FACILITATING ENGLISH AS A FOREIGN LANGUAGE LEARNERS' VOCABULARY LEARNING, TASK COMPLETION AND CONTEXTUAL VOCABULARY EXPLORATION PROCESSES IN A MOBILE SUPPORTED SITUATED LEARNING ENVIRONMENT

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ÇİĞDEM UZ BİLGİN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
COMPUTER EDUCATION AND INSTRUCTIONAL TECHNOLOGY

AUGUST 2016

Approval of the thesis:

FACILITATING ENGLISH AS A FOREIGN LANGUAGE LEARNERS' VOCABULARY LEARNING, TASK COMPLETION AND CONTEXTUAL VOCABULARY EXPLORATION PROCESSES IN A MOBILE SUPPORTED SITUATED LEARNING ENVIRONMENT

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ABSTRACT

FACILITATING ENGLISH AS A FOREIGN LANGUAGE LEARNERS' VOCABULARY LEARNING, TASK COMPLETION AND CONTEXTUAL VOCABULARY EXPLORATION PROCESSES IN A MOBILE SUPPORTED SITUATED LEARNING ENVIRONMENT

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August 2016, 237 Pages

The aim of this study was to investigate how vocabulary learning, task completion, and contextual vocabulary exploration processes of English as a Foreign Language (EFL) learners can be facilitated in a mobile supported situated learning environment. METU Science and Technology Museum which is a large, open space populated with interactive science exhibits was chosen as an authentic learning environment. Mobile system which includes instructions of the experiments and also provides dictionary and visual definition support facilitated learners to complete the authentic tasks and learn vocabulary in context. The mobile system and authentic learning environment were integrated based on the principles of Situated Learning Theory. In five-week period, 25 students from Department of Basic English conducted interactive experiments in

authentic learning environment with the support of mobile vocabulary learning system. Embedded mixed design was employed in which quantitative phase within a larger qualitative phase was embedded. While quantitative part included one group pretest-posttest design and system logs, qualitative part included semi-structured interviews, retrospective reviews, and observation. The results of the study indicated that contextual vocabulary learning can be supported and enhanced with mobile technologies by taking into account the factors of contextual clues, word frequency, and learners' domain knowledge, interest, and focus. Moreover, situated learning environment promoted long-term retention, contextual and incidental learning of vocabulary. Lastly, suggestions for creating mobile supported situated learning environments and practical implications were revealed.

Keywords: Situated Learning Theory, Mobile Learning, Contextual Vocabulary Learning

ÖZ

İNGİLİZCEYİ YABANCI DİL OLARAK ÖĞRENENLERİN KELİME ÖĞRENMELERİNİN, GÖREV TAMAMLAMALARININ VE BAĞLAMSAL KELİME ARAŞTIRMA SÜREÇLERİNİN BİR MOBİL DESTEKLİ DURUMLU ÖĞRENME ORTAMINDA DESTEKLENMESİ

Uz Bilgin, Çiğdem

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Ağustos 2016, 237 sayfa

Bu çalışmanın amacı, mobil destekli durumlu öğrenme ortamında İngilizceyi yabancı dil olarak öğrenenlerin kelime öğrenmelerinin, görev tamamlamalarının ve bağlamsal kelime araştırma süreçlerinin nasıl desteklenebileceğini araştırmaktır. Halka açık ve etkileşimli bilimsel deneylerin sergilendiği METU Bilim ve Teknoloji müzesi, otantik öğrenme ortamı olarak seçilmiştir. Deneylerin nasıl yapılacağıyla ilgili yönergeleri içeren ve aynı zamanda görsel ve sözlük anlamı desteği sağlayan mobil sistem, öğrenenlerin otantik görevleri tamamlamasını ve bağlamsal kelime öğrenmelerini desteklemiştir. Mobil sistem ve otantik öğrenme ortamı Durumlu Öğrenme Kuramı ilkelerine göre entegre edilmiştir. Beş haftalık süreçte, 25 METU Hazırlık sınıfı öğrencisi etkileşimli deneyleri otantik öğrenme ortamında, mobil kelime öğrenme

