt and McCarthy (1997) suggest L1 and L2 words rarely map exactly onto each other. However, concrete objects such as milk make it easier to comprehend referential meanings (Melka, 1997). Therefore, it was appropriate to do a L1-L2 matching test, but the problem was active oral production of items. This was because it is difficult to check productive knowledge shown by a subject, who is required to produce a target word in the absence of context according to Melka (1997). In this

project, however, the authentic kitchen setting itself clearly showed its context, which might have mitigated this difficulty.

The diagram (Fig. 34) below portrays the procedure for tests performed in both learning environments. Immediate post-tests (Post-test 1 and 2) were carried out immediately after the end of all cooking sessions, and delayed post-tests completed two weeks later. For readers' information, it is made clear that both settings had only productive test in pre-test done as receptive test requires participants to match a label onto each item and random matching might cause their incorrect knowledge, potentially undermining the results of the test.

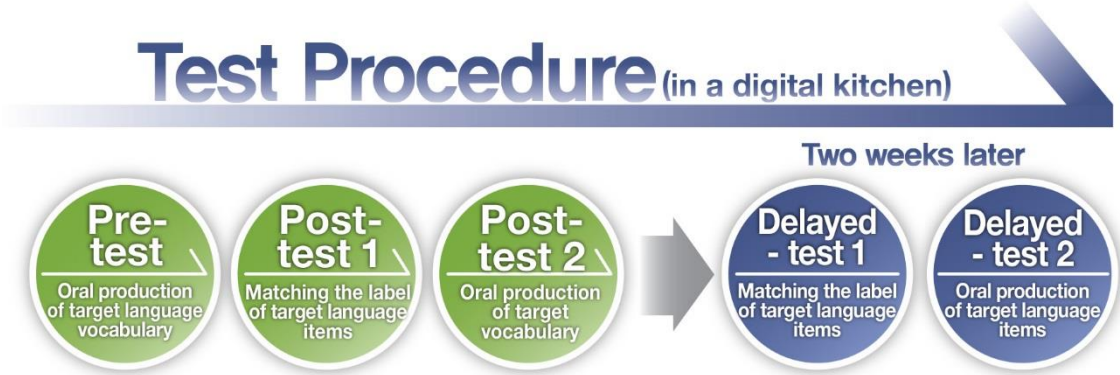

Figure 34 Test Procedures in Two Settings

4.7.1 Tests in Korean Digital Kitchen

The pre-test was designed to assess the extent to which much a participant knows vocabulary items and to serve as a baseline to compare with post-tests. It was a verbal production test. Each individual was shown ten real objects and then asked to produce them in Korean one by one. In order to keep the test consistent, the word test order stayed the same with all participants. Furthermore, for each object, the researcher showed no reactions such as back-channels and gestures but pointing out the next object to avoid any confounding variables. The researcher held an audio-recorder by hand to record his or her performance.

4.7.1.1 Productive Tests

We needed to assess the testees' phonological performance. We therefore established the extent to which each individual was able to actively produce each item prior to the cooking session, using the adapted verbal rating scale (see Section 4.9.1.1). After they finished the cooking task, each individual completed the post-test separately following exactly the same procedure as the pre-test. We assessed them again individually on exactly the same items two weeks later as a delayed post-test. We were

therefore able to record granular evidence in terms of individual changes in active production of specific vocabulary items over a period of two weeks. Figure 35 below shows the objects shown to users for the productive pre-test, post-test and delayed-post-test in the KDK.

Figure 35 Pre & Post-tests in the KDK

4.7.1.2 Receptive Tests

Although the testing procedures were the same as in the European Digital Kitchen in relation to the active production test of spoken form, the KDK had an additional receptive matching test for recognition of written form in the post- and delayed-post test. Each subject was also asked to match 10 pieces of paper with the Korean name of the object in both Korean and Roman scripts to each of the 10 physical objects employed in the cooking task (Fig.36) within one minute. This additional test was important to see the extent to which learners had managed to learn to recognize the L2 written forms of the target vocabulary. The figure below shows the labels matched to the items.

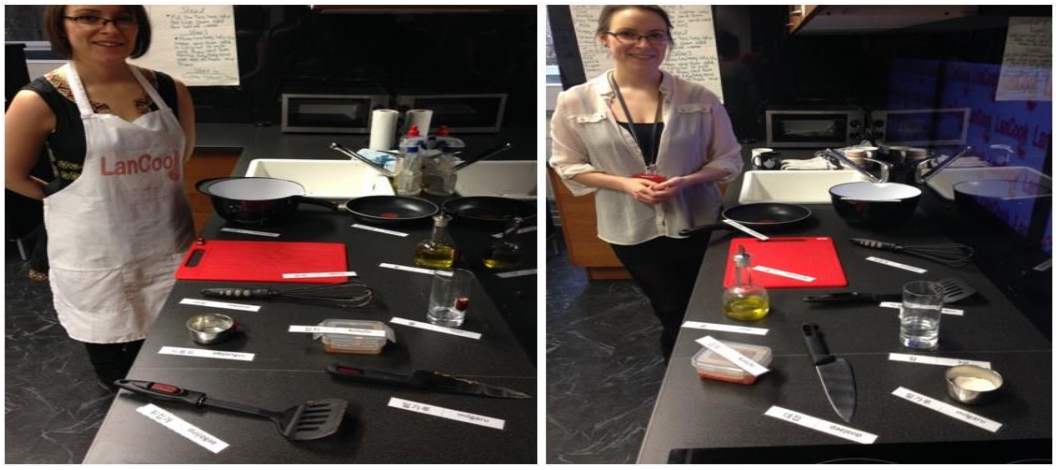

Figure 36 Immediate & Delayed post-tests in the KDK

A delayed post-test attempted to assess learners' ability to recall. It included the same tests as conducted in an immediate test, and maintained the circumstances as similar as possible to the previous one. The only difference was that the test was done two weeks later. The diagram (Figure 40) in Section 4.8.3.2 shows how the cooking procedures proceeded.

4.7.2 Tests in Classroom

The participants learning in the classroom underwent similar procedures to the tests taken in the KDK. However, instead of being shown the real objects in the KDK, users were shown photos of the same objects. The testing environment and procedures therefore matched the respective teaching environments and procedures as closely as possible. The script for testing was the same in both environments, as was the person doing the testing, and the test data were collected in the same way. In Figure 37 below, we see the photos which users were shown and had to name. Figure 38 below shows the written labels matched to photos in the receptive tests.

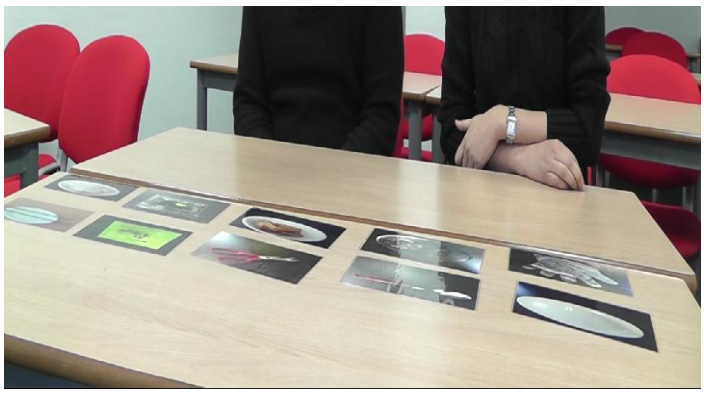

Figure 37 Productive post-tests in Classroom: Name the Object (Oral)

Figure 38 Receptive post-tests in Classroom: Matching Labels to Objects (Written)

4.8 Data Collection procedures

4.8.1 Pilot Study

Pilot studies were conducted to anticipate potential problems in the procedure, collection, and analysis of data prior to actual data collection. Indeed, Murray (2009) suggests that a pilot study lays the foundation for error correction before embarking on an actual study.

The prior study was carried out between mid-October and mid-December, 2014, and was conducted with two different recipes in both a digital kitchen and a classroom. A total of 6 non-Korean participants in three pairs agreed to undertake the cooking sessions. They all were from different countries, and resembled, to a large extent, the target population in the main study in terms of learners' background. The first two pairs conducted it in the digital kitchen to see whether or not the computer software system worked well and whether the recipes were organized enough for subjects to complete the session. The final pair carried it out in both settings to remove any possible issue in comparing experimental conditions. In the former case, generally, both the computer software and recipes posed various problems to subjects carrying out the cooking session, whereas in the latter one, there were no major issues that needed to be fixed, except the way each photo slide with letterings on was shown. This section describes what went wrong and what actions have been taken to improve the practicality based on participants' feedback and the researchers' perspective.

Many problems were spotted. First, participants found some of the technical disturbance annoying and problematic to finish the given task. Moreover, built-in sensors at each stage in During-task sensed too fast for participants in finishing the given task, which meant users did not have enough time to follow each stage. What made things worse in relation to this problem was 'a green shaker', an aid tool that users could shake to go to the next stage when they were done with the given task. It is usually sensed with just one or two shakes for a computer to read, but it didn't work well enough to be sensed, which caused users to heavily shake it several times until it worked. This led to the skipping of steps, leaving many steps unperformed. Participants could therefore not complete the stage step by step. Furthermore, quite often, heavy shaking caused a serious clash within a computer, enough that a window popped up saying the program should be closed down. Participants had no choice but to start from the beginning.

To address these problems and develop the program, a few actions were taken. To reduce 'waiting time', each stage in Pre-task was redesigned to show direct slide

with lettering and photo but with enough time. When it came to a sensor issue in During-task, users were encouraged to press the 'forward' button, rather than using the green shaker. To this end, there was a need to describe each button on the screen of the GUI display. A description paper to help participant understand many buttons such as '≤ ≥ √ ? ‖' meaning forward, backward, tick, and question each on a tablet was hung up on the wall beside the GUI (Appendix C). This way they were allowed enough time to complete each course and were able to move to the next stage at the right time.

Those changes allowed me to prevent unknown factors which could have influenced scores in observational and statistical data. The same procedure went for data collection by means of semi-structured interviews and questionnaires, which otherwise could have caused participants' biased attitudes and perceptions without proper revision of each question.

Thus, the pilot study revealed a range of potential problems such as malfunctioning computer and issues with the recipe software. By carefully conducting the prior study, the researcher could detect disturbances that might happen in the real quasi-experiment in advance and improve the design of the study.

4.8.2 Quantitative (QUAN) data

4.8.2.1 Test results

This study used participants' scores to gather evidence of their vocabulary learning, and conducted statistical analysis. The aims for the use of statistics were threefold: to compare participants' scores from two settings, to investigate the extent of vocabulary learning; to make informed interpretations about an association for descriptive and inferential interpretation. As Chance and Rossman (2006) claim, statistics is a mathematical body of science that pertains to the collection, analysis, interpretation and presentation of data. Descriptive statistics were used to summarize the population data whilst inferential statistics were needed to draw meaningful conclusions about the entire population (ibid.). This study hypothesizes that subjects cooking in a digital kitchen would outperform the ones in a classroom in terms of vocabulary and culture learning. To gauge the extent, each individual's performance was scored based on three tests taken both in a classroom and in a digital kitchen: pre-test, immediate post-test, and delayed post-test. A number of variables were generated to see the associations and relationships, such as post Receptive scores in Classroom – post Receptive scores in Digital Kitchen and post Productive scores in Classroom – post Productive scores in Digital Kitchen. These variables were coded to see the difference

in recall and production tests. The same went for the delayed post-tests. A total of 48 individual participants' scores by group were combined together to compare and see how different they were. Thus, test results of statistical data (see Section 4.9.1.1) helped answer the research questions of this study, offering causation of variables.

4.8.2.2 Questionnaires

Questionnaires help researchers collect information from respondents (Bryman, 2012). This instrument also allows for exploration of the relationship between variables, and highlights possible issues that can be examined in-depth during the follow-up semi structured interviews (Borg and Gall, 1989). The questionnaire in this study was designed to further investigate participants' attitudes and to verify information which was raised by interviews, observation, and the literature review. It allowed a quantifiable level of response.

Closed questions were used in questionnaires. They are easy for participants to answer in a questionnaire and enhance the comparability of answers; they help clarify the meaning of a question for respondents as participants sometimes find questions ambiguous (Bryman, 2012). Closed questions are, however, limited in that the fixed answers might not include interesting replies that participants come up with; thus it has a possibility of "a loss of spontaneity in respondents' answers" (Bryman, 2012). To address this issue, the present paper used open questions as well, which are useful to gather data on participants' feelings and opinions (Kumar, 1999). It was not by questionnaires, but by interviews. The semi-structured interviews were therefore used for in-depth investigation, and the approach helped examine possible issues that were highlighted through the questionnaire (Borg and Gall, 1989). Thus, this study used a questionnaire with both types of questions with interviews complementing questionnaire data.

To investigate learners' attitudes towards two different learning settings, this paper employed the Likert scale method, which measures intensity of feelings about the issue in question (Bryman, 2012). Participants were asked their degree of agreement with a series of statements on how they perceive a digital kitchen and a classroom in relation to language and culture learning and whether or not the key difference in resources available in both settings influences learning. Based on these criteria, participants responded to the statements that express their opinions and attitudes with level of agreement as strongly agree (SA), agree (A), neutral (N), disagree (D), strongly disagree (SD) (Bryman, 2012). This scale was chosen because it is arguably the most

commonly used format to obtain responses in a consistent way and it is easy to identify the similarity between items (Bryman, 2012).

The questionnaire included six closed questions and the final two questions included ten sub-closed statements which investigated factors that influenced participants' attitudes and experiences. A questionnaire pilot test was done beforehand as it ensures that questions work well, and that the research tool as a whole functions well (Bryman, 2012). Overall, the questionnaire was redesigned to cover quantitative findings to be a more comprehensive tool tailored for the current study. All the questionnaires were individually administered to all participants after the cooking session in both settings. The questionnaire is attached (Appendix D).

4.8.3 Qualitative (QUAL) data

4.8.3.1 Video Observation

The major aim for using observational data was to portray participants' learning process in the two cooking sessions. That is, the approach was designed to help the researcher see in great detail how each pair starts to learn a foreign language and other cultural aspects by investigating the entirety of their experiences in two different settings. The nature of the observation offers the possibility to gather authentic data from real-world settings, which is a unique strength of this data collection instrument (Cohen *et al.*, 2011). The method provides researchers with a very powerful tool for gaining insight into situation. It also helps see things that might otherwise be missed and to discover things that participants might not freely talk about in interview situations (ibid.). It was therefore expected that observational data would allow me not only an opportunity to explore participants' unconscious yet pivotal behaviours relevant to learning, but also to examine what occurs naturally without predetermined ideas and by being immersed in this research situation.

In the KDK, two cameras were set up to gather video data, one for the pre-task and the other for the rest of tasks, and digital audio-recorders were also placed hanging up on the wall in the kitchen, together with a wired microphone in case video-recorded data is not audible. On the other hand, in a classroom, just a single camera was used in front of two participants conducting the cooking session. Illustrative photos (Figure 39) were taken from a randomly-chosen pair, and help see how cameras shot participants in two settings as below.

i) In a kitchen ii) In a kitchen iii) In a classroom

Figure 39 Examples of cooking experiences in both settings

In the KDK, the researcher was observing what participants were cooking according to instructions on the GUI via a Skype camera set up on the roof behind the kitchen. This was to minimize and avoid a researcher's intervention and elicit as natural an interaction as possible. Then, the parts considered important for learning were transcribed. To compare the two environments, 10 out of 48 cooking sessions were transcribed: 5 pairs from the KDK and 5 pairs from a classroom. 10 pairs were randomly chosen, and I kept observing their behaviours over and over again. This helped me to see where students demonstrated stark contrast in specific points in relation to learning (e.g., learners' reaction to objects to remember the target words and their repetition of vocabulary items).

4.8.3.2 Semi-structured interviews

The aim of the semi-structured interviews was to elicit richer qualitative data after the questionnaire and to explore issues which had been hard to find answers to through questionnaires and observations. The interview is flexible, allowing new questions to be brought up during the interview while also offering a means of entering into the world of the individual to explore concepts and construct meaning (Bryman, 2012), and enables researchers to investigate issues of an unknown meaning through modification (Gubrium and Holstein, 2001). This data collection instrument allowed me to obtain in-depth statements of subjects' opinions and experiences of learning experiences of learning from two cooking sessions in two different settings.

The interview followed the administration of the questionnaire completed immediately after the two cooking sessions, and two participants in pairs were interviewed after two cooking sessions. The interview was, albeit not entirely, conducted in a similar way as in the focus group. All students took part in the interviews, and each pair was interviewed together. The interview approach was valuable because it "offers the opportunity of allowing people to probe each other's

reasons for holding a certain view" (Bryman, 2012, p. 503). This way, the semi-revised-structured interview contributed to even richer qualitative data.

Interview questions were derived from research questions after there had been enough discussion with a main supervisor and a research assistant to avoid any ambiguous wording, and to ensure relevance to the focal point of this study. In this way, potential issues were identified and minimized. To enhance the quality of the interview, two pilot studies were conducted beforehand (Drever, 1997). The interview question sheet is attached (Appendix E).

Taking all aspects of Section 4.6, 4.7 and 4.8 into consideration, the current study collected data throughout the cooking session carried out both in a classroom and in a digital kitchen in the same way as shown in Figure 40.

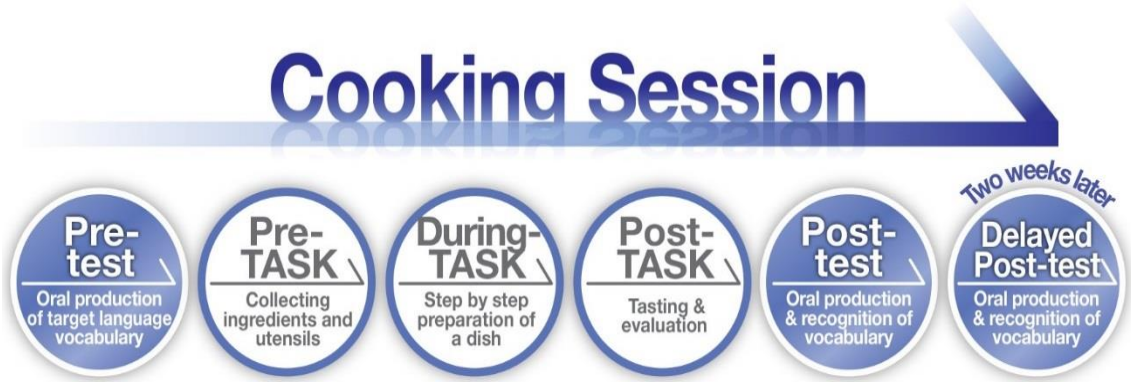

Figure 40 Flowchart of Tests and Tasks

4.9 Data analysis procedures

The data analysis has, in general terms, observed the issue of 'fitness for purpose' (Cohen *et al.*, 2011) in the sense that the purpose for undertaking the research has determined the kind of analysis performed on the data. For QUAN data, SPSS (Statistical Package for Social Sciences) software was employed, whereas for QUAL data (i.e. video-recordings and interview transcripts) manual techniques were used. A diagram (Fig. 41) below shows the overall picture, followed by specific details of analyses.

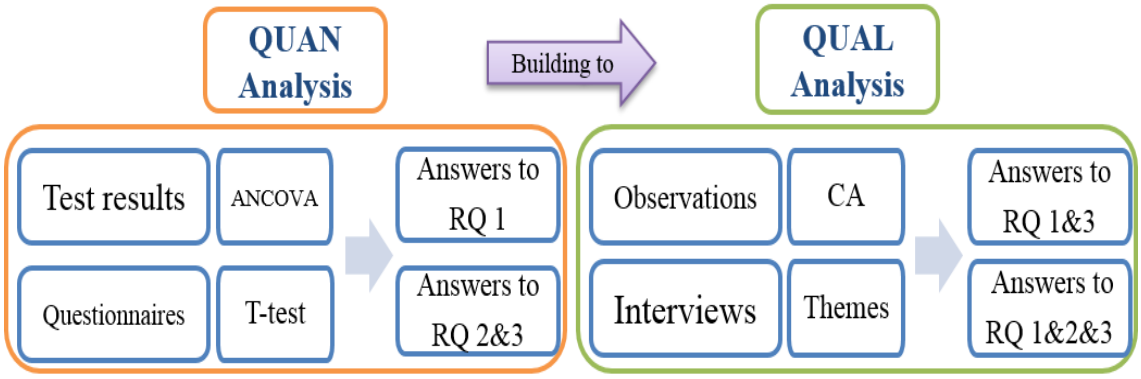

Figure 41 Data Analysis Procedures

As stated in Section 4.4.1, quantitative data are first demonstrated and then followed by qualitative data to build up on the quantitative outcomes.

4.9.1 QUAN data analysis

4.9.1.1 Statistical analysis and ANCOVA

The current research employs Statistical Package for Social Sciences (SPSS) and Excel to analyse data of test results and questionnaires. The benefits of using statistical analysis are to examine relationships, test hypotheses, describe what is happening, make comparisons to find similarities and differences, and understand the distribution of each variable across the respondents (Punch, 2009). Statistics can also shed light on variability (Wray and Bloomer, 2006). This research involves measuring variability and difference in learning attitudes and behaviours in two separate learning settings. SPSS and Excel can serve as methodological tools to help ascertain a range of results projected by the study. SPSS procedures included both descriptive statistics (i.e. participants, gender and age range) to determine the frequency and percentages of variables, and the causation among variables. The procedures also contained inferential statistics (i.e. means and standard deviation), which helped establish the statistically-significant differences, if any, between variables in terms of learning. A paired-samples t-test has been used.

The software is based on numerical data for analysis, so data from questionnaires and test results were coded in numbers as shown in Figure 42. A wide variety of aids such as tables, figures and graphs are based in this chapter to demonstrate descriptive and inferential statistics.

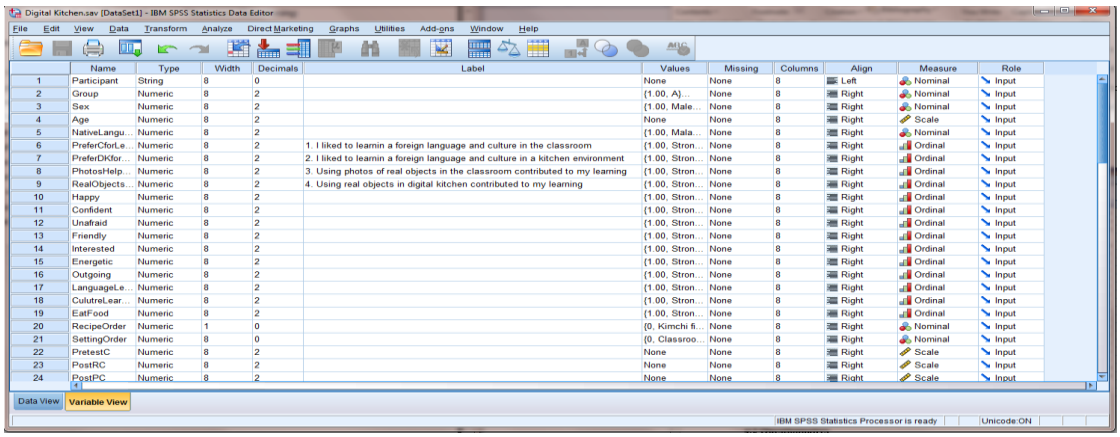

Figure 42 SPSS data analysis

This study hypothesizes that participants will outperform in vocabulary learning when using real objects in the digital kitchen than those cooking by using just photos in the classroom, which is relevant to research question No. 1. To answer this question, the score increase from pre-test and two post-tests in the classroom was compared with that of the digital kitchen by using SPSS software, which made it easy to examine the mean differences of how well participants learned two sets of skills.

Analysis of Covariance (ANCOVA) helps explore differences between groups while statistically controlling for an additional variable. The additional variable (called a covariate) is a variable that may be impacting scores on the dependent variable. Pre-test scores in this study will be controlled (i.e. be the covariate). 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. So, ANCOVA was used to see the influence of a classroom and the KDK on vocabulary learning. 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 < .005 indicates a significant difference; *F* indicates a variability between groups (caused by the independent variable); Cohen's *d* or *eta squared* (η^2) 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 mean that two variables are associated with one another and the difference has any practical significance. It is the effect size known as 'strength of association' via *eta squared* that makes it possible. These all are basic assumptions made in ANOVA. The tool enabled this study to reveal

if the mean vocabulary scores at post- and delayed post-test for the two groups are significantly different after the initial pre-test scores are controlled for.

In receptive tests (matching), each correct answer was counted one point while the wrong was zero, and totals for each condition were then calculated. A good case in point was Ellis and He's study (1999) in which scoring option was just either 0 or 1 for each lexical item. It was, however, different in verbal production tests in that quantifying the ability in the L1-L2 and L2-L1 production was very complicated and hard to compare. A sensitive vocabulary test (productive) can show that there has actually been low level of learning from some low-strength teaching or learning intervention (ibid.). Therefore, this study adapted the Lexical Production Scoring Protocol-Spoken (LPSP-Spoken) that Barcroft (2002) suggests, as a way to quantify the scores. As learners acquire new words in bits and pieces, the measure that is sensitive to partial word learning is appropriate (Barcroft, 2002). The framework sets up five scales: 0, 0.25, 0.5, 0.75, and 1, depending on how a learner performs in production tests (Appendix F). Based on the scoring scheme, scores reflect production of both completely and partially produced words in order to be as sensitive as possible to one's overall knowledge of lexical items.

4.9.1.2 Questionnaire statistics

In addition to the score coding, participants' responses to the questionnaire were assigned a numerical value in a file whilst being entered into an SPSS file and the same procedure applied to this data. The results were used as indicators rather than proofs. Thus, questionnaires complemented the statistics of subjects' scores, contributing to answering the second and third research question.

4.9.2 QUAL data analysis

4.9.2.1 Conversation Analysis

Conversation Analysis (CA) is an analytical method that offers insight into how people organise their conduct to achieve their daily affairs that occur naturally during spoken interaction. The method allows researchers to holistically investigate the data with special attention given to the details of naturally-occurring spoken interaction represented by a detailed transcript (Seedhouse, 2004; Ten Have, 2007). Furthermore, CA offers valuable information on the fine details of learners' interaction and on how they use their language resources to socialize within the small group discussions to show 'understanding and knowing' (Koole and Elbers, 2014). While CA does not have an original point of interest in learning, a number of researchers have recently taken the

approach to address the questions related to language learning (Seedhouse 2005; Hall *et al.*, 2011; Kasper and Wagner, 2011; Pallotti and Wagner, 2011; Kurhila and Kotilainen, 2017; Seedhouse, 2017). Employed as a methodological tool to explore interaction generally around computers since the early 1990s, CA has recently made its inroads in HCI to investigate the complexities of the context of a learning environment (Hooper *et al.*, 2012; Verdines, 2012; Price and Jewitt, 2013a; Price and Jewitt, 2013b).

CA is used to identify instances of local learning in interaction, and examines the moment-by-moment interaction by using verbal and non-verbal cues. Using the analytical tool, the researchers were able not only to discover evidence of learning manifest in the details of the interaction (Preston *et al.*, 2015; Kurhila and Kotilainen, 2017; Masats *et al.*, 2017; Pallotti *et al.*, 2017; Park and Seedhouse, 2017).

In this study, the audio/video recordings of the cooking in the pre-, during-, and post-task stages in two different settings helped observe the pairs in great detail to see how subjects address the problem in interaction and have better learning access to both linguistic and cultural aspects. Thus, the approach helped understand participants' learning process and thereby offered learning evidence. CA was therefore suitable for the data analysis of task-based interaction in two settings, showing which environmental factors might have contributed to a higher or lower score.

This study used the Jeffersonian transcription conventions (Appendix G), which allows for a precise notation of prosodic features and voice quality. However, the kitchen played a role as one interactant and had a range of functions. Hence, the conventions were adapted for analytic purposes related to technological development. The adapted conventions are presented in Section 5.3.1 of Chapter 5.

4.9.2.2 Thematic analysis

Where CA provides *what* was going on in the two learning environments and *how* learning was happening, interviews offer *why* it was being done (DeCuir-Gunby *et al.*, 2011). The integration of two qualitative data types thus allow researchers to obtain a richer description of social activity of 'learning'.

Thematic analysis is a flexible research tool providing a rich and detailed account of data. (Braun and Clarke, 2006). The tool also allows researchers to interpret various aspects of the research topic (Boyatzis, 1998). Therefore, thematic analysis was employed to investigate the qualitative data derived from interviews. The recorded interviews were first transcribed and then given to all participants, so they could double check errors or typos for form and meaning clarification where necessary. The thematic

focus in the interview analysis was participants' comments on their own experiences in the two different environments. The transcription was carefully scrutinized and repeated until recurring patterns or themes began to emerge (Holloway and Wheeler, 2002). In this study, the semi-structured interview was used to explore what they could learn, what they found difficult, and what they thought about the experience in a traditional environment versus a real-world environment for language learning. This approach helped answer all of the research questions.

Based on the step-by-step guide of thematic analysis (Braun and Clarke, 2006) below (Fig. 43), interviews were first transcribed by the researcher of this study as precisely as possible and then double checked by all interviewees. Then interesting features were coded in a systematic fashion across the entire data set in relation to research questions. It was followed by combining codes into potential themes and making sure that themes were reasonable for the extracts. The final stage was to refine the specifics of each theme and produce a report.

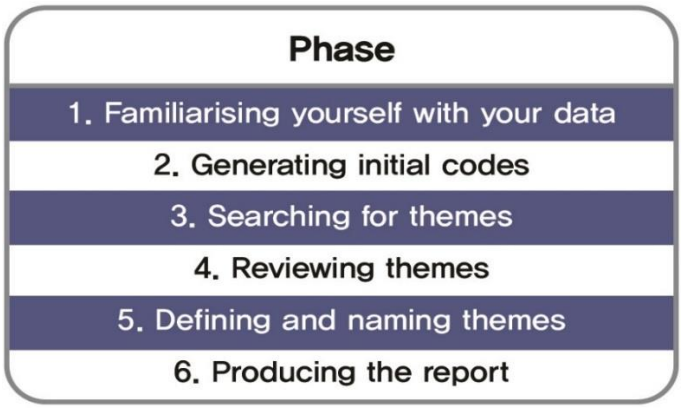

Figure 43 Thematic Analysis Steps

When analysing interview data, Nvivo10, one of the CAQDASs (Computer Assisted Qualitative Data Software), was used for several reasons: offering great potential to organize large volumes of data (Bryman, 2012); assisting the researcher with the organization and analysis of data that requires human interpretation (Clare *et al.*, 2012); aiding the researcher in her or his search for "an accurate and transparent picture" (Welsh, 2002, p. 1). Thus, the computer-mediated software helped initially sort interviewees' comments into a few categories. Throughout this thesis, themes will be supported by participants' interview quotations to establish a clear link with the raw data. Of course, individual participants were assigned pseudonyms for their anonymity and confidentiality.

4.10 Reliability, Validity and Reflexivity

Reliability, validity, and reflexivity are important criteria in establishing and assessing the quality of any social research. This section describes what the three criteria are and how they are met in relation to this study. Overall, the current research attempts to support three crucial research criteria.

4.10.1 Reliability

Reliability concerns the likelihood of similar results being obtained when the study was repeated (Payne and Payne, 2004). It refers to whether or not similar results could be produced by the same data collection procedures, the same data analysis processes, and the same participants. In accordance with standard practice of reliable research, the overarching methodology was shown. How a mixed methods approach is organized in relation to research questions was displayed via diagrams. Moreover, the developments of applied quasi-experimental design tailored for this study were made clear so other researchers will be able to repeat using the same technology. With regard to data, transcripts will be displayed in the document, and the detailed analyses will be available for scrutiny. All data was coded by the researcher of this paper and reviewed by peers to avoid miscoding. This makes the process of a mixed methods approach, a quasi-experimental design and the data replicable, transparent and retrievable (Bryman, 2012) at any time for inspection for the reader. This study is thus reliable.

For the reliability of questionnaires, a consistency test was conducted using Cronbach's Alpha reliability test. The closer the co-efficient level is to 1, the more it is reliable and vice versa (Pallant, 2013). As displayed in Table 5 below, the Cronbach's Alpha value showed sound reliability for the questionnaires [$\alpha = 0.742$]. This has been calculated with an item analysis, which demonstrates how well a set of questions (or items) measures one construct.

Table 5 Cronbach's Alpha statistics

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.742	.755	14

4.10.2 Validity

Validity is considered essential to evaluate the quality and acceptability of research. The criteria is related to "the integrity of the conclusions that are generated

from a piece of research" (Bryman, 2012, p. 47). This study used a mixed methods approach, which enabled what was statistically measured to build up on what was observed in videos and interviews. This triangulation of data strengthened the credibility of the present study. On the whole, the following procedures show how the instruments and data meet three validities.

4.10.2.1 Internal validity

Internal validity questions whether the measurement tool is measuring what it was supposed to measure (ibid.). For the quantitative data, the numeric data is displayed through the Figures and Tables, enabling readers to confirm the proposed findings, and the qualitative data from participants' interviews is provided through the analysis procedures of the researcher. In particular, CA takes an emic perspective and does not make any claims beyond what is in the transcript. Most of all, according to the claim by Cohen *et al.* (2011), the use of multi-method data collection is perceived as being important for ensuring validity, enabling researchers to minimize any possible limitations of using one method and to achieve broader and better results. In terms of methodological issues coming from the lack of random assignment, it was mentioned earlier that this study mitigated potential problems by asking participants to choose their own partner from their friends. Therefore, the internal validity is supported in this study using multi-layered data sources.

4.10.2.2 Ecological validity

Ecological validity refers to the extent to which social scientific findings are applicable to people's every day, natural social settings (Bryman, 2012). Simply speaking, it means it studies the environment in which a certain social action occurs. In experiments, for example, where researchers investigate language teaching and learning in a psychological laboratory, it can be said that the studies do not have ecological validity because the researchers should examine a place where learning actually occurs, such as a classroom, to see how people learn language. The present study, however, used two environments where learning usually takes places in our everyday life. The settings are quite natural rather than unreal. It is raising the credibility, therefore enhancing its ecological validity.

4.10.2.3 External validity

The final one is called external validity, which questions whether the results of the study can be generalized beyond the research context. Since the quasi-experiment of

this study occurs in natural environments, the main findings may be applied to other subjects and settings, allowing for generalizations to be made about other populations. Additionally, this study could gather 48 participants, but they are from mixed genders and 20 different nationalities to raise the applicability as much as possible. This thus supports the external validity.

4.10.2.4 Reflexivity

Reflexivity should be considered. The terms refers to the "researcher's engagement of continuous examination and explanation of how they have influenced a research project" (Dowling, 2008, p. 747). In general, when conducting interviews, researchers often tend to compel interviewees into particular avenues of responses (Cohen *et al.*, 2011). It was found that the researcher of the present study encouraged some interviewees to produce specific words that he intended to hear. This affected the quality of the data. .

The researcher taking place of the computer to conduct the task in the classroom may also make participants feel differently compared to the one in the digital kitchen where they carry out the task themselves, thereby influencing the result of the experiment. However, since the researcher in the classroom reacted to the participant in the classroom almost as similarly as possible to the way the digital computer interacts with participants in the digital kitchen, the researcher could minimize his interactional involvement.

4.11 Ethical issues

Paying keen attention to the ethical implications is as important as designing research properly when conducting social research because it is mainly concerned with protecting participants. Indeed, Neuman (2012) claims that social researchers should be reminded that two sets of values need to be balanced: "the pursuit of knowledge" and "the rights of research participants" (p. 53). Bryman (2012) also suggests that any harm to participants should be avoided, although physical harm is rare in educational research (Neuman, 2012). Since this study involved potential physical harm during cooking in a real-life kitchen as well as observing all participants for data collection, and ethical issues can arise at any stage of a quasi-experimental study, consideration has been taken to ensure safety and confidentiality.

To begin with, to avoid physical damage to participants, the current study instructed and demonstrated to all subjects how to use the digital kitchen before cooking, in particular how to deal with dangerous equipment such as the cooker. Any

participant who was instructed to use the equipment and felt uncomfortable had the right to refuse to attend the cooking session. Furthermore, to ensure personal confidentiality and anonymity, various forms such as biographical information sheets and consent forms were offered to protect their rights: they were informed that participation in the study was voluntary and they have the right to withdraw whenever they want; the data would be used for research purposes only, such as for a thesis and academic conferences – it was made clear that some participants did want their names to be anonymous or used under a pseudonym; they were also asked for their permission to complete the interview, questionnaires and audio/video recorded observations. However, participants were not informed of exact aim of the research since it might have an impact on the result of the research.

In order to conduct this research, the researcher has applied for Ethical Approval of a research project from Faculty Ethics Committee at Newcastle University, and the school has approved this study (Appendix H).

4.12 Methodological issues and limitations of the study

Limitations are mainly from the method itself. First, data mixing was an issue. The mixed-methods approach often combines "nomothetic and idiographic approaches in an attempt to serve the dual purposes of richer understanding and generalization" (Bazeley, 2004, p. 5). This is to gain an overview of social regularities from a larger sample while understanding the other through detailed study of a smaller sample. However, full integration of these methods was limited. In this study, four data sources were used and it was difficult to properly integrate data in the analysis. To mitigate this methodological problem, I have used a *completeness* approach (Bryman, 2012), which assists in revealing dimensions derived from each set of data. The qualitative data base was necessary to deliver an understanding of how physicality helped learning, and how the statistically derived models provided access to underlying dimensions in the data not readily evident in the detail of the qualitative analyses. That is, QUAN displayed learning as products, while QUAL demonstrated the processes of learning. However, the current study will still remain limited in serving both aims of in-depth understanding and typification.

The next aspect is the degree to which quantitative and qualitative components can or should be integrated (Buber *et al.*, 2004). This can be an issue when determining how best to present the ideas and evidence generated through the completed study because the results from one type of analysis are presented and then the results for the

other before an attempt is made to combine them together in a general conclusion. After finding learning in the KDK was more effective than in a classroom using QUAN, the present study used QUAL to identify environmental factors which might explain these differences. The study tried to progressively unveil relevant evidence on a path to a common conclusion, rather than to organize on the basis of method used. However, it remained limited in proper integration.

4.13 Chapter Summary

This chapter outlined the research questions and the methodological considerations in undertaking this research. In order to explore the different natures between the KDK and a classroom on foreign vocabulary and culture learning, this study used a mixed methods approach using multiple data. Quantitative data (i.e. test scores and questionnaires) was used to secure whether and to what extent students learn the vocabulary in two different settings, whereas qualitative data (i.e. observations and interviews) was employed to uncover how and why differences in learning occur. It was SPSS that helped analyse QUAN data, while CA and thematic analysis QUAL ones.

In order to see the intervention effect, this study employed a quasi-experimental research design in which pre-and post-test were administered and participants were not randomly assigned to each group. Applying a previous research model, this study was able to create a new design, where two locations and two recipes were used in such a way as to explore the intervention effect.

The data collection was conducted in a SLA context of a real world learning environment in Newcastle, UK across 2 months with 48 international adult participants from 20 different cultural backgrounds.

The following chapter will present the analysis and interpretation from the data using both quantitative and qualitative paradigms found in the two separate environments.

Chapter 5. Data Presentation & Analysis

5.1 Introduction

This chapter presents data and analyses from a range of sources used in a mixed method approach, including quantitative data (i.e. descriptive and inferential analysis from test results and questionnaires) and qualitative ones (i.e. conversation analysis from observation, and thematic analysis from interviews) in relation to the research focus and the main arguments. This data demonstrates whether using all five senses helps students' vocabulary and culture learning more effectively than employing less senses such as just sight, and if so, to what extent and how learning occurs in the two different settings. This chapter also reveals learners' attitudes towards the two separate environments of the digital kitchen and the classroom, and their preferences between manipulating objects and simply seeing photos of them.

Each set of data presented is designed to answer the relevant research questions for triangulation purposes. The table 6 below shows how each data format is integrated in relation to answering research questions.

Table 6 Research questions and Data to be used

1. Do participants learn vocabulary more effectively in the digital kitchen by touching and manipulating real objects to complete a real-world task than in the classroom using pictures of objects to complete a pedagogical task? If so, to what extent and how?
2. What are learners' attitudes to learning in two different settings?
3. Does using real objects to cook in the digital kitchen help students learn cultural aspects more effectively than looking at photos of the objects in the classroom? If so, to what extent and how?

	Quantitative Analysis		Qualitative Analysis	
	Test results	Questionnaires	Observation (CA)	Interviews
RQ 1	♣		♣	♣
RQ 2		♣		♣
RQ 3		♣	♣	♣

5.2 Quantitative Data Analyses

This section aims to present statistical evidence to determine whether there are greater learning gains in vocabulary and cultural aspects in the KDK than in the classroom, and show learners' attitudes toward two learning settings. The quantitative evidence, in particular test results, helps demonstrate students' learning as a product. The numeric analyses and graphs below show a clear distinction between two different learning environments.

5.2.1 Vocabulary Tests and Analysis Tool

The quasi-experiment was conducted to find if there was a significant effect of an independent factor on a dependent variable as explained in Section 4.4. The independent factor was the learning environments of a classroom and a digital kitchen, whereas the dependent variable was learners' vocabulary learning. To explore how the two different learning environments led to varying levels of students' learning, a series of ANOVA (Analysis of Covariance) were conducted. This section relates to answering the first research question.

5.2.1.1 Classroom VS Digital Kitchen Environment

The figure 44 below shows the overall vocabulary gains over time between the KDK and the classroom. The KDK saw higher scores at a statistically significant level in all post-tests than the classroom. The pre-test scores were 0.14 in the KDK and 0.16 in a classroom, the difference between which showed no statistical significance. So both groups started out with virtually no 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 visiting Korean restaurants, for example, however, this has no effect on the pre-test score.

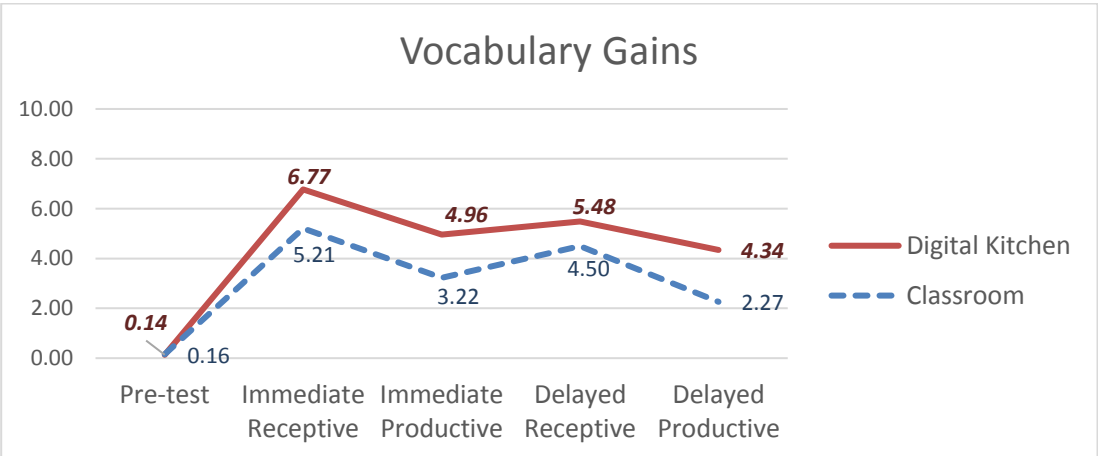

Figure 44 The flow of Overall Vocabulary Gains in all tests

Thus, the gains in score were higher in the KDK than in a classroom for both the post-test and delayed-post-test, and in both receptive and productive areas. Now, if the overall mean differences in gains were statistically significant in all cases, it can 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 more detailed analysis of the figure above, 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 below. Preliminary checks for all results were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes and reliable measurement of the covariate.

Table 7 ANCOVA 1 (Receptive Post-test scores)

	Descriptive Statistics					
	M	SD	N	F	*p*	η^2
Digital Kitchen	6.77	2.44	48			
Classroom	5.21	2.10	48			
Tests of Between-Subjects Effects						
Pre-test				3.07	.08	.03
Location				11.87	.00	.11

A one-way between-groups analysis of covariance was conducted to compare the effectiveness of two different interventions designed to see learners' gain on vocabulary scores (Table 7). The independent variable was the location, and the dependent variable consisted of immediate scores on vocabulary learning administered after the intervention was completed. Students' scores on the pre-test administration was used as the covariate in this analysis.

After adjusting for pre-test scores, the KDK (*M*=6.77, *SD*=2.44) saw higher vocabulary scores than that of a classroom (*M*=5.21, *SD*=2.10), and there is a significant difference between the two intervention groups on receptive post-test scores on vocabulary learning, F (1, 93) = 11.86, p = .00, partial eta squared = .11. There was a weak relationship between the pre-test and post-test scores on vocabulary learning, as indicated by a partial eta squared value of .03.

Table 8 ANCOVA 2 (Receptive Delayed post-test scores)

	Descriptive Statistics					
	M	SD	N	F	*p*	η^2
Digital Kitchen	5.48	2.35	48			
Classroom	4.50	2.20	48			
Tests of Between-Subjects Effects						
Pre-test				5.63	.83	.05
Location				4.94	.02	.05

With regard to examining the impact of the intervention on students' scores on productive vocabulary learning in two different learning settings as in Table 8, the results also show a statistically significant difference in receptive delayed vocabulary scores between a digital kitchen (*M*=5.48, *SD*=2.35) and a 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-test and delayed post-test scores on vocabulary learning, as indicated by a partial eta squared value of .05.

Table 9 ANCOVA 3 (Productive Post-test scores)

	Descriptive Statistics					
	M	SD	N	F	*p*	η^2
Digital Kitchen	4.97	1.86	48			
Classroom	3.21	1.74	48			
Tests of Between-Subjects Effects						
Pre-test				8.03	.00	.08
Location				25.29	.00	.21

A one-way ANCOVA was run to explore how influential distinctive situations were on learners' scores on both productive post-test vocabulary learning (Table 9 above) and productive delayed post-test learning in two different learning environments. Receptive post-tests in a digital kitchen registered higher vocabulary scores (*M* = 4.97, *SD* = 1.86) than a classroom (*M* = 3.21, *SD* = 1.74). The scores were statistically significant $p < .00$, *F* (1, 93) = 25.29, *p* = .00, partial eta squared = .21. Even though the pre-test score is significant, the eta squared statistic (.08) displayed a negligible effect size.

Productive delayed post-test (Table 10 below) has shown a similar orientation, but its score difference between two settings is statistically significant $p < .00$. Learners' vocabulary scores from a digital kitchen (M=4.36, SD=1.90) is higher than that of a classroom (M=2.26, SD=1.70), F (1, 93) = 37.32. The eta squared statistic (.29) demonstrated a medium effect size.

Table 10 ANCOVA 4 (Productive Delayed post-test scores)

	Descriptive Statistics					
	M	SD	N	F	*p*	η^2
Digital Kitchen	4.36	1.89	48			
Classroom	2.26	1.70	48			
Tests of Between-Subjects Effects						
Pre-test				11.56	.00	.11
Location				37.32	.00	.29

The data of test results combined clearly indicates that the receptive score is higher than the productive one. A reasonable explanation is that learners have more to do when using a word. That is, they needed to not only know the meaning, but the pronunciation or spelling. Indeed, 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 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 Kitchen (EDK), which showed the 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 own strategies to encounter vocabulary items repeatedly by seeing, looking at, and looking up the target words, hence promoting their learning. However, learners in the KDK were not in the same condition. They rarely had an opportunity to be exposed to Korean in Newcastle as few Korean people live there, unless they intentionally looked it up in the dictionary and the internet.

Thus, word acquisition is not a once-in-a-while thing (Nagy and Anderson, 1984). In order for the information to be stored in long term memory and to be retained and recalled later, newly learned words should be repeated in different exercises (Chastain, 1971). Furthermore, there is so much to know about each word that one meeting with it is not sufficient to gain knowledge (Nation, 2001). After the cooking session, learners were advised not to refer to anything relevant to what they had learned until they came back in two weeks, so as to avoid another factor compromising the results of the test.

5.2.1.2Summary of Test Findings

Thus, based on the whole scores of 48 participants in each setting, the ANCOVA showed a series of differences on vocabulary learning in two different environments - the KDK registered higher scores than a classroom not just in immediate- and delayed-post-tests, but also in receptive and productive knowledge. Overall, the score differences all turned out to be statistically significant and provided evidence that learners were able to learn vocabulary items better in a digital kitchen than in a classroom for both the post-test and delayed-post-test and in both receptive and productive areas.

5.2.2 Questionnaires

This section relates to answering the second research question. A total of 48 questionnaires were given to participants in Newcastle to seek their attitudes towards learning in two different learning environments: a classroom and a 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). So, the t-test was used to compare attitudes for two groups. To analyse the figures within a data set, several measures were used, such as mean (*M*), mean difference (*MD*), standard deviation (*SD*), t-test (*t*), and probability (*p*): *p* value < .005 indicates a significant difference (Cohen, 1988).

5.2.2.1 Preferences and Attitudes toward Two settings

All items in the questionnaire were assigned a numerical value and rated on a 5 point scale according to Fowler (2008): Strongly Agree (SA = 1), Agree (A = 2), Neutral (N = 3), Disagree (D = 4), Strongly Disagree (SD = 5). So, the lower the means are, the more strongly participants agree with each statement in the questionnaires and *vice versa*. That is, the mean scores close to 1 indicate strong agreement. The number

was given to four decimal places in SPSS and Excel spreadsheets and they were all rounded to two significant figures.

The first two questions were related to their preference over learning setting. Table 11 below shows results of students' preference over learning environment.

Table 11 Preferences toward two learning settings

		Mean	N	Std.D	t	*p*
Q1	I liked to learn a foreign language and culture in the classroom (Class)	2.27	48	.92		
Q2	I liked to learn a foreign language and culture in a kitchen environment (DK)	1.29	48	.58		
Q1-Q2	Class – DK	0.98		1.06	6.40	.00

A paired samples t-test was conducted to evaluate the impact of the intervention on students' scores on students' preference toward the two different environments of a classroom and a digital kitchen. There was a statistically significant decrease in 'preference' scores from Q1 (M = 2.27, SD = .92) to Q2 (M = 1.29, SD = .58). The statistics of learners' responses show that the mean score of respondents from a kitchen (M = 1.29) is closer to 1, which indicates strong agreement with the statement, and the mean difference (MD = 0.98) is statistically significant t (47) = 6.40, p < .00 (two-tailed). Therefore, the digital kitchen is preferred to a classroom in terms of learning a foreign language and culture. What was conducted to further explore if learning modes makes a difference in their learning preference was the next table 12 below.

Table 12 Paired-sampled T-test on Learning Modes

		Mean	N	Std.D	t	*p*
Q3	Using photos of real objects in the classroom contributed to my learning (Photos)	1.56	48	.68		
Q4	Using real objects in digital kitchen contributed to my learning (Real objects)	1.29	48	.50		
Q3-Q4	Photos – Real Objects	0.27		.84	2.22	.03

This also shows a statistically significant decrease in scores from Q3 (M = 1.56, SD = .68) to Q4 (M = 1.29, SD = .50). Their specific answers to the third and fourth questions demonstrate that kitchen users (M = 1.29) have mean scores closer to 1 (Strong Agreement) than classroom learners (M = 1.56) do. The mean difference (MD = 0.27) reaches statistical significance t (47) = 2.22, p < .03 (two-tailed). This reveals that

being able to use real objects to cook the dish in a kitchen helped them learn more effectively than just using photos in a classroom. This reveals how learners perceive their experiences in two settings - being able to use real objects to cook the dish helps them to learn more effectively than just using photos in a classroom. That is, they found learning in a digital kitchen more enjoyable and interesting than in a classroom. This might contribute to significantly higher level of learning in a kitchen.

Thus, students found the digital kitchen and physical objects more useful and helpful to learn vocabulary items and cultural aspects. This indicates that students are familiar with visual aids in learning (Paivio and Desrochers, 1981), but they want one more dimension to enhance learning: touch (Nattinger, 1988) .

All this information is shown in a different way in Figure 45 below with the combined figures of two scales represented: the aggregate of Strongly Agree and Agree (SA/A) and the other aggregate of Disagree and Strongly Disagree (D/SD).

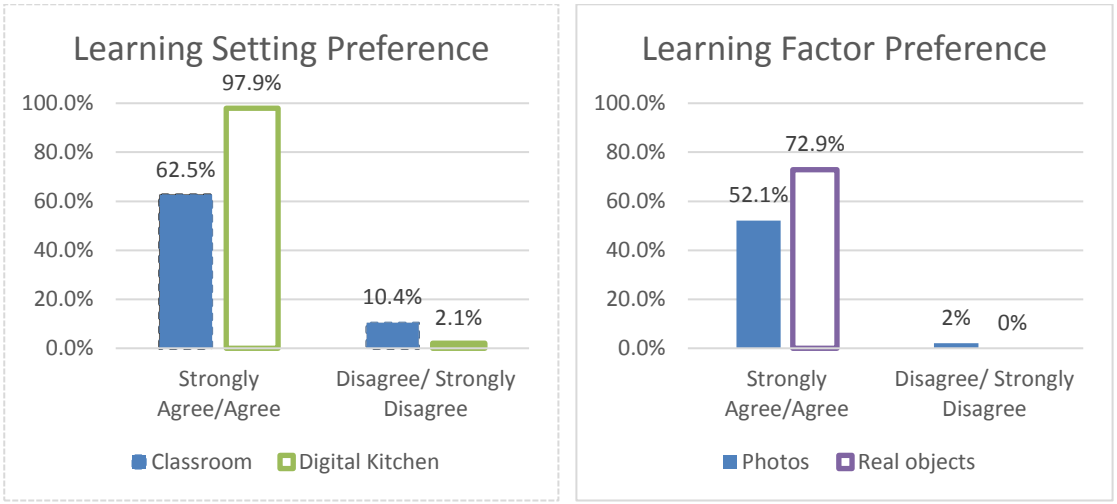

Figure 45 Comparison between Classroom and Digital Kitchen

It is noticeable that students acquired linguistic and cultural knowledge in both environments, but showed different percentages in their preference over a learning environment and a learning mode: with a kitchen (97.9%) and a classroom (62.5%), with real objects (72.9%) and photos (52.1%). It is clear that learners preferred the kitchen setting over the classroom in terms of learning.

The other two questions were designed to measure how learners find two settings in terms of affective state and motivation and its statistical results are shown below. The questions were as follows: *Q 5. Describe how you are feeling now, especially in relation to the learning tasks you've done in the digital kitchen. I was feeling:* and *Q 6. Describe how you are feeling now, especially in relation to the*

learning tasks you've done in the classroom. I was feeling:. Participants were shown 10 options of affective states or emotions: happy, confident, unafraid, friendly, interested, energetic, outgoing, motivated to learn language and culture, motivated to know the Korean culture, and motivated to eat food as shown in Table 13. The learning process depends on a series of factors, one of which is affective factors that are crucially important in explaining individual differences in learning outcomes (Ellis, 1994; Henter, 2014) and are involved in the motivation of behaviour (Arnold, 2000).

Table 13 How learners feel in two settings

		Mean	N	Std.D	t	*p*
Happy	Class	4.06	48	.86		
	DK	1.33	48	.48		
	C - DK	2.73			18.06	.00
Confident	Class	3.60	48	1.12		
	DK	2.15	48	.92		
	C - DK	1.46			5.10	.00
Unafraid	Class	3.77	48	.90		
	DK	1.70	48	.77		
	C - DK	2.06			9.39	.00
Friendly	Class	4.06	48	.63		
	DK	1.44	48	.62		
	C - DK	2.63			16.48	.00
Interested	Class	3.92	48	.90		
	DK	1.21	48	.46		
	C - DK	2.71			17.20	.00
Energetic	Class	3.85	48	.85		
	DK	1.54	48	.62		
	C - DK	2.31			13.49	.00
Outgoing	Class	3.81	48	.73		
	DK	1.77	48	.78		
	C - DK	2.04			11.13	.00
Motivated to know the Korean language	Class	3.87	48	.89		
	DK	1.56	48	.68		
	C - DK	2.31			12.26	.00
Motivated to know the Korean culture	Class	4.00	48	.95		
	DK	1.42	48	.71		
	C - DK	2.58			13.10	.00
Motivated to eat food	Class	4.33	48	.97		
	DK	1.23	48	.47		
	C - DK	3.10			18.65	.00

A series of paired samples t-tests were administered to assess the impact of the intervention on students' attitudes. The analysis of every value of affective state shows that digital kitchen learners agree with the statement as mean scores are close to 1. The

mean score on the option of 'Happy' in the classroom, for example, was 4.06, whereas it was 1.33 in a digital kitchen. The mean difference was 2.27, reaching a statistical significance ($p < .00$). Distinctively, all of the mean differences have seen statistical significance between a classroom and a digital kitchen. In terms of affective states, most students found the digital kitchen to be enjoyable and satisfying. The majority of students showed positive feelings and high level of motivation.

As is the same in Figure 45 above, learners' affective state are in a bar chart of Figure 46 below with the combined figures of two scales represented: the aggregate of Strongly Agree and Agree (SA/A) on a left bar and the other aggregate of Disagree and Strongly Disagree (D/SD) on a right bar. More than 70% of students agreed with positive feelings. However, some of them still felt more confident (15%), interested (10%) and motivated to learn language (10%) and culture (13%) in the classroom, explaining in an interview that it was because they were used learning in the classroom. This was reasonable. Nevertheless, it was apparent that the majority of learners tended toward the digital kitchen when it comes to positive emotions in addition to enhanced motivation to learn language, culture and food (more than 80%).