sistemi desteğiyle gerçekleştirmiştir. Gömülü karma yöntemin kullanıldığı bu çalışmada, nicel veriler daha geniş kapsamda olan nitel verilere gömülmüştür. Nicel veriler öntest-sontest desenden ve sistem loglarından oluşurken; nitel veriler yarı-yapılandırılmış görüşmeler, geçmişe dönük sesli düşünme ve gözlemden oluşmaktadır. Bu çalışmanın bulguları bağlamsal kelime öğrenmenin bağlamsal ipuçları, kelime frekansı, öğrenenlerin alan bilgisi, ilgisi ve odak noktası gibi faktörler dikkate alındığında mobil teknolojilerle desteklenebileceğini ve geliştirilebileceğini göstermiştir. Ayrıca, durumlu öğrenme ortamı kalıcı öğrenmeye, bağlamsal ve rastlantısal kelime öğrenmeye katkı sağlamıştır. Son olarak, mobil destekli durumlu öğrenme ortamlarının geliştirilmesine ve uygulanmasına yönelik öneriler sunulmuştur.

Anahtar Kelimeler: Durumlu Öğrenme Kuramı, Mobil Öğrenme, Bağlamsal Kelime Öğrenme

To My Family…

ACKNOWLEDGEMENTS

I would like to express my special appreciation and thanks to my advisor Assist. Prof. Dr. Tuğba Tokel and my co-advisor Assist. Prof. Dr. Şenöm Tuğba Yalçın, for their encouragement, guidance, advice and wisdom.

I would also like to thank my committee members, Prof. Dr. Zahide Yıldırım, Prof. Dr. Kürşat Çağıltay, Assist. Prof. Dr. Sedat Akayoğlu, Assist. Prof. Dr. İsmail Yıldız for their brilliant comments and suggestions.

I am also so grateful to Prof. Dr. İlhan Varank who always supported and encouraged me. We miss you; you will be in our hearts forever.

I would like to thank my professors at Yıldız Technical University, Prof. Dr. Feza Orhan, Assoc. Prof. Dr. Serhat Bahadır Kert and Assist. Prof. Dr. Betül Yılmaz, for their continuous support, encouragement and advices since my undergraduate years.

I would like to thank Instructor Emine Yetgin, for her support during implementation and writing process of my dissertation, without her help it was not possible to complete this dissertation study.

I am also so grateful to Prof. Dr. Younghun Baek and Prof. Dr. Brett Shelton from Boise State University. Their advice and support on my research as well as on my career have been priceless.

I also want to thank my colleagues and friends who always supported me during the whole process, Sezin Eşfer, Selda Kayak, Meryem Köşkeroğlu Büyükimdat, Arzu Öztürk, Gülşah Bilgiç Tozmaz, for their support, encouragement, friendship and feedbacks.

Special thanks to my Master of Science advisor Prof. Dr. Arif Altun who first taught me to do scientific research. I am so lucky to meet him at the beginning of my academic career.

A special thanks to my mother Süheyla Uz, my father Abdullah Uz, my aunt Hülya Uz and my sister Başak Uz Öztürk for their contionus support, love and encouragement.

Finally, I am so grateful to my lovely husband Ozan Özgün Bilgin. I would like to express my special appreciation for his endless patience, encouragement and love during this long and though process.

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

CHAPTER 1

INTRODUCTION

In this chapter of the study, an introduction to the study will be presented with background of the problem, problem statement, purpose of the study, research questions, significance of the study, and definition of terms.

1.1 Background of the Problem

Two common strategies that have been widely used in order to learn the meaning of the words are dictionary use and contextual guessing (Huang & Eslami, 2013). In the past, the main method in vocabulary textbooks was presenting word lists and giving the meaning of the words in native language. This method promoted and suggested learners that vocabulary learning was an issue of memorizing the target language equivalences of native language words (Shrum & Glisan, 2015). However, authentic, meaningful, and contextual learning started replacing this approach since 1980s (Brown, Collins & Duguid, 1989; Lave & Wenger, 1991). Many theorists and researchers have argued that there are positive outcomes of using meaningful contexts to help learners to acquire target words (Gibbons, 2009; Webb, 2008). Those strategies have various advantages. While looking up the meaning of the words promotes in-depth comprehension of the text, contextual guessing is crucial in learning English as a foreign language (EFL) (Huang & Eslami, 2013). EFL learners do not have the opportunity to learn vocabulary in the context of ordinary communication; therefore, it is suggested to provide information with its context and in meaningful settings (Gibbons, 2009). After all these

perspectives emerged, a debate started between incidental vocabulary learning and explicit instruction as an instructional strategy.