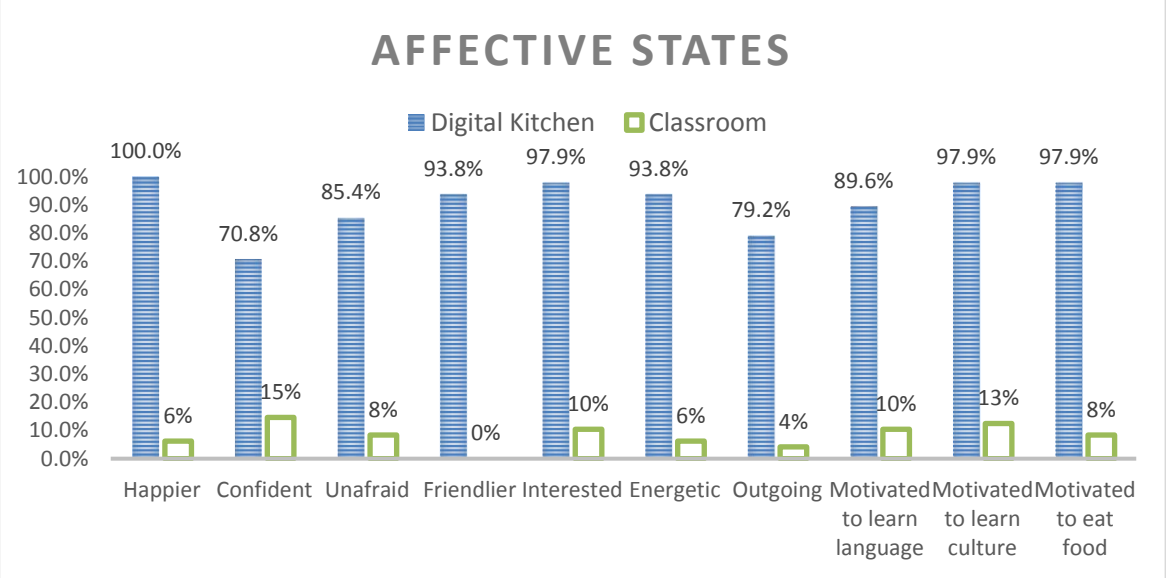

Figure 46 Learners' Attitudes toward two settings

To summarise, learners displayed stark contrast in terms of learning environment, learning mode and affective factors when learning foreign language and culture. They preferred a digital kitchen and real objects to the classroom and photos. Learners' feelings and motivation were overwhelmingly in favour of a real-world environment and students preferred the digital kitchen environment over a classroom, and manipulating real objects over using photo as learning aids. Being able to touch and

manipulate physical objects as part of a meaningful task in a digital kitchen helped students learn vocabulary and culture more effectively than merely being able to see them in photographic format in a classroom. It can therefore be claimed then that learners had a higher motivational level for the digital kitchen environment than in the traditional classroom.

There is one additional thing to be considered in terms of triangulation of data. The results of questionnaire analysis display participants' learning attitudes toward two settings, rather than showing direct learning outcomes from the two different settings. However, since these affective factors contribute to the extent of language learning (Krashen, 1982), it can be said that the results represent learning output students made in a sense. Moreover, since the outcomes of vocabulary learning were clearly demonstrated through test scores, and language learning directly related to culture learning, the questionnaire data can be used as one of quantitative data. Therefore, this study will use the data analysis as part of learning outcomes which form triangulation that supports the arguments being made, in particular for the third research question related to culture learning.

5.2.2.2 Summary of Questionnaires

As clearly illustrated in the questionnaire, learners preferred the KDK and real objects to the classroom and photos for learning foreign language and culture. This was supported further by learners' affective factors. Being able to touch physical objects themselves played a role in increasing their motivation and enjoyment, hence made a difference in their attitudes towards the two separate settings.

5.2.3 Summary of Quantitative Data

The results clearly showed that the KDK environment was more effective in promoting incidental vocabulary learning than a classroom setting. Learners were able to learn Korean vocabulary items at a significantly higher level in the KDK than in the classroom for both reception and production, for both spoken and written media, and in both the post-test and delayed-post-test. In terms of long-term gains, we should note that long-term memory scores are higher in the KDK than the classroom in both delayed receptive and delayed productive tests. Furthermore, learners' manners, disposition, and feelings were overwhelmingly skewed toward a technology-embedded environment, and students preferred the KDK environment over a classroom, and manipulating physical objects over using photo as learning aids. Being able to touch and manipulate physical objects as part of a meaningful task in the KDK helped students learn

vocabulary and culture more effectively than merely being able to see them in photographic format in a classroom.

5.3 Qualitative Data Analysis

Having established that users learn the Korean vocabulary items more effectively in the KDK environment than in the classroom environment, this section shifts the focus to understanding the processes of learning by analysing what exactly happens in the two environments which might account for this difference. Overall, how different students' learning processes are in two settings is explained, and quantitative data are used for triangulation where necessary.

5.3.1 Observation

This section illustrates observation of cooking sessions carried out in the two settings. Moment-to-moment interactions in two different environments are shown to reveal learning processes and interactional features, and compared in combination with numerical data for triangulation purposes. The set of data shows two areas of learning: vocabulary and culture acquisition, helping to address the first and third research questions. For readers' information, the Korean used in the session is transcribed in both Korean and Roman scripts and translated into English, as in Table 14 below. It is followed by CA conventions as well.

Table 14 Korean Scripts

Korean in Korean script	Korean in Roman script	English translation
숟가락	*Sutkarak*	a spoon
숟가락으로 잘 섞어 주세요	*sutkarakeuro jal sseokeo juseyo*	mix them properly with a spoon
젓가락	*Jeotkarak*	chopsticks
밥	*Bap*	rice
칼	*Kal*	a knife
칼로 썰어주세요	*kalo sseoreojuseyo*	cut the food by using the knife
뒤집개	*Duijipkae*	a turner
물	*Mul*	water
도마	*Doma*	a chopping board
김치	*Kimchi*	pickled cabbage
나머지 모두 만들어서 접시에 담으세요	*Nameoji modu mandeuleoseo jeopsie dameuseyo*	put the rest of the mixture onto the plate
접시	*Jeopsi*	a plate
유부초밥	*Yubuchobap*	rice covered with fried tofu

CA Conventions	
KDK & alphabet initial	Each interactant's name
[	Overlapping speech
((*text*))	Annotation of non-verbal activity
text	Sounds of Korean letterings learners make
text	Text in bold to indicates a translation into English but not talk in English produced by speakers
TEXT	Capital letters to show shouted or increased volume speech.
(Numbers)	the time of a pause in speech
↗ ↘	Rising and falling tones
:	Prolongation of a sound
underline	Indicating the speaker is emphasising or stressing the speech
?	Rising pitch or intonation
☆	'Image Help' available on the computer screen
√	Sound to indicate successful performance on the step
/**?**/	Help symbol on and off on the GUI screen

5.3.1.1 Vocabulary Learning

This section portrays the processes of vocabulary learning by comparing features occurring in two separate settings: first the KDK and then the classroom. The section combines CA transcripts with vocabulary scores to support the argument.

5.3.1.1.1 Learning Process I

5.3.1.1.1.1 KDK

This episode is from a digital kitchen in which two learners in the pre-task are collecting each item to cook *yubuchobap* according to instructions. Since learners were not taught the words, they were supposed to guess what the 10 items were. One word the participants were trying to understand was a spoon, *sutkarak*. Participants are trying to figure out the form and meaning of the vocabulary item not just according to the vocabulary learning process (noticing, retrieval and creative use), but also through mutual collaboration and negotiation, and interaction with the KDK.

Extract 1

1	KDK	*sutkarak*= spoon
2	V	=*sutka*
3	KDK	*sutkarak* **spoon**
4	V	oh ah:::: (5.0) ((*showing that she is thinking which one is right*))
5	J	ah↑ ((gaze and *considering which one to pick up by gesturing*))
6	V	ah let's see three letters of

7	J	hmm ((*looking at his partner and computer to find out the correct item*)) this is↑= ((*pointing at a certain item*))
8	V	=no no, it's [a long] ((*finger-pointing at another one*))
9	KDK	[☆]
10	V	look at the ((*pressing the button on the display*))
11		It's got more letters in the
12	KDK	*sutkarak sutkarak* ((*the image of a spoon slowly fading in on the screen*)) **spoon**
13	V	*sutga*. oh [spoon] ((*nodding and showing that she finally understands the meaning*))
14	KDK	[*sutkarak*] *sutkarak* = **spoon**
15	J	hm ((*nodding like he surely understood it*)) this long was a spoon. ((*picking up a spoon and placing it on the desk*))
16	KDK	√

The interaction starts with an audio prompt from the KDK, which ask learners to collect a spoon. In line 2, V tries to work it out by imitating the sound from the computer, followed by the second ready-made repetition of sound. J is about to pick up a certain item, but his rising tone and gazing at GUI obviously shows his uncertainty in line 5. The duo tries to figure it out both by themselves and by negotiating each other in lines 3 to 6. This is where two users notice the need for the vocabulary. The computer offers a timely prompt in line 7 and they negotiate which one is the correct one. With no agreement made and a timely prompt by the computer, they employ a search strategy by requesting help in lines 8 to 10. This way, V and J work out the form and meaning of the word (lines 12 to 15). In particular, considering his prosodic feature in line 15, J seems to link the knowledge to his memory by holding the spoon as in Figure 47. His head movement and physically using the available object display his understanding.

Figure 47 *Sutkarak* Line (15)

After this excerpt, the duo proceeds to the during-task phase and begin to retrieve and creatively use the previously-learnt word by manipulating equipment according to the instruction. Subsequently, the following conversation takes place.

Extract 2

1	KDK	숟가락으로 [잘 섞어 주세요]. *sutkarakeuro jal sseokeo juseyo* **mix them properly with a spoon**
2	V	[this must be *su* (1.0) *karak]* **spoon** (grabbing the correct item))
3	J	ah *sukarak*. **spoon**
4	V	we want *jeotkarak*. **chopsticks**
5	J	hahaha
6	V	yeah, because this is *jeotkarak*, isn't it? **chopsticks**
7	J	((*looking at the computer*)) yeah
8	V	This is *jeotkarak* ((*pointing at the correct item*)) **chopsticks**
9		((*manipulating the item and mixing the ingredients with a spoon*))
10		This is what? ((*indicating what she is using and looking at the tablet*))
11		((*referring to the computer*)) *sut*.
12	J	*sutkarak*.= **spoon**
13	V	=*sutkarak*. *sutka::rak*. (6.0) **spoon**
14		((*keeping mixing the ingredient with the spoon*))
15		I'm mixing, using *sutkarak*. **spoon**
16	J	yep.
17	V	I am mixing *bap*. **rice**

This excerpt begins with the computer instruction. Right after the sound of the target vocabulary item is heard, V repeats the phonetic form of the word and tries to confirm her understanding by holding up the right item, which consequently helps her partner practise the word (lines 1-3). However, V seems busy remembering other words such as *jeotkarak* (chopsticks), which might cause her to forget the word knowledge in lines 4 to 9. She seems to be preoccupied with the word probably because the second and third syllables of two words *sutkarak* and *jeotkarak* are the same in form, but different in meaning. So, she requests help to retrieve the word again in two ways, one to the computer and the other to her partner. Turning to the computer, she attempts to work out the phonetic form by producing 'sut' in lines 10 to 11. Having already read the written source given by the computer, J finally gets the form, and models the full sound to scaffold her understanding, which serves as a useful explanation to V (line 12). That is how V repeats the sound and when she figures out the form in full in line 13. Interestingly enough, when the second practice comes out, she shows a slight prolongation of the sound, and long pause of 6 seconds. Given that V grabs the spoon during that pause, she looks like she is 'reaffirming' the word while she uses the real spoon in her hand in line 14. That is, she takes advantage of 'physicality' to link her linguistic knowledge to memorisation, thus resulting in her deeper level of learning. Not just the pause but also linguistic repetitions of the target word clearly show that she is in the process of understanding. As a result of her learning, she now gets to the point

where she generates the word in her own context in relation to another word, *bap* rice, in Figure 48 (lines 15 to 17). Two users' mutual orientation to the computer system and each other functions as a resource which can help address the interactional difficulties.

Figure 48 Grabbing & Manipulating a spoon (Lines 15 to17)

Thus, it is evident that through the tasks learners try to remember a word by noticing, retrieval and creative use in relation to task-induced involvement as well as by collaboration and negotiation. It was also interesting how she creatively uses the target word – she produces an unprompted commentary on her action, and integrates the L2 word into the L1 commentary. This occurs when physical senses are followed.

5.3.1.1.1.2 Classroom

In the classroom interaction, on the other hand, interactional features seen in the digital kitchen, such as joint efforts and transaction, are rarely spotted. The Extract 3 below is from where two participants attempt to understand the same word *sutkarak* in the classroom.

Extract 3

1	Computer	*sutkarak*= spoon
2	J	=*sutkarak*↑ **spoon** *((struggling to guess what it is))*
3	Computer	*sutkarak* **spoon**
4	A	[picture please] ((*gazing at teacher*))
5	Teacher	[guess anything you want?]
6	J	for picture please.
7	Teacher	picture.
8	Computer	*sutkarak sutkarak* **spoon**
9	J	[*sutkarak*] **spoon**
10	A	[*sutkarak*] **spoon**
11	J	*sutkarak*. **spoon** ((*collecting the right item and putting it on the desk and looking at something else*))

The teacher's playing an audio clip allows J to practice the phonetic form of the word (line 2). Her prosody and body movements however indicate in line 3 she has no idea and needs help. So, A requests image help, and the teacher asks them to give it a try at the same time in line 4 to 5. That is, the duo's lack of knowledge for the target word in this pre-task evokes the learners' need to *notice* the word. So, J requests help, which makes the teacher provide the relevant source in which the image fades in along with audio sound of the word. This is how the duo understands the vocabulary item in its form and meaning (lines 6 to 10). The task helps them figure out the linguistic form. They appear to pick up the items using the photos (Fig. 49). Given their static movements, what they do with photos is only moving the item and watching, with their arms on the desk. Once they move it, they do not even give it second glance. No more dimensions are observed. Simply using photos does appear to motivate them less and provide less connection for their memorisation.

Figure 49 Picking up *sutkarak* in Classroom

In the same way as in the digital kitchen, the duo proceeds to the during-task phase in the classroom, and begin to retrieve and use the relevant word according to the instructions. However, the moment of generative use where previously met words are used in a different way is not spotted in this stage as in Extract 4.

Extract 4

1	Computer	숟가락으로 잘 섞어 주세요. *sutkarakeuro jal sseokeo juseyo* **mix them properly with a spoon**
2	J	*sutkarak*?= **spoon**
3	A	=*sutkarak*. **Spoon**
4		pic picture please?=
5	J	=[photo.]
6	Teacher	[picture?]
7	J	use use the spoon ((*picking up the photo of the correct item and folding the picture*))

8	Computer	숟가락으로 [잘 섞어 주세요]. *sutkarakeuro jal sseokeo juseyo* **mix them properly with a spoon**
9	J	[to mix them.]
10		yes.
11	A	hmm. *((sounding like he understood it))*
12	Teacher	you can use your hands. Maybe doing something? *((offering the relevant photo card))*
13	A	Aha
14	J	hmm *((just placing the card on the desk))*

They focus on the teacher, rather than mutual discussion and negotiation, to figure out the task, particularly with regards to image help (lines 1 to 6). Even before the sound comes out, J tries to *retrieve* the target word by looking at the computer image. Her folding the paper in line 7 suggests she desires to manipulate an actual spoon (Fig. 50) but she can't use it. The teacher encourages them to use their hands to do what is required according to the instruction, but they just leave the card on the desk and simply observe it. It looks like they are under pressure in front of an authoritative person and feel awkward interacting with no proper materials. Not even a moment of creative use of the word is ever shown throughout this step.

Figure 50 Simple observing with photos of objects

Thus, classroom interaction demonstrates a different environment in terms of interactional features. To figure out the word, the interactants only turn to image help, rather than negotiating and sharing their knowledge about the word. Students notice the need to understand the target vocabulary, but do not show any sign of creative use. While commentary on their own action was seen (e.g., line 15 of Extract 2) in the KDK, there was no sign of it in the classroom. Furthermore, students are encouraged by a teacher to mutually resolve the problem, rather than autonomously deal with it. The presence of a teacher in front of them keeps them from mutual interaction. This is probably why they do not show as cheerful a mood as in the digital kitchen. These differences seem to result in less engagement in learning in the classroom. This is evidenced by the vocabulary gain of the word from test results: according to the

vocabulary scores in their excel file, the two pairs in the two different locations show remarkably different results in Table 15. Digital kitchen users scored significantly higher than the other pairs in the classroom.

Table 15 Vocabulary Item results (*sutkarak*, spoon) for the 4 participants

	Digital Kitchen		Classroom	
	Ja	V	Ju	A
Pre-test	0	0	0	0
Immediate Receptive test	1	1	0	0
Immediate Productive test	1	1	1	0
Delayed Receptive test	0	1	0	0
Delayed Productive test	0.75	0.75	0	0

5.3.1.1.2 Learning Process II

5.3.1.1.2.1 KDK

The interaction sequences below come from the period between the during- and post-task phases when the pairs are about to complete the dish and learn more about the cultural aspects of *kimchi*, pickled cabbages. When one learner shows a clear sign of wanting to further revise each item, the KDK offers image help, triggering interactional domino effects, which help learners obtain the knowledge throughout the task. In particular, manipulating physical objects is seen as an aid in making connections to their memory (Nattinger, 1988).

Extract 5

1	KDK	/?/
2	S	can I play this again? because I want to know the. ((*pressing the button for the repetition help*))
3	M	*kal.* **a knife** ((*holding the knife up high*))
4	S	*kal.* **a knife**
5	KDK	칼로 썰어주세요. *kalo sseoreojuseyo* **cut the food by using the knife**
6	S	칼로.↗ *kalo* **using the knife** (4.0)
7		So 집개 *jipkae.* ((*looking at M and asking for his confirmation*))
8	M	(1.0) 뒤집 뒤집개 *duijip duijipkae.* **a turner** ((*pointing it out*))
9	S	뒤집개 *duijipkae.* ((*pointing it out together*)) **a turner**
10		물 *mul.* **Water**
11	M	물 *mul.* **water**
12	S	도마 *doma.* **a chopping board**

13	M	도마 *doma*. **a chopping board**
14	S	(1.0) ((*pointing out kimchi*))
15	M	김치 KIMCHI ((*pointing out kimchi*))
16	S	김치 *kimchi* and (2.0) 밀가루 *milkaru*. **flour** ((*pointing out another item*))
17	M	밀가루 *milkaru*, yeah. I got *milkaru*. **Flour**
18	S	(1.0) ((*controlling GUI to move onto the next stage*))
19	KDK	√

In line 1, the computer offers a timely prompt showing HELP 1 is available on the GUI, and in line 2, S presses the HELP 1 button for a repetition, consulting her partner at the same time. In the time between S asking for help and the system providing it in line 5, M decides to help S in understanding the vocabulary item she is looking for and assumes the 'teacher' role. In line 3 he produces the Korean word 'kal' and simultaneously holds up the knife (see Figure 51). In line 4, S displays uptake by repeating the target item. Nattinger (1988) argues that physical actions can be seen as an aid in making connections in the memory, and here we see evidence of learners in the KDK environment developing their own multimodal speech exchange system in which they employ physical objects as aids to vocabulary learning and, in effect, peer teaching. It is important to stress that the users themselves have developed this speech exchange system on their own initiative, using the environmental supports of their choice. In lines 7-17 the vocabulary revision sequence continues.

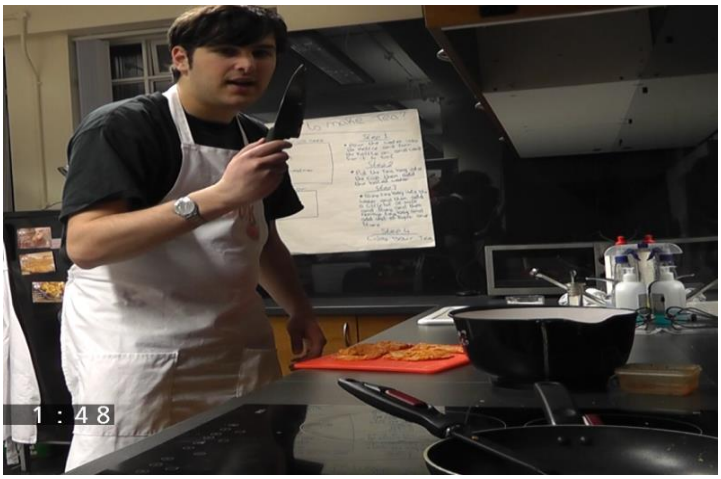

Figure 51 Associating an object with word in Line 3 (Holding up the knife)

S turns to M to confirm the target word in line 7 by first producing the wrong sound *jipkae*. In line 8, M pauses and then produces the correct form after some initial hesitation. In line 9, S displays uptake, repeating the form *duijipkae* correctly as well as confirming the meaning by pointing at the right object. The same basic revision/learning sequence is repeated with two more words (*mul* and *doma)*, with both partners correctly

revising meaning and form. In lines 16 to 17, S appears to remember *milkaru* before M, suggesting that the roles have reversed and that S helped M remember the word. The particular speech moves which occur in this speech exchange system include requests, identification, elicitation, repetition, information transfer, and confirmation. The type of multimodal learning move unique to the KDK (illustrated in the photo of line 3) involves M holding a knife up high to identify the item to his partner. It demonstrates that he could associate the real object with the word, displaying his learning. In the KDK, they feel in charge of their learning and the organization of the interaction, and show autonomy. However, this type of move was not available in the classroom as learners could only hold up photos rather than physical objects. The speech exchange system which learners have developed involves them using each other as resources for vocabulary learning and revision, using the KDK system where necessary for input, and using the physical touch of objects as learning and teaching support.

5.3.1.1.2.2 Classroom

The sequence depicted in Extract 6 is from during-task interaction where both interactants are trying to figure out the same word *kal* (knife) in the classroom. They were finally able to complete the step, but had some difficulty with their learning in this classroom setting. Note that the teacher is providing exactly the same help prompt (lines 1 and 13) as the digital system in Extract 6.

Extract 6 Lack of Association

Lines 1 to 19		
1	T	칼로 썰어주세요. *kalo sseoreo juseyo* **cut the food by using the knife**
2	H	(1.5) ((*thinking*))
3	E	칼로 *kalo.*↗ ((*thinking*))
4	H	knife.↗((*pointing at a correct photo*))
5	E	(1.0) ((*about to pick it up but looking like she is not certain*))
6		도마 *doma.*
7	H	도마 *doma?*
8	E	I think. ((*moving her head left and right and indicating she is not sure*))
9		(2.0) ah I'll ask for image help. ((*looking at a teacher*))
10	T	ok.((*providing the image help*))
11	E	what is *kal*? **a knife**
12	H	it was knife. ((*pointing at a photo of the item*))
13	T	칼로 썰어주세요. *kalo sseoreo juseyo* **cut the food by using the knife**
14	E	oh hm. ((nodding))
15	T	ok.

The teacher's prompt in line 1 gives the learners the instruction. E and H practice the form of the target vocabulary (*kal*), and H tries to connect the linguistic information to his memory by looking at the relevant photo in lines 3 to 5 (as in Figure 52), but their rising intonation at the end and in lines 6 to 8 clearly display uncertainty about the word. It is not until the image help is provided (lines 9 to 10) that the two learners are clear about the word in line 12 and 14. However, their link to the word is provided only by the image on the desk. Their only learning support was a photo, rather than an object. This is in stark contrast with the way the task is carried out in the KDK, where participants could make rich associations with their memory by holding and manipulating the object as part of a meaningful task.

Figure 52 Vocabulary Item Results (*kal*, knife)

Table 16 Vocabulary Gains in KDK and Classroom

	Digital Kitchen		Classroom	
	S	M	H	E
Pre-test	0	0	0	0
Immediate Receptive test	1	1	0	1
Immediate Productive test	1	1	0	0
Delayed Receptive test	1	1	0	0
Delayed Productive test	1	1	0	0

The above Table 16 compares vocabulary gains for the item *kal* (knife) as acquired by the participants in Extract 5 and demonstrates that the KDK pair learnt the same word more effectively than the classroom pair. Now, a different perspective for learning is taken in the next section.

5.3.1.1.3 Learning Process III

The two episodes given below are excerpts from each of the two environments in which two learners are in the during-task phase for cooking *yubuchobap*. In the previous pre-task phase, they acquired receptive knowledge of *jeopsi*, the Korean word

for plate. They are now trying to remember and use this word productively. Students display their learning using several strategies - repetition and repair, Human-Computer interaction, mutual collaboration and negotiation, and information transfer. In particular, the number of repetitions during this step is notably different between two settings.

5.3.1.1.3.1 KDK

The first episode (Extract 7) is from the digital kitchen and split into four consecutive sections. This shows learners' gradual learning. Lines 1 to 6 demonstrate that the duo is attempting to make sense of the meaning of the target word *jeopsi* by pointing at it and trying to produce the verbal sound. Following the computer instruction, C asks for V's clarification of the phonological sound by silently making the form and pointing it out in lines 1 to 2 (left in Fig. 53). V agrees with her idea by repeating the sound, however, both learners are not quite sure, as is evident in their rising tones in lines 3-4 as in Extract 7. Since the word *jeopsi* has one more syllable *e* in a sentence, they appear to get confused. Nevertheless, V wants to ignore her uncertainty and move on (line 5). Regardless of V's indication, C wants to explore the linguistic knowledge by turning to the computer to play it again in line 6 (right image in Fig. 53).

Extract 7

1	KDK	나머지 모두 만들어서 접시에 [담으세요.] *nameoji modu mandeuleoseo jeopsie dameuseyo* **put the rest of the mixture onto the plate**
2	C	[((*making the form of the sound by mouth and asking V for confirmation by pointing at the plate*))]
3	V	((*smiling and nodding*)) *jeopsie*↗ **plate**
4	C	((*pointing it again*)) *jeopsie*↗ **plate**
5	V	so, let's eat.
6	C	say that again. ((*pressing the button to play it again*))

Figure 53 Meaning-checking by the object and GUI

C's ongoing repetitions (line 2, 4) following the computer help indicates that she still does not understand. Willing to help C, V shares what she thinks the answer is.

However, V gets the meaning wrong as is clear in line 9. She seems to think that 'jeopsi' refers to chopstick as the Korean sound of 'jeopsi' is very similar to that of English word 'chopsticks'. C tries to correct it again by repeating the sound (line 10). All of sudden, what V sees already displayed on the computer screen in relation to the step (Fig. 54) makes her realise she gave her interactional partner wrong information (line 11). This makes the duo request help again from the computer in line 12 (Fig. 55).

Extract 8

7	KDK	나머지 모두 만들어서 접시에 담으세요. *nameoji modu mandeuleoseo jeopsie dameuseyo* **put the rest of the mixture onto the plate**
8	C	*jeopsie*↗= **plate**
9	V	=use chopstick to eat it. ((*pointing at chopsticks*))
10	C	I guess so. *jeopsie*↗. **Plate** (Fig. 53)
11	V	ah picture.((*looking at a tablet*))
12	C	((pressing the play button))

Figure 54 Image Help on the Interface (Line 11)

Figure 55 Meaning-checking by pressing the help button

Having received the audio-visual help, both learners consolidate their knowledge of the word form further through repetition in lines 15 to 17. Interestingly, not just *jeopsi* but other target words such as *yubu* and *bap* in the image aids are practised and

verbalised for learners to examine their linguistic knowledge in lines 18 to 22 (Fig. 56). Nation (2001) argues that decontextualisation through negotiation affects memory, and here we see evidence of learners in the KDK environment developing their own learning space in which they can have access to reading, listening, explaining and negotiating.

In the meantime, the duo's repetition helps them figure out and agree to ask for help as they almost understand the word in lines 23 to 28 in Extract 9.

Extract 9

13	KDK	[나머지 모두 만들어서 접시에 담으세요.] *nameoji modu mandeuleoseo jeopsie dameuseyo* **put the rest of the mixture onto the plate**
14	V	ahaha
15	C	oh my god haha ((*having a close look at the image*))
16		yeah yeah yeah[*jeopsi.*] **plate**
17	V	[*jeopsi.*] **plate**
18	C	*yubu*::[*chobap.*] **rice covered with fried tofu**
19	V	[*yubu.*] **fried tofu**
20		*yubuchobap.* ah the dish name **rice covered with fried tofu**
21	C	*bap.* **Rice**
22	V	*yubuchobap.* **rice covered with fried tofu**
23	C	ah *jeopsi.* **Plate**
24	V	*jeopsi.*= **plate**
25	C	=*jeopsi jeopsi* plate. **Plate**
26		*jeopsi* **plate**
27	V	*jeopsi.* I will play it again. **plate**
28	C	yeah play it again.

Figure 56 Computer as an interactional partner

While C is still unsure of the end syllable '*e*' as is clear in her prosody in line 30, V seems to pick it up a bit more by pronouncing it correctly, and finally understands the meaning and the form of the word as indicated by her movement in line 33 as in Figure 57. V's understanding now scaffolds the linguistic information, thereby helping C repair the word.

Extract 10

29	KDK	[나머지 모두 만들어서 접시에 담으세요.] *nameoji modu mandeuleoseo jeopsie dameuseyo* **put the rest of the mixture onto the plate**
30	C	*jeopsie*↗ **plate**
31	V	[*jeopsi*] **plate**
32	C	[*jeopsie*↗] **plate**
33	V	*jeopsi* is not chopsticks. [It's plate] **plate** ((clearly pointing at chopsticks and a plate in turn to confirm her understanding))
34	C	((also pointing at the one))[*jeopsi*] **plate**

Figure 57 Meaning Confirmation

This episode (Extract 10) shows what role the KDK setting as a learning environment plays and how it can contribute to learners' comprehension. The digital kitchen is turned to as a co-interactant and part of the organization of the talk-in-interaction by the learners, who initiate their trouble and helps contribute to the solution of interactional trouble. The kitchen as an interactant creates an interactional space which fostered the dialogic process among one another to the point that the form and meaning of a word *jeopi* are figured out. In particular, repetition of the target word is made 17 times. Sawyer (2006) claims that the dialogic process of scaffolding offers language learners the opportunity to internalize the language information, and Kurhila and Kotilainen (2017) highlight the significant consequences of repetition for the interaction and the learning process in a digital kitchen. Here, there is evidence of the KDK environment shaping the atmosphere where interaction, collaboration and information transfer to one another can be promoted along with a remarkable number of repetitions. This is how the trio of the kitchen and the two learners resolve the interactional difficulties.

5.3.1.1.3.2 Classroom

The interaction styles in the classroom are in contrast with the digital kitchen. The sequence (Extract 11) below is from a during-task interaction where two learners

are trying to work out the same word *jeopsi* (plate). They were able to deal with the problem properly, but had trouble with their learning in the classroom.

Extract 11

1	Computer	나머지 모두 만들어서 접시에 [담으세요.] *nameoji modu mandeuleoseo jeopsie dameuseyo* **put the rest of the mixture onto the plate**
2	M/R	[((*both speakers getting the plate wrong, R picking up the wrong photo and M pointing at the same as R*))]
	R	*dameuseyo.* **put it on**
3		*jeopsie.* ((*picking up the wrong item*)) **plate**
4		*dameuseyo.* ((*picking up the wrong item*)) **put it on**
5	M	put the rest of. ((*placing her right finger on her lips indicating it is not clear and so she is thinking*))
6	Teacher	((*providing the audio-visual help again*))
7	Computer	나머지 모두 만들어서 접시에 담으세요. *nameoji modu mandeuleoseo jeopsie dameuseyo* **put the rest of the mixture onto the plate**
8	M/R	((*concentrating on the computer screen*))
9	R	ahh:::=
10	M	=put the rest of
11		is that the *yubu* ((*picking up the photo of yubu*)) **fried tofu**
12	R	*jeopsi* **plate** ((*placing the correct photo of plate on the desk and showing no signs of manipulating it*))
13	M	yeah onto the plate
14	R	*jeopsie*↗ **onto the plate**
15	M/R	((*gesturing that they are ready to move on*))
16	Teacher	you want to move onto the next step?
17	M/R	[YES]

Figure 58 Less 'Uptake'

The sequence begins with an instruction from the audio prompt by the computer. While the duo repeat after the computer to work out the word, they seem to not understand it, as is evident in their movements in lines 1 to 5. Recognising the learners' uncertainty, the teacher offers them the relevant help again. Listening to and watching the slide on the computer screen, both speakers figure out the word. R understands the

meaning and form, as is evident in her verbal and nonverbal cues, which is how M gets to know the word. Given that M focuses on just how to perform the activity in the step in lines 10 to 11, and that the only resource for her to use is photos in line 12 as in Figure 58, she appears not to be interested in the linguistic aspects. Only when R addresses their difficulty, does M agree that R has collected the correct photo by explaining the meaning of the word in line 13. However, R still feels not so sure of the form due to the additional syllable 'e' in the sentence given on the screen (line 14). Nor do they show any desire to know more.

This sequence in the classroom demonstrates how students figure out the word. They both turned to the teacher for help and information transfer to understand the word. However, it did not look like they were sure of their learning. This interaction shows less mutual collaboration, negotiation and dialogic processes than the one in the KDK. Furthermore, the number of repetitions is considerably less (3 times) in comparison to that (17 times) of the kitchen. Repetition throughout the tasks can be viewed as 'uptake' which may contribute to acquisition (Ellis, 2003, p. 199). This can explain why classroom learners scored zero in their vocabulary test. According to the vocabulary scores in the table 17 below, the kitchen users obtained full gains in all tests, whereas the classroom pair gained no points in any test. This suggests that learning strategies, in particular repetition, impact learning.

Table 17 Vocabulary Item results (*jeopsi*)

	Digital Kitchen		Classroom	
	V	C	R	M
Pre-test	0	0	0	0
Immediate Receptive test	1	1	0	0
Immediate Productive test	1	1	0	0
Delayed Receptive test	1	1	0	0
Delayed Productive test	1	1	0	0

If we compare the speech exchange systems observed in all the extracts from both settings, there are similarities and differences. In both cases, participants use each other as learning resources. They also use the HELP facility (whether KDK or human) as a resource. Both groups work out and confirm the meaning of the object (*sutkarak, kal* and *jeopsi*), although the KDK pair does so more quickly than the classroom pair. One clear difference is the ability of the KDK users to move around and physically manipulate the objects they are learning about. There is also a fundamental difference in speech exchange systems between the KDK and classroom contexts. This can be clearly

perceived by comparing the 48 interactional transcripts which cover the 24 pairs working in both settings, and this difference is also visible in the extracts. In the KDK, the learners have actively developed a multimodal speech exchange system that they are in control of, and in which they decide when and how to make use of the available resources (system help, physical objects, each other) to facilitate their learning on their own terms. This means that they are able to achieve their own learning objective (revising vocabulary) very efficiently. This led to more meaningful communication (Nunan, 2004) for negotiation, confirmation checking, or information transfer (Nunan, 2004). In the classroom setting, by contrast, there is much less sense of the users being autonomous or of them organizing their own learning. This is partly due to the presence of the teacher and the classroom setting. As can be seen, the teacher is giving exactly the same prompts and help as the KDK. However, the human presence of the native-speaker teacher seems to inhibit learners' ability or willingness to self-organise their learning in the same way as in the KDK environment.

5.3.1.2 Culture Learning Processes

This section presents the processes of cultural learning in the same way as the vocabulary learning processes. It is based on Moran's (2001) 'cultural knowings'. As stated in Table 5 at the outset of this chapter, the section combines questionnaires and CA transcripts with interview verbatim to answer the third research question and support the argument.

5.3.1.2.1 Cultural Knowings

How to use kitchen utensils depends on cultural background, as different cultures have their own way of handling them. In Korean culture, people often use chopsticks when eating food. The two settings asked learners to use the utensil to eat the dish on a plate. This is where users' cultural experience and learning occurs.

Two episodes below are from the during- and post-task phase when they are exposed to cultural aspects and learn by tasting the dish. They show that the KDK plays an integral role in the culture learning process. Before tasting, the KDK provided a detailed explanation about how to use chopsticks as part of the task, allowing learners to acquire cultural information (*knowing about*). The fact that users experience cultural practices by *cooking* the authentic Korean dish helps them establish a relationship with the Korean culture (*knowing how*).

Lines 1 and 9 in Extract 12 below demonstrate the initial state of learners' cultural knowledge. M from Romania explicitly acknowledges her lack of skills in using

chopsticks (line 4), whereas L from China finds the explanation different from the Chinese way of manipulating them (line 10). The explanation continues to help users, but their reactions are the same. No matter what kind of guidance the KDK provides, the two learners from different cultural backgrounds do not follow the instructions, M making fun of the KDK, by repeating the explanation to indicate she cannot do as told (line 12) and L still displaying her doubtfulness (line 18). Although a concern about difference and difficulty in cultural practices arises, they adjust to the new experience of foreign culture, in particular, M turns to physical touching and practice, and L manipulates chopsticks in her own way to get the hang of it. This shows how the duo enriches their cultural understanding (*knowing why*). So, M slowly makes gradual progress, which causes L to compliment her development (line 26). Both of them eventually pick up the piece of the dish and eat with chopsticks, enjoying the taste of the dish. Positive evaluations of the dish display their obvious enjoyment (line 34 and 36). These evaluations demonstrate they are raising self-awareness of the target culture (*knowing oneself*). Nevertheless, at the end, M wants to stick to her own way. This is because as a Romanian she is accustomed to using a fork. Eventually, she puts the chopsticks down on the desk and uses her fingers instead in lines 37 to 40.

Extract 12

Lines 1 to 40		
1	KDK	now, before tasting the dish you made, let's learn how to use chopsticks.
2	M	OH.
3	L	AH.
4	M	I don't know.
5	L	I know.
6	KDK	first secure your chopstick between crook of your hand and your ring finger
7	L	really? ((*sounding like it is not right way*))
8		second hold another chopstick like a pen keeping the hand loose
9	M	I never met=
10	L	=just DIFFERENT. ((*using chopsticks*))
11	KDK	Third get your chopsticks to move with ease and secure them in your grip
12	M	with ease? you joking.((*sounding like it is absurd*))
13	L	hahaha ((*facing M*))
14	M	haha ((*looking at L*))
15		And finally move the second chopstick up and down to grip food and practice that's it.
16	M/L	((*manipulating chopsticks according to instructions*))
17	KDK	oh are you left-handed? no problem it's the same way try.
18	L	eh? really? just different.
19	M	do you use that, do you that different way?
20	L	YEAH I have my own way. ((*showing M her chopsticking*)) I

21		I have my ??. This shows around us using my finger
22		It's hard to use [ ]
23	M	[ ]
24	L	I'll push tick?
25	M	sure ((*keeping practicing*))
26	L	ah good ((*looking at M's way*))
27	M	I can move it but I don't think I can take any food
28	KDK	자, 이제 맛있게 먹어봅시다. *ja ije matitge meogeobopsida wow well done now enjoy the food as you like.*
29	M	as you like? Hahaha
30	L	Haha
31		((*chopsticking*))
32	M	hmm ((*tasting the dish*))
33	L	Hmm hmm ((*tasting the dish*))
34		very good.
35	M	(4.0) ((*chewing the food*))
36		it's good
37	L	((*chopsticking to grip another piece of food*))
38	M	((*trying to use chopsticks and hand together to grip food*))
39		I just want to use my hand ((*putting chopsticks down and grip food with her fingers*))
40	L	hahahaha.

This cultural learning process is seen not just in this dish-making, but in the other recipe, *kimchijeon* in Extract 13 below. The users went through the different recipe and different cultural aspect. Two learners below were given an explanation about kimchi, a main material for their task, before tasting it (*knowing about*). There were no chopsticks in this recipe, but surprisingly, one participant asks for real chopsticks to use (*knowing how*). Two users show two different areas learning about culture, S about kimchi and MA about chopsticks. S's comments on Koreans' health status clearly display her understanding in line 2 (as in Figure 59) of GUI's previous explanation, whereas M focuses mainly on properly using the chopsticks in lines 3 to 7 by repeatedly practicing it. These moments exhibit clear signs of their cultural knowledge transforming from receptive to productive (*knowing why*). MA eventually picks up a slice of the dish and eats, showing his reaction in line 7. S and MA's verbal cues clearly display their enjoyment. These evaluations demonstrate they are raising self-awareness of the target culture (*knowing oneself*).

Figure 59 “so, this is why people are so healthy in Korea”

Extract 13 Post-task Interaction in a Digital Kitchen

1	S	(5.0) ((*use a fork to eat food. After tasting the dish, gesturing like she really loves it*))
2		so this is why people are so healthy.
3	MA	yeah.= ((*keeps chopsticking to pick up the slice of dish*))
4	S	=in Korea.
5	MA	yeah. ((*keeps repeating the same movement of chopsticking*))
6	S	really good.
7	MA	((*finally succeeds in picking up the food and eating*)) hm. ((*sounding like it is awesome*))

These two examples show how the KDK environment is oriented to by learners, who co-construct the organization of the talk. The duo demonstrates the mutual interest in taking advantage of the food and equipment in a digital kitchen, all of which serve as mediators that help learners not just to be exposed to specific cultural contexts, but to carry it out themselves by either tasting or practicing, hence leading to their understanding of Korean cultural aspects of people and food. All the senses are employed and pleased. They could physically use the objects to cook the dish and use them to savour it. That is, the everyday environment provides a learning space, which supplies learners with actual objects, and offers them better opportunities to enhance learning outcomes.

The power of physicality is shown in their self-report as well. In the follow-up interview, M and L made it clear how the kitchen helps learn foreign cultural aspects and how learning is enhanced as below:

> *For me, I think learning in digital kitchen is more experimental and helped me remember words or cultural more quick yeah, more quicker yeah. It is much more interesting there. (Lyi)*
>
> *Ok well the taste, and the smell actually, of course you know what exactly is. In the picture, you can imagine but maybe without experiencing, experiencing anything like this, we imagine something it rather than experience. So I think actual holding and touching objects, it helps me more. (Mat)*
>
> *We had a purpose to cook whereas in the classroom, it was something interesting to know about but what should I do with that information afterward? But whereas now, I can I can cook the dish and I can talk about some cultural aspects of South Korea, which enhances not only my*

language learning but my cultural background. When they say, well it's spicy, you have to do this with cabbage. And you are thinking oh yeah it tasted like you know like chilly and very spicy, so you could relate what you are actually eating to the cultural aspect. It's not something abstract that somebody else tells you like oh it's spicy so you're actually experiencing it. (San)

It's the fact of associating movements with words, so it's easy to commit something, it's easier to commit something to memory when you are actually going to the motions you know and the so. (Mat)

They commented on using real objects and how it brought back memories from their own culture to compare. This is important because it is how learning occurs. Fantini (1999) sees cultural comparisons as a transformative learning process, and here evidently the KDK provided learners with a space in which their own cultures are recalled, and actual resources (using chopsticks and eating foods) are seen as a powerful mediator to raise awareness of cultural similarity and difference, thus fostering cultural learning. However, the classroom learning had a different mood.

This sequence (Extract 14) below came from the same during- and post-task phase for *yubuchobap* in a classroom when students were given an explanation of the cultural aspects of how to use chopsticks and they attempted to try it out. Unlike the KDK which offers real objects to cook the dish, the classroom learners were given photos instead of actual objects, so users had limited access to manipulating the chopsticks in this episode. Learners look unsatisfied with the fact that they cannot have access to what they want.

Extract 14 Absence of real objects in a Classroom

Lines 1 to 19		
1	Computer	and finally move the second chopstick up and down to grip food, and practice.
2	A	where is.
3	Computer	that's it.
4	A	where where is the chopstick?
5	L	(1.5) ((*pretending to use chopstick with his right hand, even though there isn't*))
6	Computer	oh are you left-handed? No problem it's the same way try.
7	A	(2.0) ((*yawning and trying to use chopsticks with two photos*))
8		hahaha. ((*sounding like it's not helping*)) (2.0)
9	Computer	move onto the next step?
10	A	yeah. (2.0) I know how to use it it's easy for me.

11	Computer	자, 이제 맛있게 먹어봅시다. wow well done now enjoy the food as you like.
12	L	(2.0) ((*still keeping chopsticking with his right hand*))
13	A	(1.0) ((*looking very bored and cracking the knuckles twice*)) thank you.
14		(1.0) eat. ((*talking to L and asking him by using his two fingers*))
15	L	(2.0) ((*still speeding up chopsticking with his right hand*))
16	A	haha. ((*sounding like something is absurd*))
17	Computer	so what do you think is the taste of this dish?
18	A	what do you think? ((*talking to L*))
19		(3.0) [no, I can't eat.]
20	L	[ahm.]
21		(5.0)
22	A	it's like a pastizzi::: you have (2.0) and your your dish pas pas pas::azzi?
23	L	no no no.
24	A	I think it's kind of.
25	L	no.

Even before a teacher's explanation is completed (*knowing about*), A asks for access to chopsticks in lines 1 to 6, and shows clear boredom with their task and just follows the teacher's instructions by pretending to use chopsticks with two photos in lines 7 and 8 (*knowing how*). A's disinterest seems to be repeatedly displayed when he shows clear gestures of cracking his knuckles twice, and asks L to get engaged in the instruction by reluctant smile in lines 13 to 14 as in Figure 60. In the meantime, L reluctantly mimics the instructions as shown on a power point screen in lines 5, 12, and 15 (*knowing why*). There is no sign of enjoyment and excitement in their interaction. Asked about the taste, A straightforwardly explains that there is no way he can evaluate the dish in line 19. He just goes on to describe the taste only by the look of the dish and their own experiences in line 22.

Figure 60 Boredom in Lines 7, 8 and 13

Furthermore, when asked about the taste in the next sequence, A describes exactly what he saw, but rising intonations in his explanation in line 2 apparently demonstrates that he is not confident and not convinced (*Knowing oneself*).

Extract 15 Nowhere near the taste

1	**Teacher**	**what do you think of the taste?**
2	A	ahm salt?
3	Teacher	salty?
4	A	yeah.
5	Teacher	hm::: what do you think has salty taste?
6	A	ahm I think it's because there is (1.5) small seed↗ black seed.↗
7	Teacher	hmm ok.

Thus, absence of real objects led to the ongoing lack of cultural understanding, which subsequently limited their cultural awareness. Simply using photos gave them no choice but to use their imagination to answer the question related to taste, causing less of *knowing how*. It therefore depleted their enthusiasm, worsening *knowing why*, which brought about less of *knowing oneself*. It was obvious that lack of physicality made a big difference, hindering their learning of cultural aspects. L's brief interview transcription demonstrates his short but clear attitude as below:

Just think just picture helped a little. (Luk)

5.3.1.3 Digital Kitchen VS Classroom

A series of interactional episodes demonstrated similarities and differences, which help compare the two environments. In both settings, learners were able to interact with one another in performing their tasks to complete the dish. They all ended up learning linguistic and non-linguistic aspects of a foreign country. However, there were factors that made a difference in learning. The digital kitchen created a learning space, in which learners were able to have more opportunities to negotiate the meaning, repeat the word, and convey information to each other, whereas the classroom provided learners with fewer opportunities to interact with each other. Additionally, the physical objects enabled students to feel like they were making a real dish, establishing a space in which they could associate the object with their memory in terms of vocabulary and cultural knowledge. In the classroom, on the other hand, the only thing they could employ was their imagination. In other words, the KDK allows for all five dimensions (textual, auditory, visual, tactile, and kinaesthetic), whereas the classroom has allowed for only three s (textual, auditory, and visual). The striking difference was that the KDK

learners had the sense of touch as well, whereas classroom ones only used the sense of sight. All these points led to different levels of motivation and engagement, which subsequently contributed to contrasting levels of learning process in two different learning environments.

5.3.2 Interviews

This section presents interview data analysis to explore in-depth perspectives on learners' attitude and behaviours, and on how they viewed their tasks in the two different learning settings in terms of understanding. This data helps address all the research questions.

5.3.2.1 Learning Vocabulary and Cultural aspects

The Korean Digital Kitchen and the classroom were designed for participants to learn both linguistic and non-linguistic information via the task of cooking. Unsurprisingly, this interview yielded a host of comments on what they have learned throughout the cooking session in both locations. An underlined word indicates original Korean words and the underlined word in brackets following are their English translations. Transcriptions demonstrate their level of linguistic learning:

I picked up so many Korean words. (Coc)

We learned, I think, a few words. (Mir)

I think it's to remember the pronunciation of the food. (Liy)

In terms of vocabulary, yeah of course, we learned a lot even although we can't remember some (Nur)

It's a very different language, I mean, the different sounds, a different way of speaking, a different... to try and get your head round. (Mat)

For example, what I learned I only yeah I feel like for example I learned only kimchi of that session, oh and hoipan (pan) because it sounds like a pan. (Vid)

As shown, learners could learn Korean linguistic knowledge such as pronunciation and words, even though it was not all easy to grasp every piece of vocabulary. Much to my surprise, some of the comments showed insightful learning on differences in pronunciation and orthography compared to their own language, Dutch. Thus, they were able to achieve the goal of vocabulary retention throughout the task. Interestingly, in addition to linguistic knowledge, cultural aspects alike could be obtained as shown:

Because China and Korea has similar like a lot of similar things in culture, so the use of chopsticks and kimchi in Korea isn't new for me but it's and I

actually I do make kimchi myself so but it's really but it's really to see how like Korean culture was represented in through the kitchen like the cooking and the classroom as well. (Yan)

It's a little sweet and it provided us with opportunity to like taste it and to feel it, to feel it what is yubu. (Viv)

This is the first time I actually tried using a chopstick and I finger and used it and the part that kimchi, there are a hundred types of kimchi. That was the information for me. (Ram)

We learned about Kimchi. We got the smell how kimchi smells like and we see we saw that in the video there's like this red paste. We see that red paste in here. (Lin)

We can touch the culture actually from the kitchen. (Gab)

We learn like culture about food. What food is quite popular in Korea and how to make, like how to use chopsticks. (Jub)

Pickled vegetable, it very popular in Korea, maybe 90% of Korean eat kimchi and also I learned chopsticks. (Jen)

The vegetables should be reserved of preserved for more than 3 weeks to 5 weeks. (Jia)

The Korean people eat it almost every day. And that is healthy as well. So, we get the notion that there are people who are conscious about their health […] we were introduced a chopstick. So, it makes us know that Koreans use chopsticks when they are eating. (Maa)

According to a series of comments, the way Korean foods are made and eaten, and what Korean people value were made known to learners during their cooking experiences. Intriguingly enough, their comments gradually took a turn from their linguistic and cultural learning to comparison of two settings according to their own experiences. Students' comments were comparable as shown:

I don't know how to use chopsticks and I must say that all in the classroom experience which we had. I haven't even learned how to use chopsticks. And so it wasn't very helpful in terms of cultural learning. And I think you can ask photograph on the internet. (Han)

I did much better than the classroom in a digital kitchen. I think so. I pronounced more words correctly (Ufu)

I think it's so much better when we have to experience or something, we can do something instead of just watching the thing yeah (Jun)

Likewise, they were clear that learning cultural aspects in a classroom did not influence their learning much but that their learning performance in a digital kitchen went well. These comments led the researcher to exploring what they could do in one location but not in the other one as indicated:

We don't know what that yellow thing is. It looks like oil but I don't think it is oil. (Lin)

With the picture, I don't know how to put it and how to feel, and how to put it. (Gab)

I think it wouldn't be possible. We can imagine but we are not sure whether we are able to handle chopsticks if it's in the classroom. (Nur)

At the end of the day, we have a product, an end product that we produce together. It's yubu ah yubuchobap (tofu rice). When we were in the classroom, we got nothing to show, basically nothing to taste anyway, so I prefer eating it rather than having the picture. (Kha)

Because when we talk about culture, sometimes, it's very vague and abstract if you don't experience any of it, but if you experience it, then you totally, you will be totally successful introduce the culture to others and to promote other people's interest to know more. (Yum)

It was shown that students had contrasting views on two other cooking experiences, and the real one had made a big difference in their perceptions.

In sum, students gave accounts of their learning experiences in two separate learning environments, and they generally reported more positive feelings towards learning in the KDK. Nevertheless, they explicitly showed different ideas about the two locations. This was understandable as 48 participants had all carried out two different cooking sessions in two separate learning environments in order (Section 4.4.3 in Chapter 4). To specifically explore how they felt toward and valued two settings, an attempt to collate a few codes to create a theme for comparison was made in the next section.

5.3.2.2 Attitudes towards Learning Environments

Learners gave their views in relation to the two environments. On the whole (39 out of 48) they found learning in the KDK more enjoyable, interesting, friendlier, and 'real' (in bold below), whereas learning in the classroom was seen as more boring, abstract, confusing, and more problematic in terms of learning (underlined below). Some illustrative verbatim quotes are below:

The classroom I didn't feel of course and I didn't feel enjoy the process we learned in the classroom. But the kitchen was really ***great*** *(Han)*

You know the classroom is like old-fashioned. Something like that. I think it will be ***best if we can experience*** *the thing when we learn (Jun)*

I think in the kitchen setting, we can remember the words and objects more more ***effective*** *(Eva)*

「Jen: and we can ***imagine****. I saw the Korean words and we can imagine, but in the classroom, I think, even though you showed the picture of Korean words, it's not too, maybe not, just I can't remember it.*

Jae: in the classroom?

Jen: yeah in the classroom, I haven't remembered all the words. We just make it. Maybe sometimes, we can just remember one? maybe just a little.」

Gab: yeah from Kitchen, I think we ***compared the word and the thing*** *with the picture.*

Well I think the environment I like it ***better*** *in the kitchen because it's more* ***flexible****. (Jub)*

I ***enjoyed*** *the first one where we cook in a real kitchen, in a digital kitchen compared to classroom kitchen. (Nur)*

The kitchen I think it was ***much better*** *but in the kitchen in the classroom it was boring. (Luk)*

It's it's ***friendlier****. And it's* ***less difficult*** *to match what is seen to what you see in the kitchen. (Jos)*

We can actually do something in here in the kitchen, it's more ***real****, while in the classroom, we used a lot of imagination. Sometimes, it's it's abstract. (Sue)*

First one was classroom-based, fairly traditional in terms of listening to and looking at pictures and repeating - sometimes without any knowledge of the language, just repeating the sounds and then finding out what it means. Second one was the ambient kitchen which was ***not all traditional****. (Sun)*

I think the digital kitchen is ***more interesting*** *and the result is* ***more satisfied*** *because in the classroom, you tried very hard to memorize it but you couldn't. You see my result. It's terrible. (Yum)*

Well, for me, the kitchen experience was ***way better*** *than the classroom experience. In the classroom experience, I was feeling a bit confused because*

I couldn't relate anything, I mean, to anything really, I mean, I couldn't relate, I mean, I know that cooking, but I didn't know the word, I didn't know the dish, so it was very difficult for me to make connections to learn the language. (San)

5.3.2.2.1 Exceptional Learners

However, not all students agreed. 3 out of 48 participants preferred learning in a classroom, which suited their own learning styles:

Yeah I would say in the classroom I learn I guess the word better or I learned the word better what the pictures were. In the classroom, I guess it was more just sit-down and like focus on what's funny info. I guess there're like there might be a bit of lost attraction but it's not as fun. (Chi)

Learning in digital kitchen is more interesting because we learn and do at the same time. However, I am not sure in terms of vocabularies, I mean how many words, I don't know whether I can learn more from the digital kitchen, comparing with the real classroom, but the only one I am so certain is that it's more interesting. I had more fun. (Jub)

「Tug: well, it's about my learning because once I have a task, I just forget the language learning part.

Jae: you just focus on the task itself? Ok.

Tug: That's why I just almost don't remember any word from the kitchen, because it was just, let's make this food and it should look good. That's it. […] It's worth well for the aim of teaching, but as I said, kitchen was more kind of task-oriented for me.」

Reports said that a student of Chi could normally *just sit-down and like focus* in the classroom and were not sure how they could learn more in the digital kitchen. Furthermore, another one of Tug considered the kitchen as too *task-oriented*, which meant she was so focused on the task that she could not pay attention to the learning itself in the digital kitchen. Nevertheless, it was interesting to note that all of them agreed with the favourable features of a digital kitchen: namely, that it was fun and interesting. That explained why Jub ($p < .02$) and Tug ($p < .72$) gained higher vocabulary scores in a digital kitchen, but Chi ($p < .08$) still showed an individual learning preference toward a conventional environment (as shown in Figure 61). Jub's mean difference of scores between a

classroom and a digital kitchen was statistically significant, whereas Tug's and Chi's were not. This indicates that what they reported did not match the actual learning outcomes. However, their insights clearly demonstrated that 3 out of 48 participants preferred a classroom, and 1 participant (Chi) both preferred a classroom and learned better there.

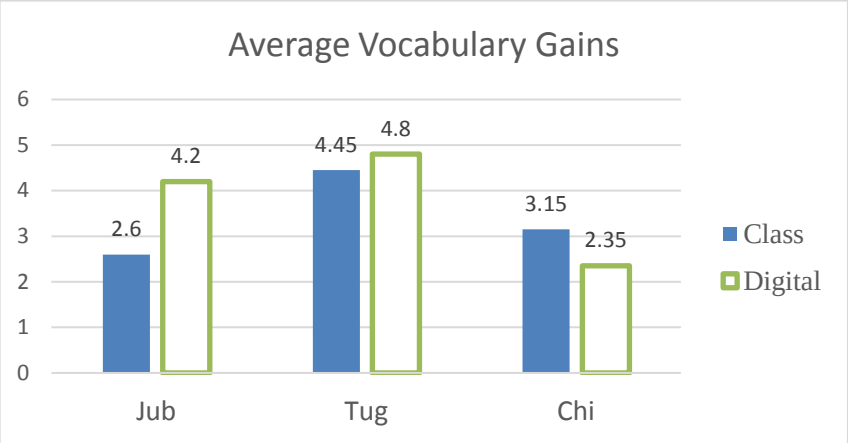

Figure 61 Individual Differences

Thus, the learners' points of view indicated that a digital kitchen does not always suit all learning styles and strategies. Nevertheless, a fair amount of comments on students' preference for the digital kitchen was evident. Why and how do they prefer a digital kitchen then?