Explicit instruction includes determining the target vocabulary, presenting the words and detailing the word knowledge. On the other hand, especially in contextual language learning environments, vocabulary growth results incidentally. While several researchers supports the idea that explicit teaching is crucial for in-depth understanding of the text (Hanson & Padua, 2011), others support the idea that most vocabulary growth results incidentally (Hirsch, 2003). On the other hand, several researchers claim that vocabulary teaching should be along an explicit-implicit continuum (McDonough & Shaw, 2012). In this respect, one of the difficult challenges for educational practitioners is to determine what should be made explicit in teaching and what should be left implicit (Brown et al., 1989).

In contextual vocabulary learning there are three main components: vocabulary, learner, and the context. Learner is one of the main components of contextual vocabulary learning, because learning process is mostly affected by how learner interacts with the context and vocabulary. Authentic and meaningful contexts are crucial in order to maintain engagement of learners and various design suggestions for context have been suggested and administered in previous studies (Huckin & Coady, 1999; Webb, 2008). Lastly, the role of vocabulary in contextual learning was investigated by taking into account the factors of discourse type and frequency of exposure to the word (Franco & Galvis, 2013). However, the gap in the literature is determining how the synergy between learner, context, and vocabulary should be in order to promote contextual vocabulary learning. When this synergy between those components is revealed one of the difficult challenges for educational practitioners which is to determine what should be made explicit in teaching and what should be left implicit will be tried to be removed.

Situated Learning Theory or Situated Cognition which was first expounded by Brown et al. (1989) claimed that knowledge is linked to the activity, context, and culture in which

it was learned. According to Chen et al. (2009), such teaching methods which implicitly separate learning and situations will result in making students memorize conceptual knowledge. Moreover, students will be incapable of applying knowledge in different contexts or situations. Various models of Situated Learning Theory were revealed so far; however, they might have minor differences according to subject domain or learning objective. In language learning, commonly stated characteristics for Situated Learning Theory were providing authentic context, authentic tasks, appropriate guidance, and authentic assessments. Those characteristics can be a well-suited theoretical basis for designing contextual vocabulary learning environments and facilitate educational practitioners to determine what should be made explicit in teaching and what should be left implicit in contextual vocabulary learning. According to Situated Learning Theory, especially for authenticity, it is highly recommended to follow participation model in which students participate in the actual work in real environment (Herrington & Oliver, 2010). Although instructional implementation which simulates real-life situations was widely used in numerous studies (Hay, 1993; McLellan, 1996; Shih &Young, 2008; Winn, 1993), instructional designers who apply Situated Learning Theory by implementation in electronic media were accepted as a further step away from real life work situations (Herrington & Oliver, 2010). Moreover, authentic texts for language learning were also widely used as implications of situated learning theory (Zahar, Cobb & Spada, 2001), however according to Ozverir and Herrington (2011), learners' interactions with resources such as texts are one of the inauthentic resources.

There were several studies who implemented principles of Situated Learning Theory in vocabulary learning (Chen & Li, 2010; Wicha & Temdee, 2013). Those studies were contexts-aware systems which are also labeled as ubiquitous learning systems that detect learner's location, learning time, individual English vocabulary abilities or leisure time in order to provide authentic language learning materials at the right place and at the right time. In context aware learning environments, a list of target vocabulary is sent to learners in order to expose them to the target vocabulary in its context. However, recent

pedagogical approaches for vocabulary learning promote contextual vocabulary exploration for EFL learners that make them active learners while inferencing the meaning of the words (Gibbons, 2009).

Various technologies have been widely used to promote vocabulary learning of EFL learners. Development of new technologies which provide personalized, portable, and mobilized learning environments resulted in a shift from traditional classrooms to mobile learning environments (Chen & Chung, 2008). Mobile technologies which can support learners in learning without constraints of time or place by making connection between learning activities and real learning environment might promote authentic activities for contextualized vocabulary learning. Kearney, Schuck, Burden and Aubusson (2011) pointed out that "mobile learning episodes potentially involve high degrees of "task and process authenticity" as learners participate in rich and contextual tasks (setting, characters, tools), involving "real-life" practices" (p. 10). In this respect, mobile technologies can be used as supportive technology to promote authentic activities in situated learning environments.

1.2 Problem Statement

EFL learners do not have opportunity to learn vocabulary in the context of ordinary communication, therefore it is suggested to provide information with its context and present meaning of the word in meaningful settings (Gibbons, 2009). In contextual learning, there are three main components: context, learner, and vocabulary. The gap in the literature is how the synergy between learner, context, and vocabulary should be in order to promote contextual vocabulary learning for EFL learners. Moreover, while several researchers support the idea that explicit teaching is crucial for in-depth understanding of the text (Hanson & Padua, 2011), others support the idea that most vocabulary growth results incidentally (Hirsch, 2003). On the other hand, several researchers support the idea that vocabulary teaching should be along an explicit-implicit continuum (McDonough & Shaw, 2012). Although in contextual learning the

great emphasis is on incidental vocabulary learning, there needs to be an explicit part. Therefore, one of the gaps in the literature is guidance for educational practitioners to determine what should be made explicit in teaching and what should be left implicit in contextual learning.

As stated in the background of the study, one of the well-suited models for contextual vocabulary learning is situated learning theory which has the main characteristics of authentic context, authentic tasks, appropriate guidance, and authentic assessments. According to situated learning theory, authenticity is one of the key components and should be maintained through real-world tasks which engage the learner. Previous studies mostly used simulation based approach or authentic texts in order to maintain authenticity (Zahar, Cobb & Spada, 2001). The second gap in the literature is creating authenticity in real environments in order to engage learner in the actual work. In this respect, mobile technologies which involve high degrees of "task and process authenticity" as learners participate in rich, contextual tasks (setting, characters, tools) can be used as supportive technologies to promote authenticity.

Although there were several studies who implemented principles of Situated Learning Theory in vocabulary learning (Chen & Li, 2010; Wicha & Temdee, 2013), a list of target vocabulary was sent to learners in those context aware systems in order to expose them to the target vocabulary in its context. However, recent pedagogical approaches for vocabulary learning promote contextual vocabulary exploration for EFL learners that make them active learners while inferencing the meaning of the words (Gibbons, 2009). In this respect another gap in the literature is promoting learners to learn vocabulary in its context by giving opportunity to explore contextual vocabulary.

1.3 Purpose of the Study

The main purpose of the present study was to investigate which factors contribute to the process of EFL learners' contextual vocabulary exploration, vocabulary learning and task completion in mobile supported situated learning environment. It aimed to

investigate how the synergy between learner, context, and vocabulary should be and which dynamics should be taken into account in a learning environment which is designed based on the principles of Situated Learning Theory. Lastly, it aimed to gather learners' experiences concerning mobile supported situated learning environment in order to understand content and practical issues.

1.4 Research Questions

The following research questions will be answered to investigate how mobile supported situated learning environment facilitate learners' contextual vocabulary exploration processes, task completion, and vocabulary learning.

Research Question 1. How does mobile supported situated learning environment facilitate contextual vocabulary exploration processes?

Research Question 2. How does mobile supported situated learning environment facilitate task completion?

Research Question 3. Is there a significant difference between pretest, posttest, and retention test scores in mobile supported situated learning environment?

Research Question 4. What are the experiences of learners concerning mobile supported situated learning environment?

1.5 Significance of the Study

When language studies were taken into account, contextual vocabulary learning studies have mainly focused on listening and reading from authentic texts for contextual learning of the vocabulary (Webb, 2008; Hu & Nassaji, 2012). When discussing situated learning contexts, educators generally refer to instructional experiences inside classrooms; however, learning language can be situated in different contexts (Egbert & Petrie, 2005). One of the gaps in the literature is creating situated learning environment

outside the classroom in order to maintain meaningful and authentic learning environments.