5.3.2.3 How the KDK helps learning

To explore their perspectives on how certain learning environments enhance learning more or less, the interview questions were structured in advance. Much to my surprise, learners commented on a wide range of specific reasons for their preferences for the KDK as below:

> *It's like I said just now experiencing it, I mean hands-on, using the chopstick compared to getting information from the video in the classroom, so the digital kitchen is totally different experience. (Kha)*
>
> *It's like learning how to ride a bicycle. You need a bicycle to learn how to ride. That's why you need actual chopsticks to use. (Ram)*
>
> *How can you learn how to use chopstick when you don't have chopstick in your hand? You can just look at from the picture, the direction how to put your fingers. I don't even know what that is. I use chopsticks at home. I use it the right way. But if you ask me how I put my fingers, I don't know. It's just*

naturally comes to me. So, it would be better to have objects in your hands. Not just flat pictures. (Lin)

I think learning in digital kitchen is more experimental and helped me remember words or cultural more quick. (Lyi)
Because I did it with my hands, I can easily recall, I can connect some image to connect to than the abstract one there, you're focused too imagining things. You might not get imagination right. So, I definitely prefer the kitchen. (Maa)
When you are actually doing something, you do build up some kind of memory. (Roi)
I think it has to do with the fact that it's hands-on experience. So, what you are learning the word, you're making the motions of it, so you can make association between the object you are using, the gestures you are using and the actual words, whereas in the classroom, it's photos. It's kind of like you really have to make an effort to commit what's in the photo to memory like ok so on in this photo we have this Korean word. (Mat)

Factors included hands-on experience, multi-sensory, Human-Computer interactions, affective motivation, products, autonomy, and cultural comparisons. This showed that an overwhelming number of comments valued experiential learning in a digital kitchen. The hands-on experience with actual objects made a big difference, contributing to changing their learning from abstract to real. Looking at photos allowed learners to benefit from two dimensions for learning (Paivio and Desrochers, 1981; Mohsen, 2016), whereas using real objects enabled them to take advantage of one extra dimension of touch, which helped connect vocabulary and cultural knowledge with their memories (Nattinger, 1988; Nation, 2001). Linguistic and cultural knowledge were captured better when they carried out a real world activity of cooking – learning by doing (Doughty and Long, 2003). That is, the real world task brought abstract concepts to life and made them easier to comprehend. This experiential learning even boosted learners' motivation and desire to gain more knowledge. 'Learning by doing' occurred in the kitchen.

In particular, what could deepen their knowledge further was the involvement of their 'five senses' – sight, smell, sound, touch, and taste. These senses were seen as a mediator for learners to link their experiences to their learning. Comments in bold indicate what they could use and the ones in underline how they evaluate them. On the whole, knowledge acquired in a digital kitchen was perceived as a platform for multi-sensory experiential learning (Trubek and Belliveau, 2009) as shown:

*It also gives us the **taste** and also we can **feel** and **touch** because I really feel the yubu is a little bit oily and also chill, which is aspect we cannot experience or we cannot tell from the pictures. (Coc)*

*We can use our **all senses** in the kitchen, making us more remember […] That is why so many people want to travel to feel the culture. (Jen)*

*You can use **all your senses** from your eyes, smell and you can taste it with your mouth and your tongue, so it's more a wholesome experience rather than just visual thing. (Kha)*

Students also reported another important distinction: interactions between their colleagues and the computer in the digital kitchen:

Actually we communicate with each other about the words I know and the words she's got. So the way we exchange information in kitchen was quite kind of free environment. (Coc)

I had the interaction with the computer […] it's very automatic and intelligent. (Jun)

I can speak freely because after touching it, the voice before touching it the voice told me with a word and I touched it and oh it rang 'ding!' And then I know it was correct and I can pronounce it to follow the voice (Jia)

It probably made the lesson more interactive to because when students I mean learning cooking, they have they also need to interact talk in English. So, it doesn't like interest students learn vocabulary or learn some cooking you know. Students have real interaction, more communication. (Jub)

Well, it's more interactive and fun and we can touch there like many stuff there. (Mut)

I had a control of the digital kitchen. (San)

If we cook in the system that provide help like in the digital kitchen and we have partner, so I have two sources to get help one from my partner and one from the system. (Sue)

The fact that learners had active interactions with another learner and the computer in a situation with no teacher indicated that the kitchen setting left room for them to be able to learn both linguistic and non-linguistic skills in an autonomous way – "supporting autonomous learning processes" (Seedhouse *et al*., 2014, p. 12). A student description made this evident:

I can learn by myself. Nobody rushes me, nobody waits for me, so I can have my own pace on what I am doing, and then once I finish, I finish one step, I

can press the tick one and go on. So I think it's more comfortable. You don't have anybody to rush you or to keep eyes on you whether you are making any mistake or not because the computer the computer can look and do it everything with the computer. It can help you with the picture and things and we can go on the next step by ourselves. (Sum)

Last but not least, since the kitchen offered real objects with which to cook the Korean dishes, they could actually produce the food themselves and really enjoy it – what Ellis (2003) refers to as end products:

There was going to be a product at the end while learning. (Mar)

And the additional bonus was food at the end. (Mat)

That those extra features were found only in the digital kitchen seemed to explain why learners felt more motivated in their learning (Bax, 2003), according to comments:

I found the experience we had in the kitchen more and more interesting and more kind of more real and more motivating rather than doing in the classroom. (Muq)

I think that's what makes it more interesting and motivating. (Kha)

With regard to the cultural aspect, learners showed their ideas on similarities and differences between their own cultures and the target culture as would be expected as commented:

I think generally in Asia, the culture is quite similar to each other. How to use chopsticks and spoons. These are similar in the cooking. (Viv)

⌜Khalik: compared to using spoon or forks. Yeah that is the difference

Nur: yeah I think the utensil

Khalik: because it is in our culture, it's more to using our hands⌟

As they encounter a different way of life, they apply their knowledge to other cultures in the learning situation. In other words, they, as learners of culture, were developing their overall abilities of personal competence (Stevick, 1986).

To sum up, the KDK was a learning environment in which students carried out a real world task with a clear goal in a real world environment, which allowed for a multi-sensory hands-on experience with physical objects, human-computer interaction, autonomous learning, end products, cultural comparison, and consequently increased motivation as shown in Figure 62 below. It was evident that all these factors transformed both the way learners behaved and the extent to which they learned.

However, it was found that a digital kitchen did not suit all learning styles due to a few features.

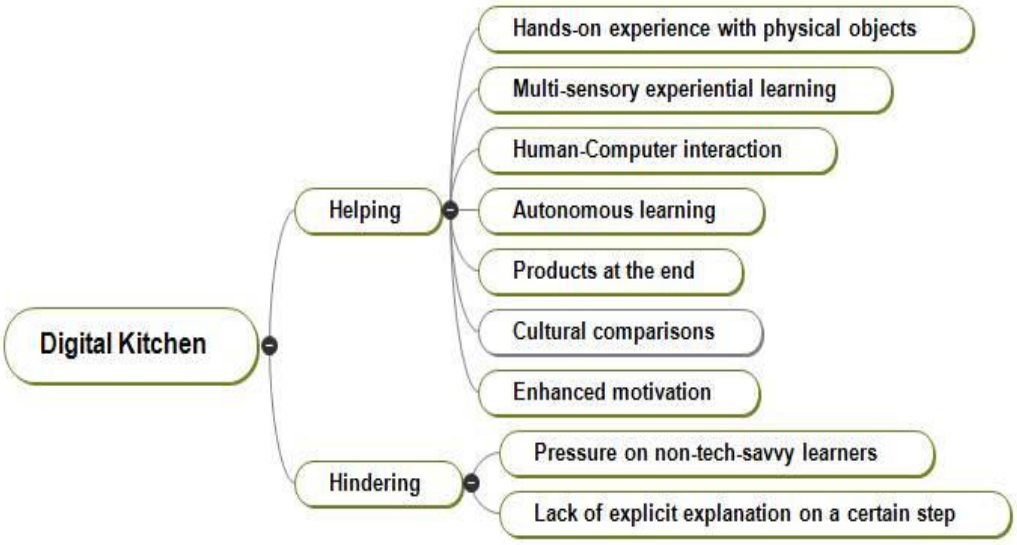

Figure 62 Learning in Digital Kitchen

In contrast, in the classroom, the contributory factors to learning in a digital kitchen were not observed, although reports pointed to favourable elements. Instead, contradictory points were discovered, making it relatively difficult for students to learn: lack of real world experience, depending on their imagination only, difficulty interacting due to the existence of a teacher making them nervous, no products at the end, boredom, and demotivation as shown in Figure 63.

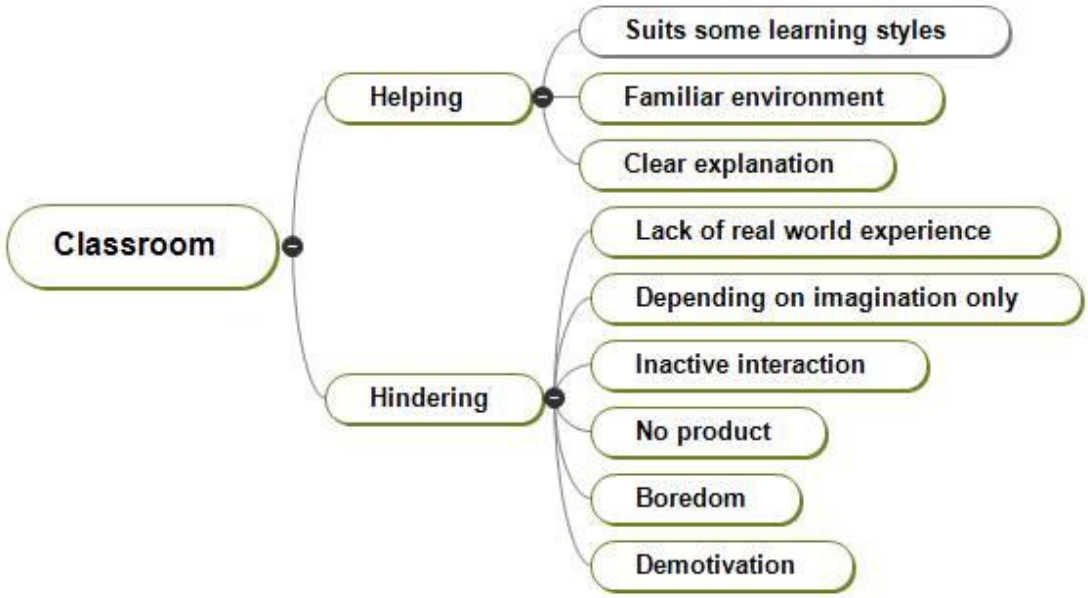

Figure 63 Learning in Classroom

5.3.3 Summary of Qualitative Data

A comparison of several CA-based episodes of cooking sessions in the two settings indicated that the Korean Digital Kitchen created an enriching interactional space more effective than a classroom for learning, helping scaffold learners so they were able to gain the linguistic and non-linguistic knowledge through a range of interactional features including negotiation, collaboration, repair, repetition, and information transfer. Furthermore, themes from the interview transcripts revealed specifically what factors influenced students' learning in the two separate settings and the relationship between three concepts. Both sets of data illustrate that being able to use physical objects rather than merely photos caused a strong effect for learners to be able to make an association to their memory, thereby reinforcing better learning outcomes. The Table 18 below compares the two learning environments in more detail.

Table 18 Classroom VS Digital Kitchen

	Digital Kitchen	**Classroom**
Learning	More Linguistic & Cultural Knowledge	Less Linguistic & Cultural Knowledge
Modes	Triple (Dual + touching)	Dual (textual + visual)
Task type	Real world task	Pedagogic task
Instructor control	Student-centred More sense of observer More autonomous learning	Teacher-centred More sense of controller Less autonomous learning
Environmental Dynamics	Less sense of anxiety Equal participation Less hierarchies Learning individualisation Increased motivation Freedom Experiential All Five senses for Learning	Anxiety at beginning Unequal participation More hierarchies Less tailored learning Less motivation Boredom Imagination Reduced senses (Seeing & Hearing) for Learning
Interactional features	More negotiation, collaboration repetition, and discussion Active interaction	Less negotiation, collaboration, repetition, and discussion Passive interaction

5.4 Summary of the chapter

This chapter has presented the analyses and interpretations from four different data sources obtained to answer each research question. Test results showed significant differences in language and culture learning between the classroom and the KDK, demonstrating the efficacy of a digital kitchen over a classroom. The KDK was also found by analyses of questionnaires to be overall preferred over a classroom in terms of

learners' attitudes and perceptions for learning but was disliked by three students with different learning styles. These findings of quantitative data helped validate students' learning as a *product*. These learning *products* from quantitative data were triangulated when learning *processes* and attitudes were revealed and integrated with qualitative evidence.

CA aided in uncovering specific processes, whilst thematic analyses demonstrated reasons for a range of different practices between the two settings in terms of results, task types, learning modes, the role of instructors, environmental factors, and interaction styles. Human-computer interaction and real-world tasks with actual objects resulted in enhanced learning in a digital kitchen.

All data from the two different paradigms showed different extents and ways of learning a foreign language and culture between two learning settings: the KDK was found to be more effective overall than the classroom. The following chapter will discuss and elaborate on these results.

Chapter 6. Findings

6.1 Introduction

This penultimate chapter presents the interpretations of the data findings and relates them to the literature previously reviewed in Chapter 2. The arguments set out at the outset (e.g., using physical objects to cook in a digital kitchen has greater positive impact on linguistic and non-linguistic learning of Korean than using photos in a classroom) are evidently supported by a range of results in a mixed methods approach. This chapter is split into four main sections which correspond to three main research questions and resultant implications. In section 6.2, the outcomes and behaviours in vocabulary learning are explored. Section 6.3 investigates participants' different attitudes towards two different learning environments. In section 6.4, outcomes and behaviours in cultural learning are examined. The chapter will then end with pedagogical and practical implications on future research on TBLT with CALL.

6.2 Vocabulary Learning

In this section, findings from the three sets of data in Chapter 5 will be summarised and triangulated to answer the first research question as below. The question focused on the effect of touchable objects on learning a specialised set of vocabulary. Test results demonstrate their learning as a product, whereas observations and interviews reveal their learning as a process (as in Fig. 64).

Research Question 1: *Do participants learn vocabulary more effectively in the digital kitchen by touching and manipulating real objects to complete a real-world task than in the classroom using pictures of objects to complete a pedagogical task? If so, to what extent and how?*

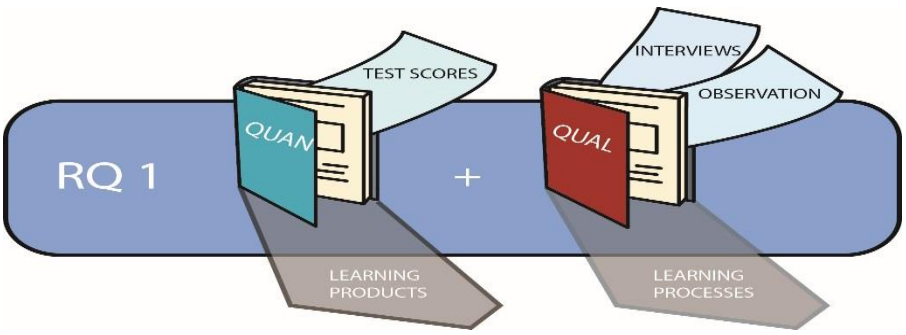

Figure 64 Data Mix for Research Question 1

6.2.1 Overall Findings in Vocabulary learning in Two Settings

Overall, it was found that learners showed better vocabulary learning in a kitchen than in a classroom, and their learning outcomes were statistically significant as shown in Figure 65.

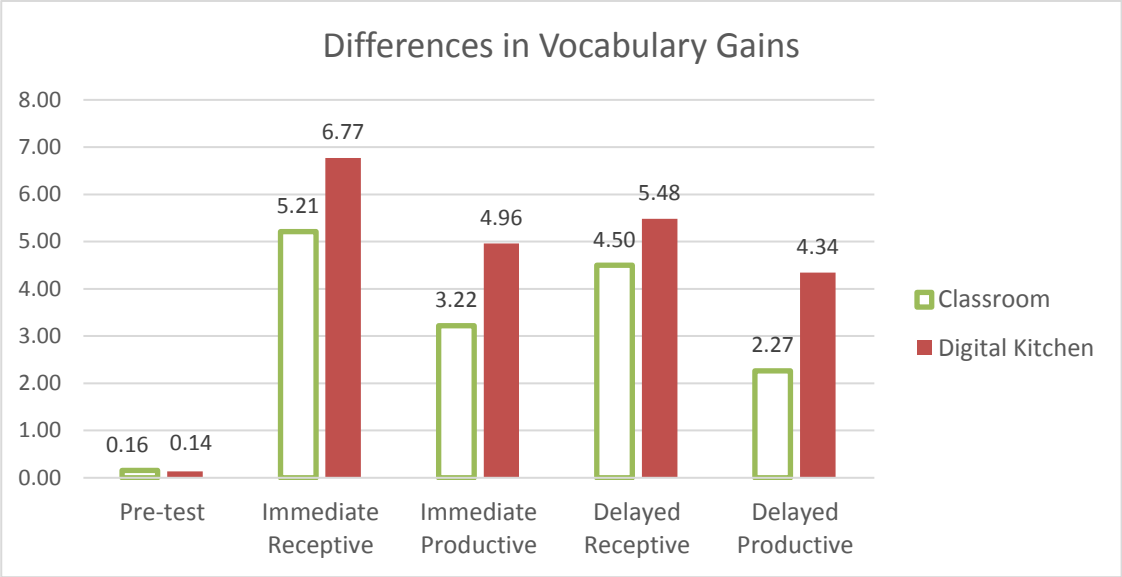

Figure 65 Varying Degrees of Vocabulary Learning

The kitchen learners were better in both receptive and productive vocabulary knowledge in both immediate and delayed tests than the classroom learners:

- Immediate receptive scores in the kitchen were higher than in the classroom $MD = 1.58$, $p < .00$
- Immediate productive results in the kitchen were higher than in a lecture room $MD = 1.78$, $p < .00$
- Delayed receptive average in the kitchen was bigger than in the classroom $MD = 0.83$, $p < .02$
- Delayed productive points in the kitchen were better than in the classroom $MD = 2.12$, $p < .00$.

This clearly suggested that the KDK was more effective in incidental vocabulary learning than in a normal learning setting, and being able to manipulate physical objects helped students learn more vocabulary items in the KDK than in the classroom.

These findings are similar to a range of studies which investigated the effect of Computer-Assisted Language Learning. Computer-mediated learning has been combined with task-based learning and this new trend has allowed for well-established lessons and outcomes (Salmon, 2011; Hinkelman and Gruba, 2012). In particular, what

was made possible due to the technological development was multiple modes for learning in which learners communicate through more than one form of interaction (Hampel and Hauck, 2004; Norris, 2004). These developments created better outcomes in vocabulary learning (Luisa, 2003). Computer technology could help learners link the form and meaning of vocabulary items to their memory more effectively when exposed to not just written but also visual modes pedagogically displayed on a computer screen, thus influencing the way students are engaged in learning activity (Abrams, 2003). However, there was one more mode that helped learning: kinaesthetic mode. Touching real objects not only motivated students, but helped them make a connection to their memory. These findings also mirror those of recent projects by applied linguists taking advantage of the trend to create an everyday learning platform (Seedhouse *et al.*, 2013; Seedhouse *et al.*, 2014; Preston *et al.*, 2015; Seedhouse, 2017). Since the project team reported significant positive effects of the digital technology on vocabulary learning but did not discover the specific factor, this study strengthened the research findings of physicality on vocabulary learning by implementing the quasi-experiment in two environments.

In contrast, in a classroom, learners were found to be less successful in their learning. It might be explained by the artificial, 'not-quite-real' 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 vocabularies. These were verbal (written and spoken) and non-verbal (image) cues delivered by a teacher. Findings from the classroom are in line with previous research that makes the link between texts and pictures, and points to the synergetic effects of the combination for vocabulary learning. Words are remembered better when they are associated with images (Underwood, 1989) and the integration of pictures and texts enable learners to engage larger parts of the brain, thereby leading to greater depth of knowledge processing (Oxford and Crookall, 1990; Mohsen, 2016). Thus, the synthesis of imagery and verbal information played a role in enhancing information processing for learning, lending support to many previous studies (Paivio and Desrochers, 1981; Paivio, 1986; Paivio, 1991; Paivio, 2007; Sydorenko, 2010; Winke *et al.*, 2010; Aldera and Mohsen, 2013; Montero Perez *et al.*, 2014). However, the classroom missed one important learning mode of touching real objects. Classroom learners had half-sensory experience in completing tasks given. This resulted in different learning outcomes.

Another explanation for the low level of learning in the classroom is related to the atmosphere. Relatively unsuccessful learning supports the claims that previous

studies presented regarding the challenges occurring when implementing TBLT. In a classroom, students experience anxiety over freedom (Lopes, 2004). Particularly in a teacher-centred classroom, a range of factors such as limited opportunities, lack of confidence, and fear of making mistakes demotivate learners in producing sustained L2 utterances in their interaction, which results in students' unwillingness to speak in a foreign language, eventually impeding their learning (Tsui, 1996). As a result, learners seemed to show less successful learning outcomes as opposed to those in the KDK.

To sum up, learners were able to learn linguistic information better in the KDK than in the classroom. Not just physicality but also various environmental factors were found to aid vocabulary learning. This wielded tremendous power and influence in the degree of their language learning. Since the different learning results might be explained by the different factors, it was thought that it would be worth further investigation in terms of environmental factors in relation to learning processes.

The factors include a range of environmental differences between the two locations as drawn in Table 18 in Section 5.3.3. In particular, four environmental factors as presented in Table 19 below are pointed to discuss different learning processes in both settings.

Table 19 Environmental Factors to Learning Processes

	Digital Kitchen	Classroom
Learning Modes	Five senses	Fewer senses (seeing and hearing)
Task type	Real world task	Pedagogically designed task
Autonomy	Student-centred	Teacher-centred
Interaction	Active	Less active

6.2.2 Vocabulary Learning processes in the two settings

This section first presents findings of CA and thematic analysis, and then discusses different learning processes, comparing the two settings in relation to tasks and vocabulary learning. Findings showed not just (a) experiential learning with physicality, but also a wide range of other reasons for different learning outcomes between the two settings: (b) task-induced involvement, (c) autonomy, (d) environmental dynamics and (e) interactional features. They all caused a different level of learning.

6.2.2.1 Experiential learning

The findings of the present study confirm that the KDK environment can help foreign language learners acquire incidental vocabulary from the task performance, thus supporting the findings of previous investigations (Tozcu and Coady, 2004; Grgurovic, 2007; Miles and Kwon, 2008). Since the vast majority of studies for incidental vocabulary learning have been conducted using tasks inside the classroom, this study broadened the scope of the research by comparing the classroom with the KDK environment.

Being able to manipulate real objects as part of tasks was found to add significant extra value to vocabulary learning, lending support to findings from previous studies (Nattinger, 1988). This hands-on experience, together with the KDK environmental features, also enabled learners to use all five senses. 'Learning by doing' helped learners incorporate new knowledge into their memory, store and retrieve it, because the act of cooking itself is an authentic task with a clear goal, hence supporting findings of Doughty and Long's (2003) study. Cooking itself is a form of 'doing' (Ellis, 2003). This finding also supports anthropologists' claim that the mundane space of a kitchen offers an ideal learning platform because cooking provides learners a multi-sensory experience which is deeply embedded into their memory (Trubek and Belliveau, 2009).

Learners carried out the cooking task using all of the senses such as smell, sound, sight, touch and taste. To be specific, learners see the vibrant colour of *kimchi*, touch interesting-looking utensils and ingredients equipped with sensors, hear the sound of a sizzling *kimchi* pancake, and smell the exceptional aroma. Most importantly, the engagement of these senses peaks when the Korean cuisine finally touches the learners' tongue, which is a sensational, amusing, exciting, and unforgettable moment. This is when learners internalise their experience using all of their senses, linking it to the linguistic knowledge in addition to cultural information deep in their memory. Employing a multi-sensory experience ensures that both linguistic and cultural information is more firmly embedded and richly connected in the learners' memory than when the same task employs fewer senses in a sterile classroom environment. For example, in terms of learning about typical English foods such as fish and chips, learning becomes much more vivid when students experience it themselves by tasting rather than just hearing an explanation or seeing a photo. There is no way the taste of crunchy batter, fresh-tasting fish, and freshly-fried chips can be experienced without feeling and tasting the dish. By activating all senses at the same

time, learners are able to maximise the number of synaptic connections (Bransford, 2000; Zull, 2002), retaining the moment and the relevant knowledge as a multi-sensory, multimodal, multi-learning, unforgettable experience.

Thus, using real objects by way of a real world activity provided learners with more vivid and meaningful experiences, which are hands-on rather than indirect and multi-sensory rather than involving few senses. Since the task was more likely to be familiar to learners (e.g. asking for directions), they were more likely to be engaged, which presumably further motivated them in vocabulary learning. All of these factors were conducive for vocabulary learning in the KDK. This is not to claim learning did not occur in a classroom, as learners certainly did learn vocabulary items. Some students still preferred learning in the conventional environment because they felt pressure when using new technology, and sometimes technology itself could not provide enough explanation needed to resolve the interactional breakdown. Personal and technical issues hindered their learning. This clearly shows that the KDK environment does not suit all types of learners. However, when looking at the aggregate of learning for the whole sample, this study concludes that the KDK environment and its various affordances added significantly more value to the enhancement of vocabulary knowledge more than in a classroom. In particular, *physicality* plays an instrumental role in enriching vocabulary learning.

It was notable to see the difference between short-term memory (immediate tests) and long-term memory (delayed tests) in two settings. In terms of productive tests, the KDK was found to contribute more to long-term memory than a classroom, whereas in terms of receptive tests, a classroom helped more in long-term memory than the KDK. This is where further research is needed.

6.2.2.2 Task-induced involvement

The multimodal nature also brought about different psychological processes (Nation 2001) and task-induced involvement (Laufer and Hulstijn, 2001) to vocabulary learning in two settings. In the **pre-test** and **pre-task** in which learners were tested and exposed to new words, physical objects in the KDK allowed participants to notice a bigger need to learn the vocabulary item, creating an information gap and motivation. In the next stage of ***during-task, post-task,*** and ***post-tests*** in which learners were required to locate and manipulate the objects, physical substances helped not only match the word to the object, but retrieve the new word to link it to their task. Learners even evaluated their knowledge by either private speech (Ohta, 2001a; Ohta, 2001b) or

interacting with their partner, reinforcing the learning of each item. However, in a classroom, absence of real objects resulted in relatively low levels of motivation, which led to less interaction. This made learners less interested to actively engage and go through the three processes. Consequently, learners showed less evidence of learning cycles.

6.2.2.3 Autonomous Learning

It is not just physical objects and task-induced involvement in the KDK that enhanced learning. So did learners' independence, according to interview data. The findings of the current study suggested that the digital technology allowed for autonomous learning, which enhanced learning, thus lending further support to the results of previous research (Larsson, 2001; Bax, 2003; Reinders, 2010). In the KDK, learners were given a number of technological affordances via the GUI, through which they could influence one another in interaction, encourage peer support and cooperation when in need of help, supporting earlier findings (Seedhouse *et al.*, 2014).

Learners were introduced to words in a real-world situation. They were not passive receivers of vocabulary knowledge, but instead were required to actively acquire the knowledge. Furthermore, learners could even collaborate with their interactional partners. One interactant's utterance called for another one's confirmation or correction. It might be either one's assistance to the other's lack of linguistic or culinary skills, or one's spontaneous interaction to the other in the moment. Whatever the case was, two speakers used their own skills to help each other and find out a solution to interactional breakdown. Surprisingly, it was not only two speakers, but the computer itself that shaped the interaction. The technology was always supporting the learners to offer help. In other words, they all were scaffolding and co-constructing a space for learning. This encouraged them to gain a deeper sense of learning. For instance, as learners needed to employ a word search strategy by requesting help, they were able to interact with both the GUI to receive assistance such as audio/visual repetition and their colleagues for confirmation checking. That is, digital technology took students outside of the structures of the classroom, and this student-centred learning environment empowered the learners themselves.

Thus, a learner-centred environment allowed for more progressive interaction, which provided a self-learning space and a range of interactional features such as negotiation and collaboration, all of which contribute to learners' perceptual transformation from the interpersonal plane to the intrapersonal plane, supporting Ellis'

(2003) viewpoint that the goal of language learning was achieved "when students are interacting themselves, without the teacher being present, as the greater symmetry of social roles" (p. 252). The feeling of being autonomous, an essential part of a pair, and achieving products at the end motivated them to learn in a way that the atmosphere in a classroom seldom manages to do (Larsson, 2001; Ellis, 2003). In a classroom, students were found to be nervous, and this teacher-oriented learning reduced proactive interaction, which might explain why self-directed talk was correspondingly detected less.

6.2.2.4 Repetitions

Another explanation for more successful learning in the KDK might be self-mediation through private speech (Ohta, 2001a; Ohta, 2001b) such as repetition, which establishes an important space for learning. The KDK employed a standard three phase pedagogical cycle of TBLT so that learners properly perform tasks in each stage. During these stages, linguistic resources were always provided and repeated more than twice. It naturally drew learners' attention to linguistic resources. As the pre-task phase required learners to pick up the correct item by providing the phonological sounds and written forms of the target vocabulary item, users were offered many opportunities to learn the lexical knowledge. Learners were focused on choosing the correct one by linguistic sound and form, so lexical knowledge was very important in this stage to move onto the next step. Interestingly, in this stage and subsequent stages, learners were often found to explicitly produce the same sound themselves or to their partner as played by the GUI. Although the tasks instruct them to provide more demanding linguistic information in the sense that there were more complicated sentences difficult to understand in instructions, learners request help more often either by turning to GUI or by relying on their interaction partner, having more chances to practice the relevant lexical knowledge. Thus, repetitions occur throughout the tasks in the digital kitchen in relation to learning.

To be specific, there was a significant difference between number of repetitions produced for a target word in each settings and this produced different levels of learning. Repetition was found to have a tremendous effect on language learning, thus supporting earlier findings (Lantolf and Pavlenko, 1995; Webb, 2007; Kurhila and Kotilainen, 2017). In the KDK, learners were able to request audio-visual help. The audio and visual aids provided by the computer was followed by one or both learners' repeated imitation of the target form. These indicate a range of learning processes on the

learners' side, such as listening and accepting what was uttered (participatory listenership), incorporating the repeated phrase into their own narrative (ratifying listenership), and finally reformulating the utterance to shape their own knowledge (expanding), thus supporting prior studies (Tannen, 1987, cited by Silva & Santos, 2006). These effects of echoing oiled the wheel of interaction in which learners could gain linguistic form and meaning of the target language. Thus, repetition offered scaffolded help for each other and served as a learning platform on which the learners could jointly manage a collaborative solution (Donato, 1994). However, in a classroom, a relatively low amount of self-directed talk was detected, which might explain why vocabulary learning was correspondingly less successful.

6.2.2.5 Contributory factor to Motivation

Digital technology offered a place in which real world tasks can be performed with physical objects in an autonomous way, creating scaffolding for learning. That is, both innovative technology and a real world task of cooking are behind an enjoyable learning experience for students. These all increased learners' motivation. This motivation in a smart learning setting turned out to promote their level of learning, allowing this research to stand in line with the findings of previous studies (Bax, 2003; Seedhouse *et al.*, 2014; Seedhouse, 2017). Learners were exposed to a real world environment where they enjoyed learning a foreign language and culture as part of socio-culture and socio-education. This integrative motivation consequently brought about intrinsic, extrinsic, and resultative motivation, building up their learning (Hermann, 1980; Strong, 1984; Gardner, 1985; Gardner and MacIntyre, 1993b). In a classroom, on the other hand, this learning and motivation effect has been restrictive as there were rules controlled by a teacher. This is not to say that students did not have a sense of motivation in a classroom, but rather suggest that the KDK could afford relatively higher level of learning compared to the one in a classroom.

Interestingly, some studies show that the relationship between motivation and L2 learning are not always related (see Garner & MacIntyre, 1993). Some results were even insubstantial. Nonetheless, this does not devalue the role of motivation in foreign language learning as other literature shows that highly motivated learners achieved greater success in language learning than those who are not as motivated (Sanaoui, 1995; Gu and Johnson, 1996).

6.3 Attitudes Towards Learning in Two Different Settings

In this section, findings from two data forms in Chapter 5 will be summarised and triangulated to answer the second research question as below. The aim of the second research question was to understand learners' perspectives and perceptions towards two different learning environments. The section also discusses different learning attitudes by comparing two settings. Questionnaires and interviews display learners' preference for a particular environment for learning and affective statements (as in Fig. 66).

> Research Question 2: *What are learners' attitudes to learning in two different settings?*

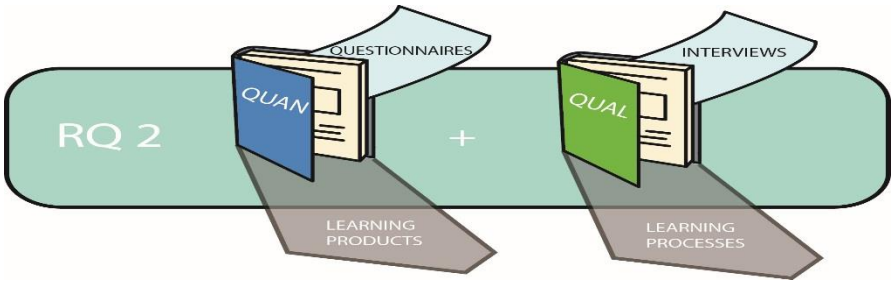

Figure 66 Data Mix for Research Question 2

6.3.1 Overall Findings on Attitudes

Overall, it was evident that as a whole, learners preferred the KDK to a classroom for learning. Stats from individual questions for each item demonstrated that students' preferences for a particular learning environment were comparable and distinctive between the two settings, with the digital kitchen at 97.9% and the classroom 62.5%. This showed their preferences toward learning environment of a digital kitchen. They were found to still like to learn in a classroom with a photo (52.1%), but showed overwhelming preference to have access to physical objects (72.9%) to acquire a specialised set of vocabulary and cultural aspects. The affective statements suggested apparent distinctions between two locations. Students had more positive feelings in the KDK than in the classroom. They were happier, more confident, friendlier, interested, energetic, outgoing, motivated to learn language and culture, and more motivated to eat food. All these results undoubtedly suggested that learners favour the KDK environment than the classroom setting. 3 out of 48 students, however, displayed a preference toward the classroom.

6.3.1.1 Different Attitudes

Attitudes toward computer-assisted learning turned out to be very positive, hence supporting findings of the wider literature (Levy, 1997; Ayres, 2002; Levy, 2007; Mahmoudi *et al.*, 2012; Afshari *et al.*, 2013). The beneficial affective factors brought in higher level of engagement in the task, which resulted in a greater level of information processes. The technology-enhanced learning environment had high face validity with learners. Of course, it does not mean that this learning approach should be taken as a replacement for classroom-based learning. Rather, it suggests that the digital technology should be taken as an extremely valuable aid in second/foreign language and culture learning. The findings are partly consistent with those in Henter's (2014) study that attitudes can serve as an indicator for learning outcomes, although her study does not reveal the relationship between attitudes and learning. However, this research showed that motivation or demotivation originating from a range of factors such as environments and learning materials could make a difference in learning. The KDK learners in an outside-the-classroom context were found to have a more favourable attitude towards learning (Oroujlou and Vahedi, 2011) probably because the digitalized setting allowed for a space in which human-computer interaction was possible, and an authentic real world task was carried out with real objects so they must have been strongly motivated to learn Korean language and culture.

Whereas in a classroom, they simply observed and manipulated photos of objects to complete the task, which neither offered a powerful means to make a connection to their memory, nor allowed learners to understand the reality of cultural aspects. Additionally, they could not use real aids necessary to figure out Korean behaviours, nor did they experience the taste of the foods crucial to understanding what Koreans like to eat. It would have been far easier had learners had access to actual objects in their hands. There is little doubt that learners' motivation was lower in the classroom. This claim is supported by the findings from interview-based thematic analysis in the next section.

6.3.1.2 Thematic Findings on Attitudes towards learning in two different settings

Obviously contrasting perspectives toward the two learning environments were shown among students as in Table 20, although not all agreed.

Table 20 Learners' Attitudes: Kitchen VS Classroom

Digital Kitchen	Classroom
Feeling great and enjoyable	Not enjoyable and just boring
Experiencing and flexible	Old-fashioned
More effective for learning	Less effective for learning
Connecting to memory	Hard to connect and relate
Friendlier and less difficult	Very difficult
Real and concrete	Abstract and confused
Not all traditional	Traditional
More interesting	Less interesting
More satisfied	Hard to memorize

A wide range of literature has suggested positive attitudes towards computer-assisted learning (Debski, 2000; Allum, 2002; Ayres, 2002; Stricker *et al.*, 2004). The KDK environment was seen to yield more positive reactions than the conventional environment, due to a range of reasons. Learners found a kitchen more enjoyable probably because of the digital technology and cooking, which helped them not just make food, but also to take part in social interaction with their partner and the electronics themselves (Reiko *et al.*, 2005; Lucia *et al.*, 2007). In particular, sensor technology and activity recognition provided learners with an opportunity to autonomously interact with other colleagues and the digital technology, which may further promote motivation (García and Arias, 2000) in their task performance, thus enhancing learning (Liu *et al.*, 2002; Ying, 2002). Furthermore, the domain of a kitchen offered physical objects to handle, which is why participants could have easier access to memory expansion for learning. The presence of real objects rather than photos served as a bridge for the learning process between simple information and meaning making (Nattinger, 1988). If learners are given information from the computer, they usually think and attempt to keep them in their memory by their own means (e.g. memorizing or writing down). In the KDK, a powerful tool aided them in learning vocabulary items and cultural aspects as real substances allowed for something touchable and multi-sensory (Trubek and Belliveau, 2009). They could even evaluate other's culture by tasting foods as a product at the end. By experiencing the way people from other cultures behave and eat, students were able to vividly understand others in greater

detail. Thus, technology and its affordances played a pivotal role in learners' taking positive attitudes (Stricker *et al.*, 2004). This is how learning is fostered in a digital kitchen.

However, classroom learners showed stark contrasts because of several reasons. The literature shows students' attitudes. Firstly, there was lack of interactivity with one another (Shen *et al.*, 2008), which took away a chance to build up knowledge. Furthermore, they could not access tangible objects and subsequently did not have a hands-on experience, which led to demotivation, resulting in less successful learning. Nevertheless, it was found that a few students still preferred to learn in a classroom. Physical objects served as a barrier to learning as some users were too focused on performing the task itself to learn, rather than working as a mediator to gain knowledge through the task. Rather, they found the visual means of photos just enough to understand. Furthermore, a classroom was shown to be more familiar for them for learning. This implies that the technology-embedded environment is not suitable for all types of learners, as is often the case. This is a point that should be fully taken into consideration, given various issues raised by a range of literature (Alatis, 1983; Jones and Fortescue, 1991; Bax, 2003) in relation to computer-assisted learning: high cost of software, low capacity of the equipment, lack of trained tutors, technology anxiety, and not being suitable for all learners. This reminds us as educators of what we need to pay more attention to and in what direction we should move towards in relation to the technology when teaching and learning a foreign language in and outside the classroom.

6.4 Cultural Experience

This section will summarise findings from three sets of data in Chapter 5 and discuss different learning processes in relation to culture learning to compare two settings by triangulating those data to answer the third research question as below. This question was designed to compare the product and process of cultural learning in two different settings. Cultural learning is seen as crucial because without it, foreign language learning is limited (Thanasoulas, 2001) and cultural knowledge oils the wheel of communications with native speakers (Bada, 2000). The conceptual model of cultural experience was based on Moran's (2001) framework, which helped not only define what culture is, but also explain what constitutes culture learning. Questionnaires show their learning as a product, whereas CA and thematic analysis demonstrate their learning as a process (Fig. 67).

Research Question 3: *Does using real objects to cook in the digital kitchen help them learn cultural aspects better than looking at photos of the objects in the classroom? If so, to what extent and how?*

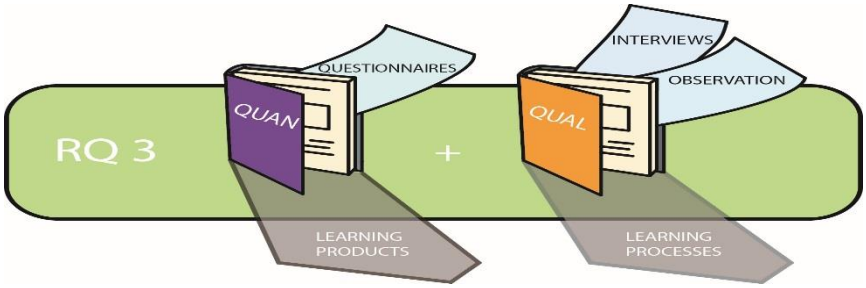

Figure 67 Data Mix for Research Question 3

6.4.1 Overall Findings in Cultural Learning in Two Settings

Overall, it was found that learners' cultural learning occurred more effectively in the KDK than in the classroom. The availability of real objects in the KDK (97.92%) created more successful learning than in the classroom (62.50%), and this was statistically significant. Students learned foreign cultural aspects better when in direct engagement in the KDK by handling actual items than when in the classroom by simply using photos. Affective statements also displayed a distinctive difference for learners' predisposition between two settings. A digital kitchen fostered more successful learning.

These findings support results from other studies examining the culture learning in a technology-enhanced environment. The computer technology provided an appealing platform for learners' cultural experience, promoting the learning of the target culture (Hanna and de Nooy, 2003; O'Dowd, 2003; Ho, 2013). A real world learning environment of a technology-embedded kitchen allowed learners to be able to acquire Korean cultural knowledge by offering a chance for learners to perform a real world task of making a Korean dish by using real objects. What was noticeable in this research was the importance of physical objects to learn Korean cultural aspects as in vocabulary learning. This helped them understand cultural information and compare them with their own culture in a digital kitchen. Since those studies above dealt with cultural learning made only in virtual learning environments in which real objects can never be offered for learners to use, the current research widened the research scope in the sense that a real world environment has been used for cultural experience. Then, how and why could learners achieve more successful learning about culture in a digital kitchen?

6.4.2 Learning Processes in Culture Learning in Two Settings

As learners encountered another way of life, they could experience four interconnected learning interactions in both settings alike: the four cultural *knowings* (see Section 2.3.4). The everyday environment of a kitchen generated a more desirable learning space in which learners used actual objects to experience the target culture, offering learners better opportunities to enhance cultural 'knowings', whereas the traditional setting could not provide tangible objects, which took away their motivation to learners' cultural involvement, hindering their learning process of cultural aspects. A range of different processes seem to come into play.

6.4.2.1 Physicality

It might be because the KDK provided specific information about physical food ingredients and equipment, the workplace, the rules and regulations, and the responsibilities of people who work there (*knowing about*). The cooking itself is a form of 'doing' (Ellis, 2003), entailing learners' direct participation in and engagement with the everyday life of Korean people according to Korean food customs and traditions. Cooking involves using physically authentic tools (*knowing how*). Learners carried out a cooking task in the manner of Korean people through a range of cultural practices such as touching, looking, saying, and using actions such as body movements and other non-verbal communication cues. Thus, first-hand engagement offers learners an opportunity to directly encounter another way of life for themselves.

The importance of direct experience in a foreign culture is also confirmed by the following Japanese EFL teacher's description (Moran, 2001, p. 132): *This experience gave me an awareness that knowing from direct, concrete experience was quite different from knowing through intellectual information. I believe that experience helps people gain more real, powerful, and deeper understanding of themselves*. It showed that authentic practices help learners establish a genuine relationship with the target culture. This can be interpreted as that in the KDK, learners were given a chance to encounter and absorb a real way of Korean life. This means learners change their behaviours to develop *Koreanness* appropriately, to adapt and integrate into Korean culture. In contrast, the classroom did not provide learners with the powerful mediator to bridge the gap for an actual cultural encounter. As a result, it was limited in adapting to the target culture. In this sense, it can be claimed

that ‘physicality’ plays an instrumental role in enriching culture experience and learning.

6.4.2.2 The teacher-student relationship

Finally, the teacher-student relationship might affect culture learning (Moran, 2001). He suggests that teachers must establish a relationship with students to properly guide them through the four stages of the experiential learning cycle as teachers function as mediators, who help students move from one culture to the other. However, the finding of this research does not resonate with Moran’s study. It is because the research showed that a learner-centred environment constructed a space in which learners take more time to negotiate and confirm their cultural learning to find out a solution to interactional breakdown. The autonomous way of learning in the KDK enabled learners to have more meaningful communication than in a teacher-led classroom, lending support to previous research (Larsson, 2001).

To sum up, the process of cultural learning is attributed to a range of factors. Learners could gradually develop their ability to integrate into a foreign culture, depending on the instructional context in which the learning occurs, cultural comparisons, their attitudes towards learning environments, and the teacher-student relationship. At the core was direct engagement and encounter with the target culture by the use of physical objects.

In broader terms, the experiential learning cycle occurs throughout learners’ experience and cultural *knowings*. Learners participate either directly or indirectly in the target culture and are engaged on a range of levels – physically, emotionally and intellectually. This becomes a concrete experience through which learners are given a chance to reflect on their observation to describe and explain the target culture. Subsequently, learners interpret the experience and then construct meaning about the experience by developing explanations about the target culture, which is known as the learning process ‘abstract conceptualization’. Eventually, they put their experience into practice consistent with their own learning goal or preference: active experimentation. In this sense, the cultural experience, learners’ encounter with Korean way of life, supports Kolb’s (1984) notion that all learning is experience.

6.4.3 Language, Culture and Food

As language and culture is a vehicle through which people interact and communicate with one another, cooking and eating food played a significant role in culture. Cooking is a universal task which is seen in every culture. It is a social activity

where one not only shares his or her experience, but enhances relationships with others. Cooking was able to build up a solid bridge through which participants enjoyably learn another way of life from the target culture, supporting previous findings (Kurlansky, 2004; Trubek and Belliveau, 2009; Seedhouse, 2017). The five senses through food allow human beings to show their feelings whether or not they like the food, and the following wordless expressions themselves, such as ‘wow’, ‘hmm’ and various gestures represent cultural identity (Robbins, 2011). Cooking and eating food is not just a source of pleasure and comfort (Ayeomoni, 2011), but also a mediator of an enjoyable and engaging activity for culture learning. Therefore, food and culture inevitably goes together, confirming a prior research finding (Joan Catherine, 2014).

Language learning can be thus completed by learning cultural phenomena, which is not just rich in food, but is embodied by the food of each culture. Language, culture and food are thus interwoven to the extent that one leads to the other. Therefore, integrating the local cuisine into the language learning process in this study is an excellent way to uncover the local culture of the native-speaking country whilst learning new language.

6.5 Implications for research on TBLT in combination with the technology

The analysis of the data suggests implications for those planning to design and implement a similar real world learning environment as the KDK: (a) the expansion of the learning environment, and the significant effect of physicality on vocabulary and culture learning, (b) three points in the field of TBLT in CALL, and four more practical implications: (c) a real world environment, (d) autonomy, (e) computer technology and (f) technology transfer from a region to a broader world.

6.5.1 Pedagogical implications

Firstly, this study addressed the issues of classroom and virtual learning environments by showing that a real world space was beneficial in terms of language skills, raising cultural awareness, and changing attitudes towards native and target societies. Whereas the majority of CALL research has focused on tasks, contexts, and resources occurring in virtual learning settings (Hampel and 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 KDK was characterized by affordances in which the kinaesthetic mode can be employed, so students not only learn a foreign language, in particular vocabulary, but also directly encounter another way of life. The KDK turned out to be a more enriching environment for vocabulary

learning in which the atmosphere of interaction and the level of motivation via cooking is unrivalled by virtual learning platforms. Therefore, the real world learning environment might be taken more into consideration as a resource for second/foreign language learning and teaching.

Such a real world learning environment should be tailored to a student's needs. As revealed, the KDK environment results in learning more effectively than in a classroom. Huang (2015) suggests that "new generation of learners appeals for technology – rich, flexible and comfortable learning space" (p. 255). Given the digital generation's needs, learning settings should be organized in such a way that technology and pedagogy can be fused. While such applications to a real world environment remain at an infant stage, it is believed that the framework will be a significant direction in the future learning space.

The pedagogical approach of TBLT has been successfully blended with modern technology, showing that the combination created a learning environment where vocabulary learning in particular was made possible. Considering the fact that task-based approaches in language education and their applications with digital technologies have been growing in prominence, particularly in the sphere of educational practice over the past two decades (Thomas, 2009), an implication of this study is that TBLT in combination with technology can serve a purpose for mediating foreign language learning as well as changing pedagogy both in and outside of classrooms.

The fact that very few pedagogical applications of TBLT in the outside-the-classroom context have been made was one of the main research gaps filled by this study. The current study clearly shows that TBLT is robust and sound enough to be used outside of the classroom for foreign language teaching and learning. So, the findings, while preliminary, suggest naturalistic settings can be useful for TBLT, providing an authentic and motivating environment for learning. This is surely one rich vein of research to continue in the future.

This study demonstrated that users could learn Korean through TBLT and CALL. Given that few studies have explored the pedagogical challenges in Oriental language contexts, where impediments and obstacles are likely to occur (Thomas and Reinders, 2010), the present study raises the possibility that technology-mediated TBLT can be well integrated even in non-Western contexts. This issue will be reflected on in detail in Section 7.5.

6.5.2 Practical implications

The fact that a real world environment was preferred among students also has practical implications for the school curriculum. Increasingly, the schools send students on field trips to places like museums and factories for educational purposes, probably because direct engagement in a real life activity aid their learning more than merely looking at textbooks in a classroom. Considering the sheer joy of experiencing a real world environment (Seedhouse, 2017), the curriculum will be able to be developed in a way that has a great deal to offer to language learners, so as to ensure the sustainability of pedagogical innovations.

The findings show that a real world setting allowed peers to autonomously collaborate with one another and even with the computer, and it turned out to be very fruitful for language learning. It is because the real world learning environment itself offers a variety of affordances and a platform for creating learning opportunities such as equal negotiations among peers (Kurhila and Kotilainen, 2017). This implies that when planning and designing technology-enhanced learning environments, the learning setting and tasks should be planned carefully in such a way that opportunities for repeated interaction can be ensured.

The digital technology employed in this study represents a fruitful resource not just in the educational arena, but also for other areas. The findings suggest that the technology-embedded setting was preferred, which increased learners' overall motivation. Learners also found enjoyment in their tasks when integrated with the technology as in Ravichandran's (2000) study. This implies that educators should take advantage of technology when designing the curriculum and developing teaching materials. Of course, computer technology is not a cure-all for language teaching and learning as there are a range of learning styles and strategies. The appropriate use of new technologies, however, allows for a more thorough combination of lesson materials and delights than ever before.

This study finds the everyday activity of cooking useful as a resource for language learning. There are a range of daily activities such as traditional games and martial arts in our life that could be adapted as pedagogical resources. If it is combined with technology and used in strategically important regional sites such as a local community centre (Kiaer, forthcoming), this will be able to promote international languages and culture in order to help anyone better realise their social, cultural and economic potential in this multilingual and multicultural era.

Many vocabulary learning studies have been arguing that technological affordances such as pictorial and textual aids enhance students' learning through tasks (e.g., Mohsen, 2016). In addition to them, by accepting that the kinaesthetic mode of physicality helps internalize linguistic and non-linguistic information deep in memory (Seedhouse, 2017), we may gain a deeper understanding of vocabulary learning and its process. It is hoped that the findings of this study will build on what was ambiguous in previous studies and add to the literature of TBLT with technology.

6.6 Chapter Summary

Chapter 6 set out to synthesize the findings from Chapter 5. Based on these findings, it is possible to draw a tentative portrait of successful learning for foreign language vocabulary and culture in the KDK. A range of environmental factors contributed to different learning outcomes and processes between the KDK and a classroom; where all five senses or fewer ones are used; whether the task that learners are performing is real-world or merely pedagogically-designed; how autonomous the learning environment is; whether a learning space can be established for linguistic repetitions; and whether the learning setting is motivating or monotonous. The technology-enhanced environment of the KDK provided a more enriching space where physicality is activated through the authentic, real-world task of cooking in an autonomous way, which helps increase their motivation. As a result, students could learn the Korean language and cultural aspects more effectively in the KDK than in the classroom.

Therefore, I argue that the digital kitchen can provide a motivating learning environment which is multi-modal, multi-sensory, multi-interactional, multi-experiential, and multi-layered. It is physicality, meaningful tasks, and computer affordances that foster students' learning in vocabulary and cultural aspects, as well as positive attitudes.

Chapter 7. Conclusions

7.1 Introduction

This final chapter revisits the aim and research questions of the present study, and draws together all of the main ideas from a range of evidence and analyses in the previous chapters. The chapter also offers contribution to the field of applied linguistics, followed by reflection on the methodological and pedagogical approach. This leads to the overall limitations of this study and suggestions for future projects.

7.2 Revisiting the Research Aims and Research Questions

7.2.1 Revisiting the Research Aims

The main focus was to address a range of well-known issues relating to language learning in the classroom in several ways. The primary aim of this study was to attempt to allow for actual task performance for learning for international adult students. More specifically, the target, as stated in Chapter 1, was to understand to what extent physical manipulation with real objects affects foreign vocabulary and culture learning in comparison with when only photos are used in a classroom. This was considered important in light of the issues related to a task-based learning method inside the classroom context (Seedhouse *et al.*, 2013; Seedhouse *et al.*, 2014). Following Seedhouse's (2017) notion of multimodal learning experience, the study sought to thoroughly examine a physical factor to language learning in a holistic learning environment of a digital kitchen. To this end, this study carried out a quasi-experiment in which learners' vocabulary learning in two different settings was compared. The study examined whether the intervention affects learning in two different learning environments and, if so, to what extent and how it brings about this distinctness. In particular, the impact of physicality on foreign vocabulary learning was examined.

In light of claims that language and culture are entwined with each other (Byram *et al.*, 2002; Montanari 2004), a secondary research target was to explore whether or not the digital kitchen affects learning of cultural aspects compared to the classroom. The third research aim was to see if learners' motivation is activated more in a technology-enhanced setting, considering the effects of motivation on learning (Bax, 2003; Ellis, 2003; Seedhouse *et al.*, 2014). To achieve these goals, the two environments of a kitchen and a traditional classroom were compared and contrasted.

Finally, since pervasive computing specialists predict that the technology allows for immediate Human-Computer Interaction from a distance and that the future sees

every corner of our homes embedded with digital sensors, this research aimed to construct a learning space for daily activities to be used as a learning resource.

Following the latest research models of a real-world environment in combination with a task-based approach for language and culture learning, the contribution of the current research is to extend the scope of a previous model. Exactly which factors contributed to foreign language vocabulary learning in Seedhouse's (2017) model of the EDK was ambiguous, but these were evidently identified in the KDK - physicality and meaning tasks via a multimodal experience in a multimodal learning environment. Furthermore, by using the global language of Korean, rarely applied in TBLT, this study responds to calls for more theoretical sophistication in research on the digital technology and learning, and for further empirical study into the applicability of general task-based learning models for other Oriental languages.

7.2.2 Summary of Findings

Employing a range of data sets from two different learning environments and using a mixed research design to collect the data, three research questions were answered.

For research question one, statistical data demonstrated that the KDK users registered higher scores on vocabulary learning to a significant extent compared to classroom learners. Through observational and interview data, the different levels of learning were demonstrated, showing that the former setting could create a more enriching atmosphere for finding out solutions to the problem than the latter: (a) negotiation, (b) collaboration, (c) repair and repetition and (d) information transfer. What is more, other determinants such as multi-sensory experiential learning, autonomous learning, and motivation allowed for more successful vocabulary learning in a kitchen than in a traditional learning setting. Thus, these environmental factors in two separate learning settings appear to have contributed to different learning outcomes and behaviours. In particular, touching physical objects was found to make a big difference in learning.

For the second research question, analyses drawn from questionnaires and interview data revealed that the preference between the two learning settings was skewed towards the KDK. Moreover, learners chose real, physical objects to learn a specialised set of vocabulary and culture. The availability of hands-on experience boosted their motivation, which resulted in different levels of learning. These all lay behind the remarkable distinction between two settings in terms of affective statements. Learners showed more positive feelings and emotions in the KDK than in the

classroom. However, as discussed in Section 5.3.2, three learners were the exception, as they found a classroom more familiar to learn a foreign language.

The third question was also answered by clear evidence from questionnaires, observations and interviews. The technology-embedded environment itself helped co-construct the active interaction, which allowed for meaningful communication between learners. More importantly, physical objects enabled them to use their five senses, which offered unrivalled level of motivation, thereby promoting cultural learning outcomes.

From these findings, it could be concluded that the KDK was able to create a more enriching learning environment than a conventional learning setting. A digital kitchen offered a variety of affordances which were not possible in a classroom. Specifically, a digital learning environment allowed for a range of affordances: all five senses available for learners to use, learner-centeredness (autonomy), an actual task, control over the task, freedom, learning individualisation, and proactive human-computer interaction. As a result, participants' motivation increased. By contrast, a traditional setting offered relatively different aspects: only one or two senses, teacher-oriented, a conventional task, less freedom, less tailored learning, boredom, and less interaction. Consequently, their enthusiasm for learning decreased. It is these differences that contributed to the different results and processes of learning in two settings. In particular, this bolsters Nattinger's (1988) study that concrete objects can enhance vocabulary learning. Furthermore, Pennington and Steven's (1992) and Ellis's (2003) study are supported in that learning effects are improved when autonomy is ensured. Therefore, this study strongly claims that physicality enhances learning of foreign languages and cultural aspects.

7.3 Contributions to the Field of Applied Linguistics

This section summarizes the contributions of the current study by looking back at the Korean Digital Kitchen (KDK), and suggests stages and procedures which should be followed. It also deals with issues to consider in constructing a digital learning environment for wider use.

This research has employed principles and procedures that previous projects (Seedhouse, 2017) had drawn out in order to build the model of a new pervasive learning environment using digital sensor technology and task-based methods, and to enrich our understanding of how this model can be used in practice to explore the

effectiveness of modern technology on language learning. The KDK makes contribution to the development of technology and understanding in several ways.