Another gap in the literature is determining how the synergy between the learner, context and vocabulary should be in order to promote contextual vocabulary learning. In this respect, Situated Learning Theory which has the characteristics of providing authentic context, authentic task, appropriate guidance, and integrating authentic assessments can be a well-suited theoretical basis for designing contextual vocabulary learning environments. Although there are various studies that implemented principles of Situated Learning Theory for vocabulary learning (Chen & Li, 2010; Wicha & Temdee, 2013), in those studies a list of target vocabulary was sent to learners in order to expose them to the target vocabulary in its context. However recent pedagogical approaches for vocabulary learning promote contextual vocabulary exploration for EFL learners that make them active learners while inferencing the meaning of the words (Gibbons, 2009). In this respect, the findings of the study will contribute to the literature to understand the factors that should be taken into consideration while designing situated learning environments that promote contextual vocabulary learning.

Moreover, another challenge for educational practitioners is to determine what should be made explicit in teaching and what should be left implicit in vocabulary learning. In this respect, the study aimed to answer this question with principles of Situated Learning Theory. Learners' contextual vocabulary exploration processes were investigated elaborately through various data sources including user logs, observation, interviews, and academic achievement tests in order to understand which factors should be taken into account to determined explicit and implicit parts of vocabulary learning.

Mobile technologies which can support learners in learning without constraints of time or place by connecting learning activities and real learning environment might promote authentic activities for contextualized vocabulary learning. Mobile technologies involve high degrees of "task and process authenticity" as learners participate in rich and contextual tasks (Kearney et al., 2011). In this respect, a mobile system was used as

supportive technology in order to enhance situated learning environment and to promote contextual vocabulary learning at the same time. The findings of the study will contribute to the literature in terms of understanding the role and contribution of mobile technology to enhance situated learning environments and contextual vocabulary learning.

1.6 Definition of Terms

In this part of the study, terms are defined in order to enable readers to understand them better.

Mobile learning: Crompton (2013) defined mobile learning as "learning across multiple contexts, through social and content interactions, using mobile devices" (p. 4).

Situated Learning Theory: Situated Cognition or Situated Learning which was first expounded by Brown et al. (1989) claims that knowledge is linked to the activity, context and culture in which it was learned.

Mobile device: Mobile device is a small computing device which is portable.

Vocabulary: Knowledge of words and word meanings (Butler et al., 2010).

QR (Quick Response) code: a kind of barcode that can be read by a digital device in order to link related information.

Tablet Computer: Alternatively referred to as tablet PC is a small wireless mobile computing device that is typically larger than a mobile phone.

CHAPTER 2

LITERATURE REVIEW

2.1 Vocabulary Learning in a Foreign Language

In the past, the main method in vocabulary textbooks was presenting word lists and giving the meaning of the words in native language. This method suggested learners that vocabulary learning was an issue of memorizing the target language equivalences of native language words (Shrum & Glisan, 2015). In early 1980s, there were only a handful of well-known teaching handbooks devoted to vocabulary teaching, few of whose teaching recommendations were based on theories or research findings (Shen, 2003). However, authentic, meaningful and contextual learning has started replacing this approach since 1980s (Brown et al., 1989, Lave & Wenger, 1991). Many theorists and researchers have argued that there are positive outcomes of using meaningful contexts to help learners to receive target words (Gibbons, 2009; Webb, 2008). Vocabulary is mostly learned in the context of ordinary communication; however, by contrast, learning words from definitions and separated from contexts, it would be an unsuccessful and slow process (Brown et al., 1989).

Learning another language can be in the target language community, which is referred to as English as a Second Language (ESL), or in non-English speaking community, which is referred to as English as a Foreign Language (EFL). Learners in ESL have an advantageous position on learners in EFL. Thus, they have the opportunity to access the

authentic use of the target language outside the classroom (Ozverir & Herrington, 2011). EFL learners do not have the opportunity to learn vocabulary in the context of ordinary communication. In this respect, there were various strategies of vocabulary learning have been recommended for EFL learners. Gibbons (2009) lists instruction of vocabulary strategies as 1) providing learners the meaning of the word with its context 2) promoting engagement of learners and giving sufficient time for learning 3) providing multiple exposures to words 4) creating an environment that promotes dialogue around words. Gibbons (2009) especially points out that the most effective way to learn vocabulary is using the context of the surrounding words or sentences to infer the meaning of the word and finally use the dictionary effectively. Shrum and Glisan (2015) emphasize *binding* in vocabulary learning which means making connections between the form (the language they hear) and the meaning (the concrete objects referred to in the input). Binding is the mental process of linking a meaning to the form. According to Shrum and Glisan (2015), binding can be facilitated by presenting vocabulary in meaningful contexts, using visuals and objects to make students match and providing meaningful inputs while presenting the target vocabulary. It has been supported with empirical findings. Bora (2013) found out those students who learned with contextual learning strategies, easily remembered and used the words in a written context; on the other hand, students who learned with traditional technics in which they listened to the words with their first language definitions, became less successful.

Two common strategies that are widely used in order to learn the meaning of the words are including dictionary use and contextual guessing (Huang & Eslami, 2013). While looking up the meaning of the words promotes in-depth comprehension of the text, inferential guessing is crucial in second language learning (Huang & Eslami, 2013). Through direct teaching or explicit instruction of target words, students acquire the in-depth knowledge they need in order to understand the meaning of words they will encounter while reading (Hanson & Padua, 2011). Another approach is learning vocabulary in the context of ordinary communication and incidentally (Brown et al.,

1989). After all these perspectives emerged, a debate, explicit or incidental vocabulary learning as an instructional strategy started.

2.1.1 Incidental Learning vs. Explicit Teaching

Two major directions towards vocabulary teaching and learning have resulted in debate among vocabulary researchers which were explicit instruction and incidental learning (Ketabi & Shahraki, 2011). Explicit instruction includes determining the target vocabulary, presenting the words and detailing the word knowledge. In contextualized language learning environments, vocabulary growth happens incidentally. Hulstijn, Hollander and Greidanus (1996) points out that: "Surely, many words must have been "picked up" during listening and reading activities while the listener's and reader's goal was to comprehend the meaning of the language heard or read, rather than to learn new words. This "*picking up"* is usually referred to as incidental learning" (p.327). Advantages of incidental learning can be listed as: 1) contextualized learning 2) more individualized and learner-based 3) promotes two activities which are reading and vocabulary acquisition (Huckin & Coady, 1999). There are also disadvantages of incidental vocabulary learning. It takes a lot of time. There is a possibility of guessing the meaning of word incorrectly and it only can be effective when the context is well understood (Huckin & Coady, 1999). Yali (2010) also points out the limitations of this approach. The first limitation is the small number of words that can be learnt by using this approach. The second limitation is the process of inferring meaning may not be correct all the time. The third limitation is that incidental learning is a slow process.

While several researchers claim that explicit teaching is crucial for in-depth understanding of the text (Hanson & Padua, 2011), others support the idea that most vocabulary growth results incidentally (Hirsch, 2003). On the other hand, several researchers state that vocabulary teaching should be along an explicit-implicit continuum (McDonough & Shaw, 2012). Hunt and Beglar (2002) points out that word knowledge is more than just reading a word; therefore, effective instructional methods

should consider knowing the meaning of the words within several contexts, using words in writing and also knowing and using word learning strategies.

A widely accepted idea for vocabulary learning is that most vocabulary growth proceeds incidentally, from massive immersion in the world of language and knowledge (Hirsch, 2003). It is a slow process requiring multiple exposures and using its different modes in many language experiences (Hirsch, 2013). In contextual learning, although the great emphasis is on incidental vocabulary learning, vocabulary learning should be along an explicit-implicit continuum. One of the difficult challenges for educational practitioners is to determine what should be made explicit in teaching and what should be left implicit (Brown et al., 1989). In this respect, it is necessary to discuss what factors influence incidental vocabulary learning and when explicit instruction should be embedded.

2.1.2 Factors that Affect Incidental Vocabulary Learning

There are various factors that affect incidental vocabulary learning, such as dictionary use, glosses, contextual clues, repetition of words, discourse type and learners' interest, focus. Conflicting results have emerged in previous studies (Huckin & Coady, 1999; Hu, 2013; Webb, 2008).