Firstly, the KDK incorporated the technological components of the EDK to produce the Korean materials for learning language and culture. Recycling the latest technological development, this study reaffirms the potentials of digital technology which might shape the future of the environments for foreign language learning and teaching in relation to CALL. The technology helped the KDK create pedagogical materials, by which participants learn linguistic and cultural knowledge of Korean. It means newly-designed materials contributed to modelling the way possible pedagogical challenges in using a different language can be overcome, expanding the applicability of the digital technology. That is, the contribution of the current study has been to confirm that the digital kitchen works for Korean language, culture, and materials as well as for European ones. This study is therefore able to build on the majority of studies in CALL by providing one more application of digital technology.

Secondly, the current study also builds up one more dimension of psycholinguistic factors in language learning, suggesting that physicality makes a difference in vocabulary learning. Memorisation was previously known to occur effectively when word information and images are combined. Now, not just verbal and visual modes, but also the kinaesthetic mode turned out to help learners encode any given information in a way that facilitates efficient storage and retrieval. Engaging all five senses, combined with learning by doing created new levels of understanding (Trubek and Belliveau, 2009, p. 16). Even though previous kitchen studies (Seedhouse *et al.*, 2013; Seedhouse *et al.*, 2014; Preston *et al.*, 2015; Seedhouse, 2017) have argued that learning is enhanced when touching follows, none of them proved actual advancements on vocabulary knowledge. This study is one of its first to show that *physicality* helps vocabulary learning in combination with CALL by using a quasi-experimental design. Thus, multimodal mnemonics might be worth being used as a tool that enables our brain to have better retention of the information. This offers enriching soil for research in SLA.

Thirdly, this study is one of the first to apply technology and EDK (European Digital Kitchen) to teaching the Asian language of Korean. As previous kitchen projects have only used Western-based languages, they faced the criticism that TBLT only reflects Western educational values. By trialling the KDK, the study not only creates a stepping stone of applying the pervasive digital learning environment from the European consortium to the Oriental one, but also starts to expand the horizons of

TBLT from an Anglo-American creation to a World-Language learning approach (see the next section of 7.5 for further discussion).

Fourthly, very little attention has been paid to the field of CALL and Korean as a foreign language (KFL). Since this study is one of the pioneering projects for Korean language and culture learning in combination with technology, it does not merely expands the horizons of pedagogical applications in Korean, but satisfies the needs of one of 'eclectic methodology' for Korean language education (Yeon, 2015, p. 1).

Finally, in a macro sense, this study opens doors for cultural exchange among the younger generation, promoting Asian language and culture in order to help people better realise their social, cultural and economic potential. The UK government is, for example, starting to recognise the importance of Asian languages. The Confederation of British Industry (CBI) (2013) claims 70% of businesses value foreign language skills among their employees. In the British Council's 'Languages for the Future' report by Tinsley *et al.* (2013) which lists the most important languages for the UK in terms of trade, diplomacy, and security, Asian languages have the following ranking: Arabic(2nd), Mandarin Chinese(4th), Turkish(8th), Japanese(10th), Hindi and Indian languages(13th), Korean(14th). These languages are represented by significant speaker populations in the UK. Yet, provision of Asian language teaching is still poor compared to European languages. The same might be true of other international countries which face a similar challenge in foreign language education. The importance of learning other languages and cultures in our global generation can never be overemphasised. An innovative way of learning Korean language and culture via an everyday activity in this project contributes to addressing this issue of provision in a way that appeals to our younger generations.

In this sense, the present study is unique and original in foreign language learning contexts. However, the model of this study is not without issues to be resolved. The KDK environment needed a huge amount of money to build as it involves a series of technical devices including electric sensors. At present, the digital kitchen cannot be produced on a large scale; currently only five such kitchens have been built in use in co-working institutions around Europe. Furthermore, it might take much time to develop the design and apply it to the curriculum; it also needs a wide range of research in other systems and skills such as grammar, writing, speaking, and listening in addition to vocabulary learning. Only when these problems can be addressed to a certain extent could this model achieve a wider use. Thankfully, these issues are in the process of being addressed by interdisciplinary collaboration by Professor Seedhouse and Dr Rob

Comber at Newcastle University who are trying to create smartphone apps in an EU-funded project called 'Linguacuisine', where app-based technology replaces sensor-based technology. Therefore, the development of the apps is expected to not only reduce the cost of instalment of the kitchen, but make engaging technology available and accessible to a very wide audience in the world soon.

7.4 Methodological contribution

Having reviewed the contributions to the field of applied linguistics, this section presents a methodological contribution by showing a model for researching language and culture learning in real-world digital environments. Drawing on a data collection method in a previous vocabulary study (Pallotti *et al.*, 2017), this study incorporated a mixed methods approach into the model to demonstrate both the product and the process of learning. The research framework was originally designed to provide convincing evidence showing the effectiveness of the KDK with digital technology, rather than simply having a trendy technological environment. To this end, a quasi-experimental design was employed comparing the two different learning settings. It is made explicit here how this could be accomplished for researching language learning.

The methodological model consists of three components: a) a methodology for gaining the quantitative data relating to learning as a product of the use of the digital technology; b) a methodology for audio-visual recording, describing and analysing the multimodal process of learning; c) a means for obtaining self-reported data showing participants' perspectives towards two settings.

a) *A methodology to gain quantitative data for showing learning as a product*. Evidence is inevitably needed to show how an innovative learning environment helps learning. So, the design included a cycle for the collection of quantitative data through pre-, during-, and post-tests, which show participants' knowledge gains. Statistics are useful to compare the learning, investigate relationships between settings, and make informed interpretations about the association (Chance and Rossman, 2006).
b) *A methodology for observational data for demonstrating learning as a process*. This research employed CA, a holistic methodology for the analysis of naturally-occurring spoken interaction (Seedhouse, 2004). CA helped portray multimodal depiction of learning processes, and uncovered how learners turn to features in the environments in interaction with peers, a computer, and a teacher in micro-detail. In this sense, the approach was really useful.

c) *A means for obtaining self-reported data*. This study tried to examine the effect of the digital technology on cultural learning. However, it was hard to assess participants' learning in cultural aspects via the three tests. To address this issue, a questionnaire was used to measure it quantitatively. Moreover, interviews were conducted because the method could offer a very powerful tool for gaining insight into the situation, such as participants' unaware but crucial behaviours and perceptions relevant to learning (Cohen *et al.*, 2011).

Likewise, quantitative data built on up to qualitative data for triangulation. Specifically, statistics revealed learning as a product that is not evident in observation, while observations helped uncover the process of learning that can't be captured in statistics. That is, the mixed methods approach made possible what a single-approach design cannot; it enables the collection of evidence from multiple sources for learning about specific items for the purpose of triangulation. It is recommended that these points should be borne in mind at the start of designing a real world digital learning environment given the multi-faceted nature of digital learning settings.

7.5 Reflections on Pedagogical Design

Back to the pedagogical design, this study shows that TBLT principles can be applied to an outside-the-classroom context to aid learning. The pedagogical approach has however been theoretically criticised in three ways, namely too much focus on functions rather than pleasure and creativity, cultural relativity, and less communication (Ellis, 2003, p. 328-38). Motteram and Thomas (2010) report on "criticisms" of the approach in relation to CALL (p. 229). This section discusses what the three criticisms are and how this study attempts to overcome each issue.

The first criticism is that TBLT is functional as opposed to enjoyable and creative in relation to language education. The KDK participants found their experience of cooking very pleasurable and creative, since they made authentic and foreign food, which could be admired and eaten. By building on Seedhouse's (2017) comments, the study considered Motteram and Thomas' (2010, p. 229) notion of 'net generation', which is a term coined by Tapscott (1998). The term suggested by Motteram and Thomas refers to the current members as different from previous generations. They take into account ten criteria when evaluating the suitability of learning materials. This study was designed according to ten features the net generations exhibit on the basis of learning principles:

- *They are independent, wanting to access information themselves*; The KDK provides an environment where autonomous learning occurs via a range of affordances.
- *They exhibit emotional and intellectual views*; The KDK exposes learners to language, culture and cuisines totally different from their own.
- *They are interested in social inclusion*; The environment emphasises the inclusion of people with different language and from other cultures.
- *They demonstrate free expression and strong views*; Throughout the tasks, users are able to evaluate their experience.
- *They are keen on innovation*; The digital technology for learning via cooking foreign cuisine is clearly innovative.
- *They emphasize mature attitude to life and learning*; They are able to make decisions and control the linguistic resources.
- *They are investigators*; They are able to play an active role in examining linguistic and non-linguistic aspects by controlling the computer tablet.
- *They enjoy exploring the myriad of opportunities available on the computer*; They are able to request help for learning as many times as they want.
- *They have a sense of immediacy*; the physical nature of real cooking task offers immediacy involving all senses.
- *They want to do everything at a high speed*; The cooking task can be performed at users' convenience.

The second one is "cultural relativity", that TBLT only reflects western educational values (ibid., 2010, p. 230). The KDK project has overcome the criticism by trialling the cooking session in a different way, by employing an Asian language and culture: Korean. It has shown that the pedagogy for Korean vocabulary learning was successful. Furthermore, this study engaged participants with foreign cultures and languages from 20 different countries and they showed no resistance to TBLT. This suggests that the pedagogy is no longer an Anglo-American creation. This research opened the door to the idea that EDK might be able to be applied to any language in the world.

The final one is the "impossibility of communication" in TBLT (ibid., 2010, p. 231). As the task in the classroom does produce insufficient opportunities or motivation enough due to lack of authenticity, the issue of developing communicative competence may arise. The KDK provides a real-world environment in which learners experience

the naturalistic communicative acts in real-life contexts, thus constructing situational authenticity. The authenticity is ensured also because the technology offers a range of supports for learning. This is how the pedagogical approach in combination with technology has developed.

The field of foreign language teaching and learning has long seen a range of innovative ways that can help with teaching and learning practices in and out of the classroom. One of them is to use two concepts of cooking and technology. Cooking-related programs on TV have been increasingly cropping up all over the world, probably because cooking is a universal task closely related to culture, and it is most importantly enjoyable. Digital technology has transformed teaching and learning and been much in use in an education arena. Therefore, the everyday activity of cooking in combination with technology may occupy a special position in relation to TBLT. Given the findings of the present digital kitchen study, it is clear that TBLT can provide a suitable basis for designing a pervasive digital learning environment.

7.6 Limitations and Further Research

In spite of contributions of this study, there are several limitations, which present possible directions for further research. Firstly, although this research has shown the difference between different levels of physicality on learning, there were a number of other supports that might be responsible for the outcomes. They include using the objects to perform a meaningful real-world task, involving all senses, and being able to self-organize learning using a range of environmental support. Time differences spent on carrying out tasks between two settings might be also one of the factors. It is not clear primarily which factor leads to significant difference. Therefore, further research in this point in combination with new languages and cuisines would be recommended.

Secondly, this study focused on students' learning of a specialised set of vocabulary, namely food-specific nouns. Learners could obtain the word knowledge needed to complete the task and understand what each ingredient and piece of equipment means. Consequently, they were likely to have problems figuring out exactly what the instruction conveys in terms of manipulation. Meaning was usually derived through the assistance of images, rather than by understanding other parts of speech and linguistic systems. Future research could therefore expand the word item into more variety to unearth what aspects of language and how learners understand. This research might further examine the use of the technology not just in such language system learning as in grammar, phonology or function in full, but in language skills

improvement, namely reading, listening, writing, and speaking. For example, as learners perform tasks by listening to sounds given by the digital kitchen, they can be given tests for listening comprehension in the end. The investigation of these areas with new languages would be fruitful.

Finally, this study tried to link language to culture and food, but the thorough investigation of the relationship among language, culture, and food was beyond the scope of the present study. Future studies could therefore for example undertake more in-depth investigation of the interplay among the three concepts with regard to learning in a real world environment.

7.7 Concluding Remarks

I'd like to conclude this thesis by quoting what the President of one of the world's leading IT companies named *Measure* commented in a report commissioned by Homeland Security Today (2015). This encapsulates and echoes the need of digital technology in our life. Of course, there are many negative sides of the technology, but the report illustrates that people have to make the most of what we create for a better world, by taking striking examples of how drones rebuild peoples' life in disasters such as earthquakes in Haiti in 2010 and typhoon in Haiyan, the Philippines in 2013.

> *We have a unique opportunity to save lives and rebuild communities… Drones can be effective and efficient tools for humanitarian purposes, we just need the right blueprint to help realise their potential as a tool for good*. (Justin P Oberman)

I hope this doctoral thesis has played its own role, whether small or big, in contributing to our understanding of whether digital technology affects second/foreign language learning, and in what way it benefits language learners. Considering the increasingly diverse range of technologies available for use in foreign/second language learning and teaching in and out of the classroom in the 21st century all over the world, it is inevitable that education professionals will need to keep up with the times and know how to use technology. In this sense, I hope that the findings from this project will serve as a useful resource not only for learners and teachers in Korean, but also for all foreign language learning students as well as researchers, so that the design and curriculum for learning continues to advance. To this end, it might involve educators not only having to understand the revolutionary technological advancements available right on our doorstep, but also taking action to achieve their goal. Perhaps, now is the time to frame the right blueprint of digital technology and maximise its educational potential, just like technicians flying drones for humanitarian purposes.

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Appendices

Appendix A. Recipe for *Kimchijeon*

Asian Digital Kitchen

LanCook

김치전 *(kimchijeon*, kimchi pancake)

Promoting Korean language learning, mobility and collaboration through cooking and technology!

※ Recipe

Kimchijeon is a Korean pancake-like dish, primarily made with sliced kimchi, flour batter and sometimes other vegetables. Kimchi, spicy pickled vegetables seasoned with chili pepper and jeotgal, is a staple in Korean cuisine. The dish is good for using up ripened kimchi. *Kimchijeon* is often recognized in Korean culture as a folk dish of low profile that anyone could make easily at home with no extra budget.

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.*

※ Application of the recipe fit for the current study

Target Vocabulary items: Kimchi, flour, water, oil, a frying pan, a chopping board, a knife, a big bowl, a spatula, a whisk

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

※ Photos of ingredients and equipment to be used

PRE-TASK

1. 김 치 (*kimchi*, kimchi)

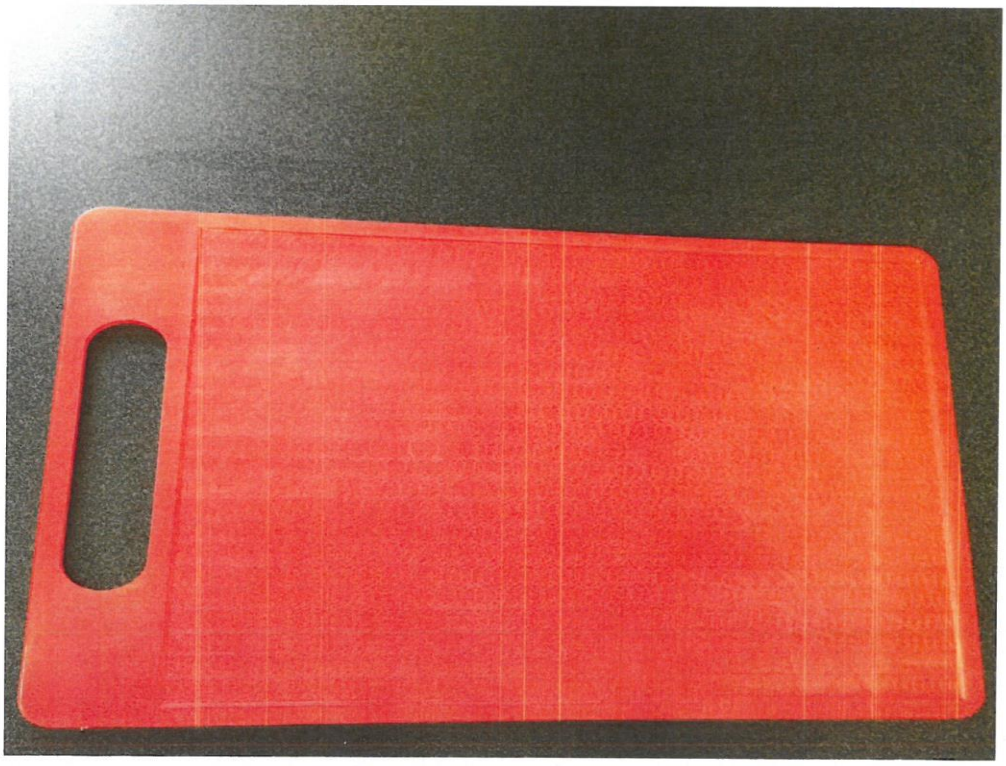
2. 밀가루 (*milkaru*, flour)

3. 물 (*mul*, water)

4. 식용유 (*sikyongyu*, oil)

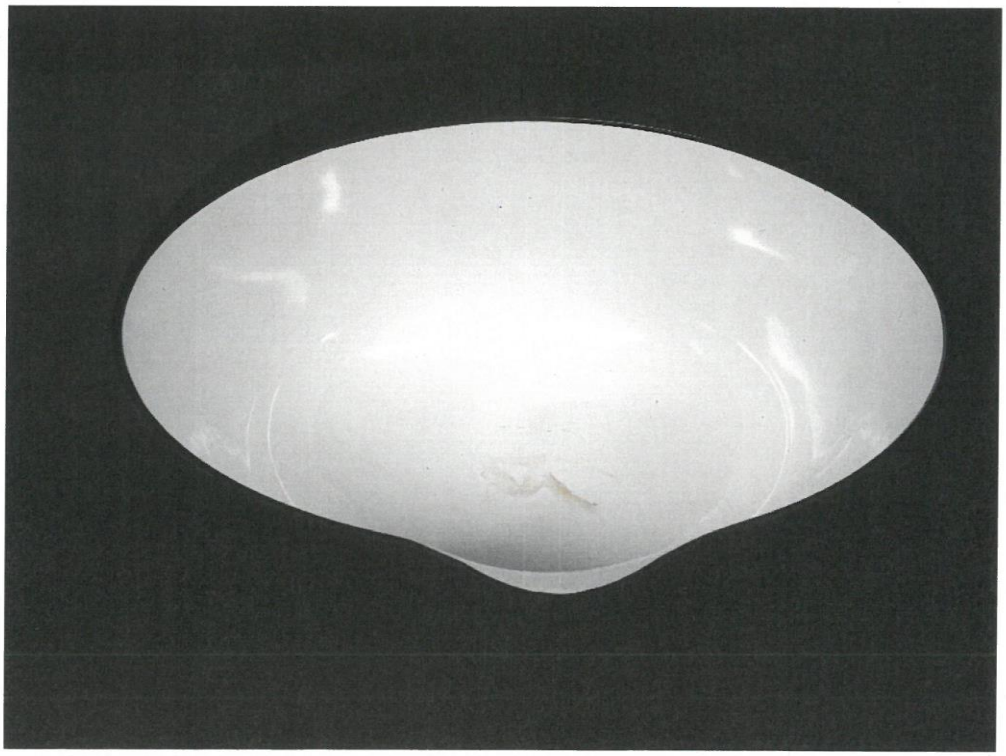
5. 후라이팬 (*huriapan*, a frying pan)

6. 도마 (*doma*, a chopping board)



7. 칼 (*kal*, a knife)

8. 대접 (*daejeop*, a bowl)

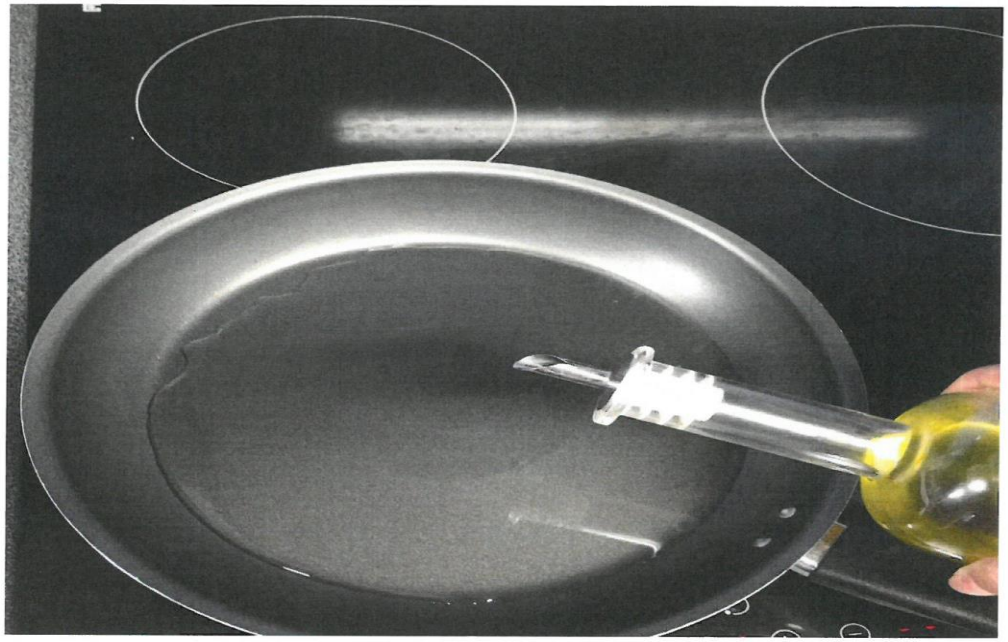


9. 뒤집개 (***duijipkae***, a spatula)

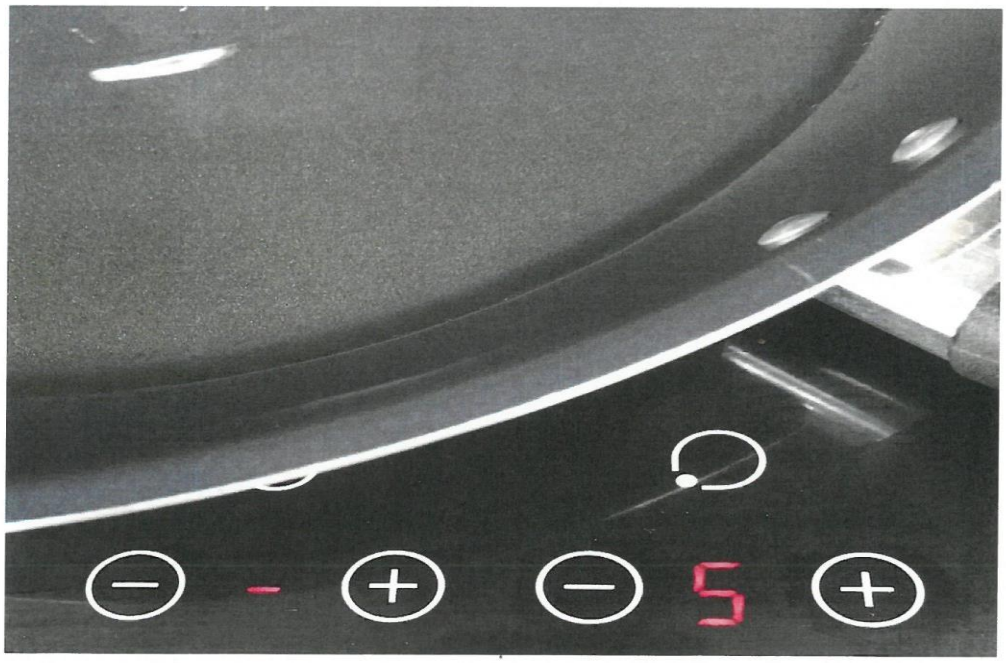
10. 거품기 (***geopumki***, a whisk)

DURING-TASK

1. 후라이팬에 식용유를 부으세요 (put *sikyongyu* into *huraipan*)

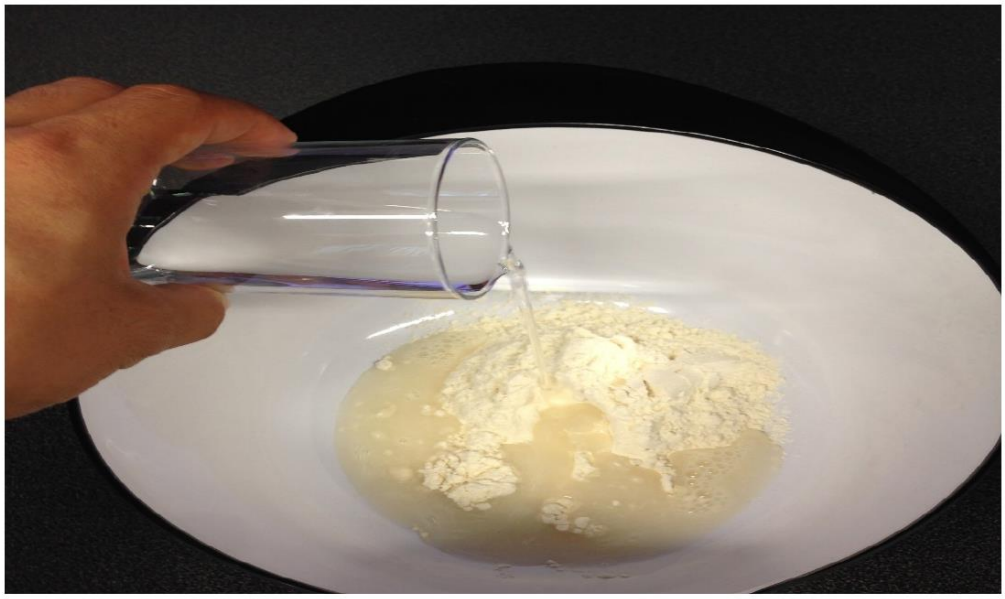


2. 후라이팬을 5 도에 가열하세요 (heat the *huraipan* to the *5*)



3. 밀가루을 대접에 부으세요 (put *milkaru* into *daejeop*)

4. 물를 대접에 부으세요 (put *mul* into *daejeop*)



5. 김치를 대접에 넣으세요 (put *kimchi* into *daejeop*)

6. 거품기로 잘 섞으세요 (mix them with *geopumki)*

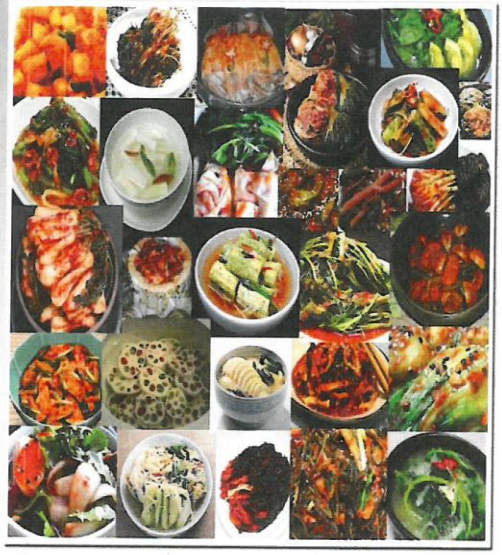
7. 뒤집개로 후라이팬에 반죽을 펴주세요 (using ***duijipkae***, put the mixture into ***huraipan***, and spread it out)

8. 3-5 분 뒤 뒤집개로 뒤집고 익으면 불을 끄세요(using ***duijipkae*** turn it over in 3-5 minutes and turn off when it's done)

9. 뒤집개로 김치전을 도마 위에 올려주세요 (using ***duijipkae*** place ***kimchijeon*** onto ***doma***)

10. 칼로 썰어주세요 (using ***kal*** cut it as you like)

11.Now before tasting the dish you made, let's learn more about Kimchi



POST-TASK

1. 자, 이제 맛있게 먹어봅시다! (Now, enjoy the dish as you like!)

Appendix B. Recipe for *Yubuchobap*

Asian Digital Kitchen

LanCook

유부초밥 (*yubuchobap*, rice covered with fried tofu)

Promoting Korean language learning, mobility and collaboration through cooking and technology!

※ Recipe

Yubuchobap is a Korean dish, made with seasoned fried tofu and rice. It is one of the popular lunch box and picnic foods in Korea. You can make it very easily at home as long as you have ingredients ready. You can find the proper ready-made kits of ingredients at Korean and Japanese grocery stores as well as in Asian ones.

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

1. Put chopped cucumber and carrot into a bowl.
2. Make two cups of rice and put it into a large bowl.
3. Add the vinegar-based sauce to the warm rice, and mix it well with a wooden spoon.
4. Add the prepared vegetables to the rice, and mix it well and cool it down.
5. Open the package of *yubu* and squeeze it slightly to drain out the extra sauce.
6. Open up each *yubu* to make a pouch.
7. Fill each tofu pocket with a rice ball.

※ Application of the recipe fit for the current study

Target Vocabulary items: a plate, rice, fried tofu, dried seasoning, sauce, a spoon, chopsticks, a bowl, a vinyl glove, a scissors.