Contextual Clues

Many authentic texts do not contain supportive information; therefore, they may cause learners to guess the meaning of the words incorrectly (Beck, McKeown & McCaslin, 1983). Contextual clues play critical role in guessing the meaning of the words correctly (Nagy, Herman, & Anderson, 1985). Webb (2008) investigated the effect of context (i.e., more informative vs. less informative) and word frequency on incidental vocabulary acquisition with short contexts, each of which contained a single target word on Japanese university students. The results showed that the group which read the contexts containing more contextual clues outperformed the group which read less contextual clues in terms of vocabulary test scores. The findings indicated that rather

than the number of exposures to the target words, the quality of the context may have a greater effect on gaining knowledge of meaning.

Two issues which were ease of inferencing or difficult to infer the exact meaning of the words can arise while contextual guessing. According to Hu and Nassaji (2012), ease of inferencing had a negative effect on long-term retention of target vocabulary. De Bot et al. (1997) pointed out that a word surrounded by rich contextual cues is often easily comprehended, but this may result in less retention. In this respect, an unclear context can be used in order to open up a learning need (Zahar, Cobb & Spada, 2001). However, in the study of Hulstijn et al. (1996), the text was authentic and contained less contextual clues. Consequently, the results showed that the text was too difficult for students to infer the exact meaning of the unknown words from the context. In this respect, Webb (2008) pointed out that if target words are supported with contexts that are uninformative or misleading, supplementary tasks or contexts involving those words are necessary to promote learners' vocabulary learning. In this respect, instructors need to be careful while choosing authentic texts and judge whether contextual clues are sufficient to infer the meaning of the vocabulary correctly.

Glosses

Glosses are one of the contextual techniques that affect incidental vocabulary learning (Hulstijn, Hollander & Greidanus, 1996). Glosses are not only limited to only verbal forms but with advances in computer technologies multimedia forms such as pictures, videos, and sounds are also available. Using various kinds of glossing which provide the definitions of difficult words with different forms is one of the newest techniques in language learning (Zarei & Hasani, 2011). According to Ramos and Dario (2015), individuals learn most of vocabulary incidentally through exposure to words in informative contexts; this exposure is promoted by reading, and facilitated with multimodal glosses.

Glosses can be in the form of first language glosses, second language glosses and computer-based glosses or multimedia glosses (Zarei & Mahmoudzadeh, 2013). First language glosses provide equivalences of target words in native language, glosses in second language, and multimedia glosses have various forms, such as pictures, text, animations, videos, and audio forms. Advantages of glossing can be listed as attracting of learners' attention, reducing students' suffering of dictionary consultation and avoiding the interruption of reading process and preventing learners from making wrong inferences for the unknown words (Zarei & Mahmoudzadeh, 2013). In this respect, using supplementary clues might disregard the disadvantages of incidental vocabulary learning which might result in guessing the meaning of the words incorrectly.

In the literature, the effect of different types of glosses on incidental learning was largely investigated (Akbulut, 2007; Chun & Plass, 1996). In the study of Akbulut (2007), immediate and delayed effects of different hypermedia glosses on incidental vocabulary learning and reading comprehension of EFL learners was explored. University students were randomly assigned into three annotation groups: a) definition of words b) definitions with associated pictures c) definitions associated with videos. Subjects were asked to read an annotated text with the intention of comprehension. Results showed that the groups that had access to definitions along with both types of visuals had significantly higher vocabulary scores than the definition only group. In the study of Chun and Plass (1996) similar findings were obtained. Their results showed a higher rate of incidental learning for words annotated with pictures+text than those for video+text or text only. Hulstijn, Hollander and Greidanus (1996) conducted an empirical study with 78 advanced university students. Participants were randomly assigned to read a short narrative story under three conditions: marginal glosses, dictionary use, or control (not receiving additional information). Results showed that providing word meanings through marginal glosses or dictionary use positively affected incidental vocabulary learning. In the study of Shahrokni (2009) the effects of online, pictorial, and textual pictorial glosses on the incidental learning of vocabulary of 90

Iranian EFL learners were investigated. The findings pointed out that a combination of text and images resulted in improved incidental vocabulary learning. Moreover, in a study of Soemer and Swan (2012) it was found that static and animated encoding mnemonics can enhance learning of Sino-Japanese Characters in the long term according to nonmnemonic learning. Masshadi and Jamalifarb (2014) compared the effect of visual cues versus textual input-enhancement on vocabulary learning of Iranian students. According to the results, visual cued group outperformed textual input enhancement group. Moreover, Hashemi and Pourgharib (2014) investigated the effectiveness of various visual materials including pictures, real objects, and flash-cards and found that visual group outperformed non-visual group in terms of vocabulary learning. In the study of Igelsrud (1993), the results indicated that the creation of a visual image does indeed aid in long-term retention of new vocabulary and it was pointed out that the experience of using visual images are helpful to the learning process.