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

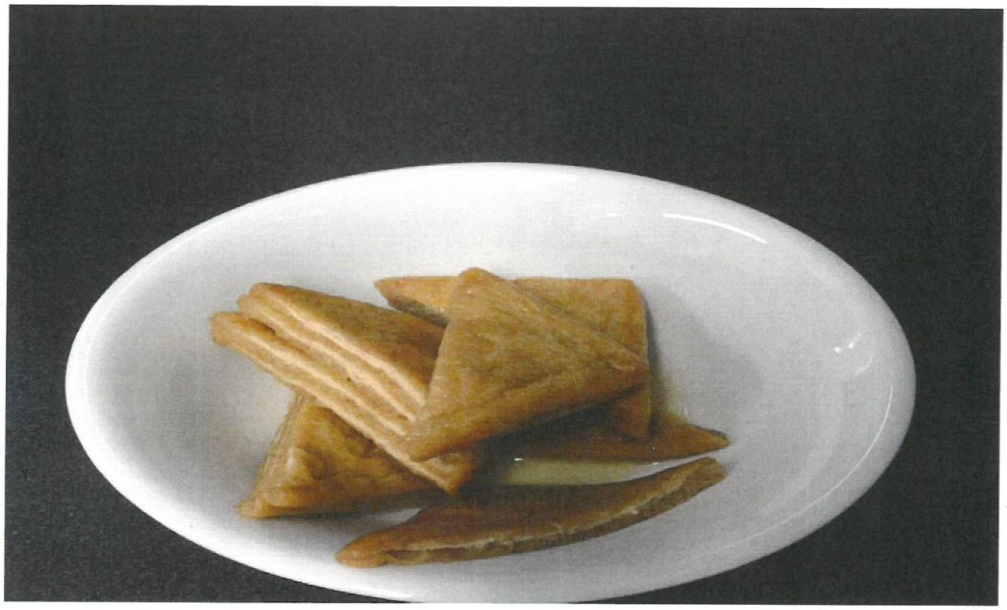
Post-task

1. Now, enjoy the dish as you like

※ Photos of ingredients and equipment to be used

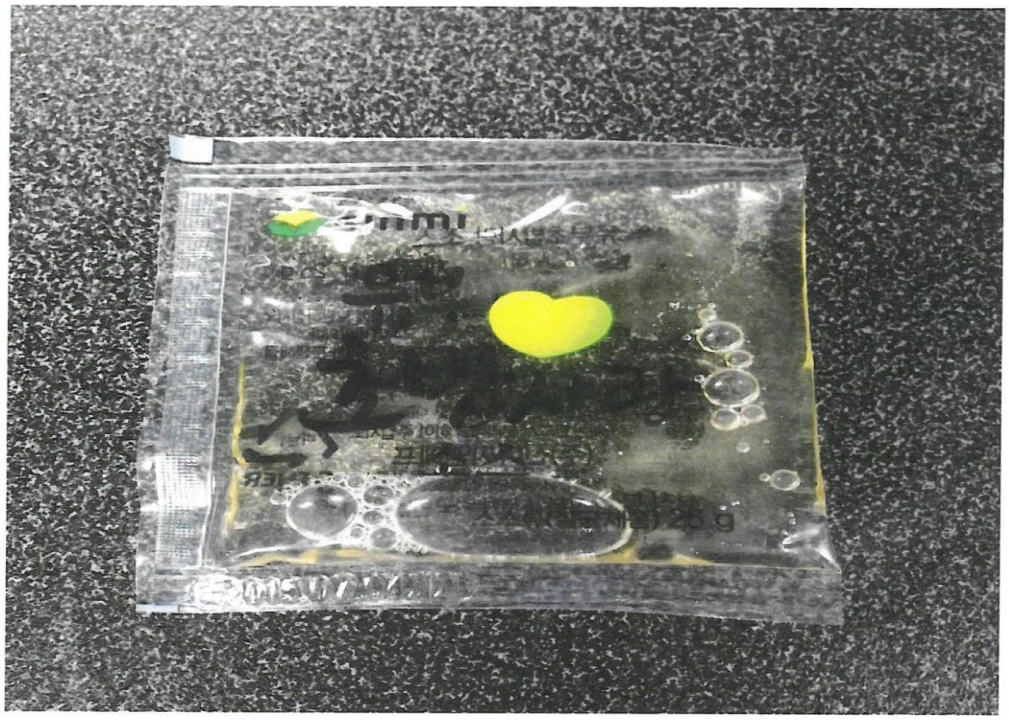
PRE-TASK

1. 유부 (*yubu*, fried tofu)



2. 조미볶음 (*jomibokkeum*, dried seasoning)

3. 초밥소스 (*chobap soseu*, sauce)



4. 밥 (*bap*, rice)

5. 숟가락 (*sutkarak*, a spoon)

6. 젓가락 (*jeotkarak*, chopsticks)

7. 그릇 (*geureut*, a bowl)

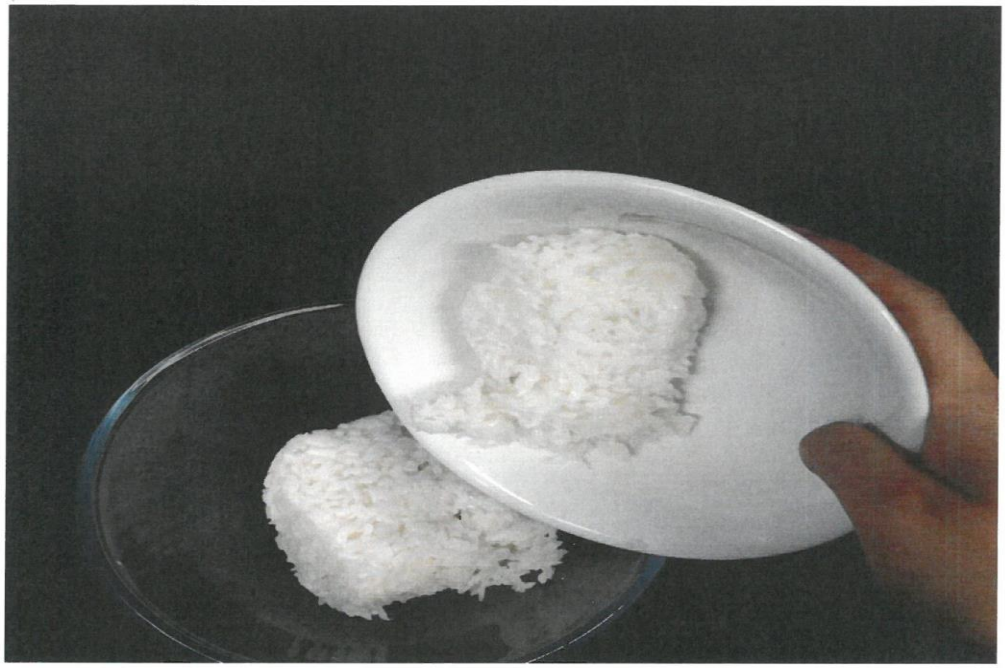
8. 위생장갑 (*wisaeng jangkap*, a vinyl glove)

9. 접시 (***jeopsi***, a plate)

10. 가위 (***gawi***, a pair of scissors)

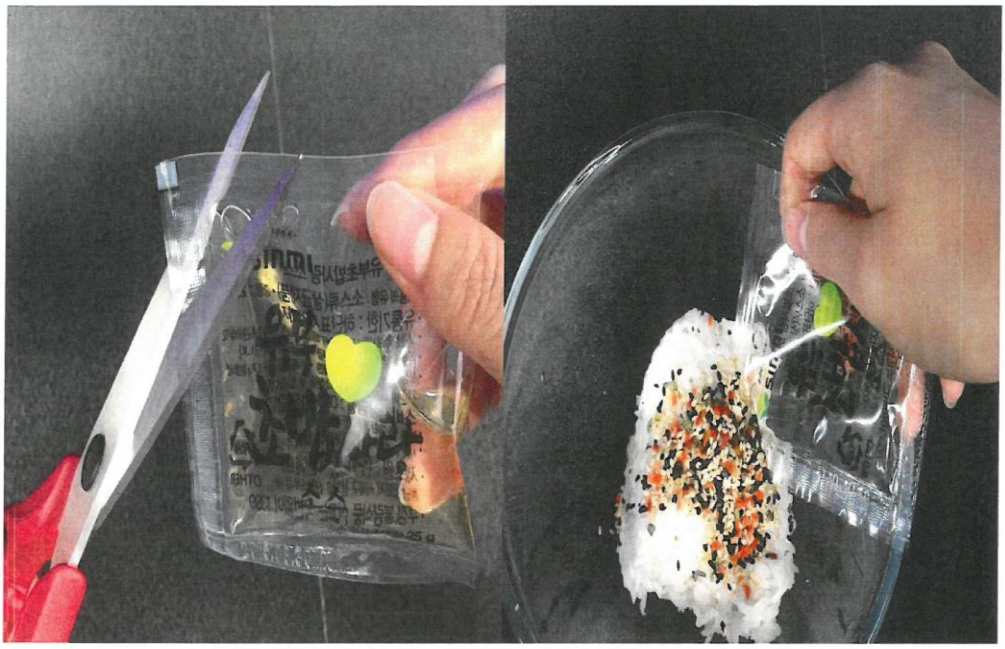
DURING-TASK

9. 밥을 그릇에 넣으세요 (put bap into *geureut*)



10. 가위로 조미볶음을 자르고 그릇에 넣으세요 (cut *jombokkeum* with *gawi* and then put it into *geureut*)

11. 가위로 초밥소스를 자르고 그릇에 넣으세요 (cut *chobap soseu* with *gawi* and then put it into *geureut*)



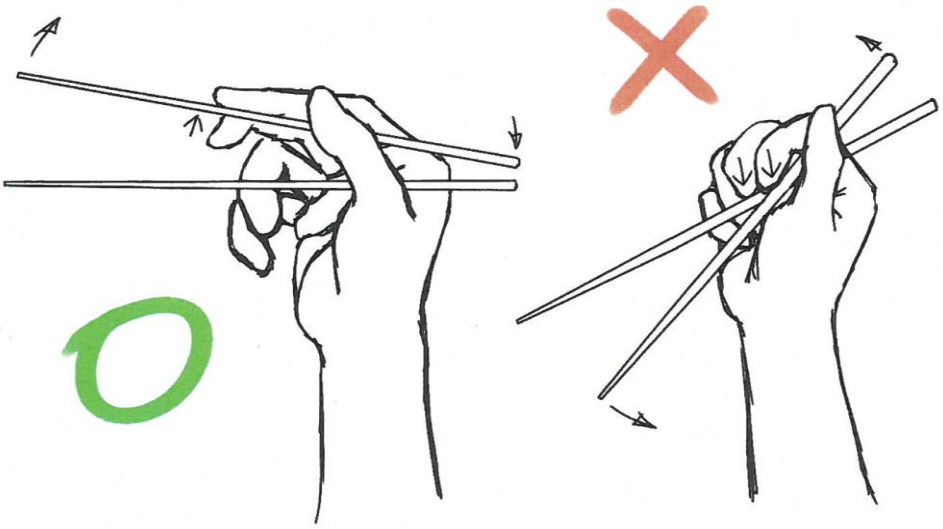
12. 숟가락으로 잘 섞어 주세요 (mixt them properly with *sutgarak*)

13. 위생장갑을 양 손에 끼세요 (put *wisaeng jangkap* on both hands)

14. 숟가락으로 밥을 유부에 넣고 접시에 담으세요 (using *sutkarak* put the mixture into *yubu* and then onto the plate)

15. 나머지 모두 만들어서 접시에 담으세요 (put the rest of *yubuchobap* on *jeopsi*)

16. 자, 이제 젓가락 사용법을 배워봅시다 (Let's learn how to use chopsticks by looking at the photo and try)



POST-TASK

1. 자, 이제 맛있게 먹어봅시다! (Now, enjoy the dish as you like!)

Appendix C. GUI Symbol meanings

The meaning of each symbol on the software

You can go backward to listen or look at the previous slide!

You can listen or look at the current slide once again!

Help Request for a photo aid!

Pause!

You are well done and move on!

You can go forward to the next slide!

Appendix D. Questionnaires

Questionnaire on language learning at Korean Digital Kitchen
'Thinking about learning how you learn a language'

Please tick to indicate to what extent you agree with the following statements:

SA= Strongly Agree, **A**= Agree, **N**= Neither agree nor disagree
D= Disagree, **SD**= Strongly Disagree

1. I liked to learn a foreign language and culture in the classroom

	SA	A	Neutral	D	SD

2. I liked to learn a foreign language and culture in a kitchen environment

	SA	A	Neutral	D	SD

3. Using photos of real objects in the classroom contributed to my learning

	SA	A	Neutral	D	SD

4. Using real objects in digital kitchen contributed to my learning

	SA	A	Neutral	D	SD

5. Describe how you are feeling now, especially in relation to the learning tasks you've done in the digital kichen. I was feeling:

	SA	A	Neutral	D	SD
Happy					
Confident					
Unafraid					
Friendly					
Interested					
Energetic					
Outgoing					
Motivated to learn the Korean language					
Motivated to know the Korean culture					
Motivated to eat the food					

6. Describe how you are feeling now, especially in relation to the learning tasks you've done in the classroom. I was feeling:

	SA	A	Neutral	D	SD
Happy					
Confident					
Unafraid					
Friendlier					
Interested					
Energetic					
Outgoing					
Motivated to learn the Korean language					
Motivated to know the Korean culture					
Motivated to eat the food					

Thank you very much for sharing your thoughts with me

Appendix E. Semi-structured interview Questions

LanCook

Interviews on language learning at Korean Digital Kitchen

'Thinking about learning how you learn a language'

1. Can you compare the two settings as much as you can in relation to the learning tasks you've done in two settings?

2. What did you learn in terms of language and culture in the two settings?

3. What were the difficulty in learning in the two settings?

4. Do you prefer either the classroom or the digital kitchen in terms of learning? Would you describe why you think so?

5. To what extent does using real objects in the digital kitchen help you learn vocabulary items better than looking at photos of the objects in the classroom?

6. To what extent does using real objects in the digital kitchen help you learn Korean cultural aspects than looking at photos of the objects in the classroom?

Thank you very much for sharing your thoughts with me

1

Appendix F. Lexical Production Scoring Protocol (LPSP-Spoken)

.00 points	.25 points	.50 points	.75 points	1 point
None of word is written;thisincludes: • nothingiswritten • theletterspresent do not meet any "for .25" criteria • Englishwordonly is written	1/4 of word is written; this includes: • any 1 letter is correct • 25-49.9% of the lettersarepresent • correct # of syllables	½ of word is written; this includes: • 25-49.9% of letters correct • 50-74.9% of letters present	3/4 of word is written; this includes: • 50-99.9% of letters correct • 75-99.9% of letters present • 100% letters correct but other letters added	Entire word is written; this includes: • 100% letters correct • 100% letters correctwithaccent addedoromitted

Instructions: (1) "Correct" refers to any letter written and placed in its correct position within a word; "present" refers to any letter written but not placed in its correct position. (2) Determine percentages by dividing letters correct and letters present by the number of letters in the target word. If more letters are written than are in the target word, divide by the large number. (3) If the same target word is written more than once, score it only once in the space where it should be written or, if it is not written in the correct space, score it in the first space where it is written based upon the target word for that space.

This rubric has been adapted to assess the spoken performance for this study.

Appendix G. Jeffersonian Transcription Conventions

Jeffersonian Transcript Notation

The following annotation conventions are adapted from *G. Jefferson, Transcription Notation, in J. Atkinson and J. Heritage (eds), Structures of Social Interaction, New York: Cambridge University Press, 1984.* A copy is also provided in Transana's Help:Transcript Notation section.

Convention	Name	Use
[text]	Brackets	Indicates the start and end points of overlapping speech.
=	Equal Sign	Indicates the break and subsequent continuation of a single utterance.
(# of seconds)	Timed Pause	A number in parentheses indicates the time, in seconds, of a pause in speech.
(.)	Micropause	A brief pause, usually less that 0.2 seconds.
. or down arrow	Period or Down Arrow	Indicates falling pitch or intonation.
? or up arrow	Question Mark or Up Arrow	Indicates rising pitch or intonation.
,	Comma	Indicates a temporary rise or fall in intonation.
!-	Hyphen	Indicates an abrupt halt or interruption in utterance.
>text<	Greater than/Less than symbols	Indicates that the enclosed speech was delivered more rapidly than usual for the speaker.
<text>	Less than/Greater than symbols	Indicates that the enclosed speech was delivered more slowly than usual for the speaker.
°	Degree symbol	Indicates whisper, reduced volume, or quiet speech.
ALL CAPS	Capitalized text	Indicates shouted or increased volume speech.
underline	Underlined text	Indicates the speaker is emphasizing or stressing the speech.
:::	Colon(s)	Indicates prolongation of a sound.
(hhh)		Audible exhalation
•or (.hhh)	High Dot	Audible inhalation
(text)	Parentheses	Speech which is unclear or in doubt in the transcript.
italic text [*]	Double Parentheses	Annotation of non-verbal activity.

Appendix H. Ethical Forms

Full Ethical Assessment Form

APPLICATION FOR ETHICAL APPROVAL OF A RESEARCH PROJECT FROM FACULTY ETHICS COMMITTEE

This application form is to be used by **STAFF** and **PGR STUDENTS** seeking ethical approval for an individual research project where preliminary ethical assessment has indicated that full ethical review is required.

A completed version of this document should be emailed to the Secretary of your appropriate Faculty Ethics Committee in the University. *Applications must be completed on this form; attachments will not be accepted other than those requested on this form. This form has been designed to be completed electronically; no handwritten applications will be accepted.*

Research must NOT begin until approval has been received from the appropriate Faculty Ethics Committee.

Section 1: Applicant Details

Applicant Name	JAEUK PARK
Contact Email	j.u.park@newcastle.ac.uk
Academic Unit	School of Education, Communication and Language Sciences
Applicant Type	□Postgraduate Research

Section 2: Project Details

Project Title	Korean Digital Kitchen: From Cooking to Learning
MyProjects Reference	
Already has ethical approval	□ No
Project Funder(s)	
Other organisations involved	
Proposed Start / End Date (dd/mm/yyyy)	Start Date _27_/_09_/_2014___ End Date _02_/10_/_2016___
Category	□ Postgraduate Research
Preliminary Ethical Flag(s)	□ Humans Non-Clinical
Supervisor (Student Research projects only)	Professor Paul Seedhouse
Who is responsible for the overall management of the research? Name & post.	Professor Paul Seedhouse
Who designed the research? Name & post.	Jaeuk Park, iphd candidate
Who is conducting the research? Name & post.	Jaeuk Park, iphd candidate
Is this a re-approval of an existing project?	□ No
Project type: Please mark the	□ Questionnaire

predominant nature of this project (one only).	□ Experiments □ Observational _____
Has Peer Review taken place	□ No

Section 3: Project Outline & Proposed Research methods

Project outline & aims

Briefly describe the aims of this research, including the anticipated benefits and risks. This description must be in everyday language. If any jargon, technical terms or discipline-specific phrases are used, these should be explained. Please use no more than 500 words.

The target of the research is to produce a technologically-enhanced situated language learning environment where learners can simultaneously learn a linguistic and a cultural skill. It is expected to contribute to addressing problems occurring in the classroom, such as boredom and lack of real life tasks. If there is any risk, it is to spend some budget purchasing proper ingredients and equipment for cooking. However, the cost is less than £70 and the supervisor will make everything available with project funding. The research environment and materials are ready.

Proposed research methods (Experimental design)

Please provide an outline, in layman's terms, of the proposed research methods. Specify whether the research will take place outside of the UK or in collaboration with partners based outside the UK, and/or if research will take place using the internet. Present an outline of the method in a step-by-step chronological order, and avoid using jargon and technical terms as much as possible. Ensure you describe the key tasks including how data will be collected and used. Please do not exceed 500 words.

The study draws on quasi-experimental design which hypothesizes that using real objects in our hand in real-life environment as an independent variable has positive effects on language learning that that in the classroom. Participants will be English and international adults of 48 in total, all of whom will conduct cooking both in iLab at Newcastle University by using real objects and in the classroom by using typical pictures and photos in the textbook.

Subjects will go through pre-, during-, and post-task in both situations, followed by post-tests. Of course, there is a pre-test before cooking to compare the score to see the achievement. The type of test is recognition and recall one where students produce phonological forms in relation to a specific vocabulary item and match a piece of paper with each object name on the right item. 10 vocabulary items will be targeted here in this research.

Research questions include the following: what are students' attitude to learning Korean language in two different settings? Does using real objects in the digital kitchen help them learning vocabulary items better that using photos of real objects in the classroom? What is the relationship between using real objects in situated learning environment and using photos of real objects in the

classroom? How does the digital kitchen contribute to vocabulary learning in terms of emotion and cognition? Those questions will be answered by multiple data sources through a triangulated approach, such as SPSS-based scoring, video-audio recordings, self-report, and a written questionnaire.

Section 4: Environment

(Complete this section only if the project was flagged 'environment' at preliminary review.)
Please provide the locations in which your research will take place, together with the anticipated risks (destruction of habitat or artefacts/emissions, etc.), potential damage and mitigating measures planned. Please use no more than 700 words.

Section 5: Human participants in a Non-Clinical Setting
(Complete this section only if the project was flagged 'Human Participants in a Non-Clinical Setting' at preliminary review)

Participant Details

Does this research specifically target participants recruited by virtue of being (select all that apply):	□ Students or staff of this University □ Adults (over the age of 18 years and competent to give consent) □ People from non-English speaking backgrounds
Does the study involve recruiting participants through a gatekeeper?	□ No
Number of participants required for the study	48 people
Source and means by which participants are to be recruited:	Individual contact via call and email

Participant Information	YES	NO
Will you inform participants that their participation is voluntary?	☒	☐
Will you inform participants that they may withdraw from the research at any time and for any reason?	☒	☐
Will you inform participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐

Will you provide an information sheet that will include the contact details of the researcher/team?	☒	☐
Will you obtain written consent for participation?	☒	☐
Will you debrief participants at the end of their participation (i.e., give them an explanation of the study and its aims and hypotheses)?	☒	☐
Will you provide participants with written debriefing (i.e., a sheet that they can keep that shows your contact details and explanations of the study)?	☒	☐
If using a questionnaire, will you give participants the option of omitting questions that they do not want to answer?	☒	☐
If an experiment, will you describe the main experimental procedures to participants in advance, so that they are informed about what to expect?	☒	☐
If the research is observational, will you ask participants for their consent to being observed?	☒	☐

Participant consent

Please describe the arrangements you are making **to inform potential participants**, before providing consent, of what is involved in participating in your study and the use of any identifiable data, and whether you have any reasons for withholding particular information. Due consideration must be given to the possibility that the provision of financial or other incentives may impair participants' ability to consent voluntarily. (No more than 300 words)

Participants will be British and international students and other adults in Newcastle. They all will be given an invitation letter via either 'Email' or 'Personal Meeting'. The invitation letter include explanations on the project aim and procedures along with contact information of supervisor and the researcher.

The specific information on this 'Participant Invitation Letter' is attached.

Participants should be able to **provide written consent**. Please describe the arrangements you are making for participants to provide their full consent before data collection begins. If you think gaining consent in this way is inappropriate for your project, please explain how consent will be obtained and recorded. (No more than 300 words)

Participants all will be provided a form 'Informed Consent Form for LanCook' which is used for a research regarding Digital Kitchen when they turn up in the research place 'iLab'. The consent form has been signed by the researcher and has been carefully written, taking a wide range of aspects into consideration, ranging from what they are required to do and how data is collected to how it is used. Participants have a right to choose whether or not to take part in the research. If they agree, they are asked to fill and sign in the consent form, which will be collected. Consent for audio/video observation will be made in written form.

Participants will be informed of general idea and purpose of the research. However, they will not be informed of exact aim as it may compromise the

research. They will not only be asked for their permission to complete the questionnaires and audio/video recorded observations (Punch, 2006), but also be informed that participation in the study is voluntary and they have the right to with draw whenever they want. Moreover, they will be informed that the recorded data will be used in a thesis and they might also be presented at academic conferences or in relevant academic publications.

The specific information on this 'Information Sheet for LanCook' is on the attachment.

Please attach a copy of the information to be provided to the participant(s) to enable informed consent. This should include the 'Consent Form' & 'Participant Information Sheet' on appropriately headed paper.

Participant debriefing

It is a researcher's obligation to ensure that all participants are fully informed of the aims and methodology of the project, that they feel respected and appreciated after they leave the study, and that they do not experience significant levels of stress, discomfort, or unease in relation to the research project. Please describe whether, when, and how participants will be debriefed. (No more than 300 words)

There is no plan to offer a written debriefing paper to participants as they have already been informed of everything about the digital kitchen research project. The researcher's contact details is fully offered on the 'Information Sheet' to participants before, during, and after the study

Please attach a copy of any debriefing sheet that you may provide on appropriately headed paper.

Potential risk to participants and risk management procedures

Identify, as far as possible, all potential risks (small and large) to participants (e.g. physical, psychological, etc.) that may be associated with the proposed research. Please explain any risk management procedures that will be put in place and attach any risk assessments or other supporting documents. Please answer as fully as possible. (No more than 300 words)

It is less likely that participants can be put at risk. To begin with, in terms of physical risk, the research involves cooking real food in an authentic kitchen environment so the heating might be dangerous but measures have been taken to ensure good safety in the research lab just in case. Everything is fine.

Secondly, with regard to psychological factors, subjects might feel uncomfortable and insecure of being audio/video-recorded. However, it will disappear as they focus on their own interesting tasks in technologically enhanced real kitchen. In relation to their own data, confidentiality will be protected. When the data is used to publish a journal, their name will not be published on documents, which will guarantee participants' anonymity. To nip the relevant issues in the bud and assure confidentiality, the names & identities of subjects are not sought in the first place.

Section 6: Data

Please attach a copy of your data management plan (if available) or alternatively note where appropriate: whether consent will be sought, how data will be accessed, how participants' confidentiality will be protected, and any other relevant considerations. Information must be provided on the full data lifecycle, from collection to archive. If you do not have a data management plan, funder-specific plans are available from the Digital Curation Centre. See https://dmponline.dcc.ac.uk/

The project involves audio and video recording the complete session with photographs on tasks. They will be asked for permission to get consent form regarding how data will be used and their confidentiality will be ensured.

The audio-video recordings will make up about 50 hours, which will be about 90GB. The school computer technician made sure that data will/can be stored at ECLS storage system and safety will be sought. Data are always seen as asset and will be treated with due care and attention in a system with appropriate identification codes and passwords. The computer on which the data is placed is not vulnerable to theft.

Data will not be disclosed to other parties who are not involved with original purpose for which the data was collected and should be held only for the time required to use it for its stated purpose when the dissertation is accepted and the subsequent papers are published.

Section 7: Permissions (Inc Overseas)

Overseas: For any research conducted outside the EEA the researcher is responsible for ensuring that local ethical considerations are complied with and that the relevant permissions are sought. If relevant please complete the table below otherwise move on to the permissions table.

Is the research to be conducted outside the EEA?	□ No
If 'Yes' please state the location(s):	
Have the appropriate local ethical considerations been complied with and relevant permissions sought?	

Permissions: Please use the table below to record details of licenses or permissions required and / or applied for e.g. LEA, governing body, etc along with the reference, status and the date when it was granted.

Permission / License	Award Body	Reference Number	Date of Permission	Status e.g. Granted / Pending

Section 8: Risk Considerations & Insurance

Newcastle University must have in place appropriate insurance cover for its legal liabilities for research studies. Dependent upon the nature of the research and how it is governed cover will either come under Clinical Trials Insurance or Public Liability Insurance. Please refer to the supplementary guidance "When does the Insurance Office need to be notified of a research proposal?" for clarification.

Potential risk to researchers and risk management procedures

What are the potential risks to researchers themselves? This may include: personal safety issues, such as those related to lone or out of normal hours working or to visiting participants in their homes; travel arrangements, including overseas travel; and working in unfamiliar environments. Please explain any risk management procedures that will be put in place and attach any risk assessments or other supporting documents. (No more than 300 words)

The only risk for the researcher is whether or not participants are cooperative till the final stage of data collection. The study requires participants to show up once again in two weeks for vocabulary retention test. If those who did cooking do not turn up in two weeks, the researcher should start the procedure from the beginning again with other participants. It may cause troubles but I do not think that it will happen quite often.

Please attach a risk assessment or any other appropriate documents as required.

Section 9: Supporting documentation

Please supply copies of any applicable and documents in support of your answers. Ensure that attached files have appropriate file names.

Document	Attached
Participant consent form	☒
Participant information sheet	☒
Participant debriefing document	☐
Questionnaire(s)	☒
Outline protocol	☐
Project risk assessment	☐
Travel risk assessment	☐
Original ethical assessment (re-approval only)	☐
Data management plan	☐
Peer review evidence (Internal / non funded)	☐
Local permissions / licenses (non EEA)	☐
Other ethical review forms	☐
Others (please list):	☐

Section 10: Declaration

I certify that the information contained in this application is accurate. I have attempted to identify the risks that may arise in conducting this research and acknowledge my obligations and the rights of the participants. I confirm that the research will be conducted in line with all University, legal and local ethical standards.	
Name of Principal Investigator:	JAEUK PARK
Signed:	
Date:	29TH September, 2014

If you have any queries on this form, please contact your Faculty Ethics Coordinator or visit the website at http://www.ncl.ac.uk/res/research

Please email or send this form to the appropriate Faculty Ethics Coordinator

For office use only:

The appropriate Ethics Committee has considered the ethical aspects of this proposal. The committee recommends that the programme/project be:

☐ Approved ☐ deferred (for reasons attached) ☐ not approved

Name of Committee Member:	
Ethics Committee Concerned:	
Signed:	
Date:	