Differences among textual and visual annotations could be based on individual differences. For instance, in the study of Taki and Khazai (2011), students were separated into four different short-term memory ability groups. Results showed that presenting learning materials with pictorial or written annotations was much more beneficial for learners with high-visual and high-verbal abilities. Also, presenting learning materials with pictorial annotation to learners with high-visual ability as well as presenting the materials with written annotation to learners with high-verbal ability resulted in better vocabulary learning.

Previous results showed that dictionary use or glossaries of any type were conducive to better word retention compared to no additional aid groups (Xu, 2010). Moreover, pictorial+text support had more promising results compared to textual or dictionary use (Chun & Plass, 1996; Shahrokni, 2009). This results could be supported with the idea that language cannot be learned with words alone, because they are the abstract representations; as a result, language needs connections between perceptional experiences (Bristch, 2012). In his respect, photographs or visuals can focus the

learners' vision on particular aspects of content that move them from passive to active learners (Britsch, 2012).

Frequency of Vocabulary Exposure

Frequency of vocabulary exposure has a significant impact on incidental vocabulary learning (Huckin & Coady, 1999). Repeated exposure to words in meaningful collocations is necessary to make form-meaning associations (Hu, 2013; Ramos & Dario, 2015). When a learner sees a word for the first time, information about its spelling is connected to the context. After one exposure a learner may have a general sense of the context (Stahl, 2003). There are two important factors related to multiple exposures to the word. First, exposure to a word in multiple contexts from different perspectives is crucial (Stahl, 2003). When a person knows a word, he should know how this word functions in different contexts. Second, how many should be the minimum number of repetitions of words to be learned is another issue that has been largely investigated in incidental learning studies. Horst, Cobb, and Meara (1998) found that eight exposures of the target words were essential for vocabulary learning. Huang and Lio (2007) suggested that being exposed to a word at least 15 times is required for learners to recall the word meanings. Pellicer-Sanchez and Schmitt (2010) found that words with more than 10 exposures were learned substantially better than those with fewer exposures. According to Webb (2007), to develop full knowledge of a word more than ten repetitions may be needed. On the other hand, Rott (1999) suggested that six encounters may be enough to learn a word.

Previous studies exploring the effect of word frequency on vocabulary learning found out different results, ranging from 3 to 17 exposures for acquisition of words (Hu, 2013). In order for repetition to be effective, it should be distributed across different meaningful contexts. Learning word function in different contexts is crucial in incidental vocabulary learning environments.

Learner's Attention

In incidental vocabulary learning, another important issue is learner's attention (Huckin & Coady, 1999). Researchers had different opinions about this issue, thus several of them claimed that without attention, vocabulary learning was impossible (Webb, 2008); several of them stated that at least some degree of conscious attention was necessary (Ramos & Dario, 2015). According to Webb (2008), learning only occurs when the learners' attention is focused on the meaning of the word. On the other hand, others argue that a certain amount of attention to meaning, but also to form is required for vocabulary learning to happen (Ellis, 1994; Ramos & Dario, 2015). In the study of Alcon (2007), the effectiveness of incidental focus on form was investigated. Data was collected from 17 recordings, 204 learners' diaries and 204 delayed post-test translations were gathered during a whole academic year from 12 high school EFL students. It was found that a certain degree of attention must be placed on the vocabulary in order for learners to notice the vocabulary they are being exposed to. According to Ramos and Dario (2015), more research needs to be administered to establish the degree of the attention in order for the enhancement of vocabulary learning.

Learner's Interest/ Prior Knowledge

Another issue which was explored in previous studies of incidental learning was learners' interest. According to Huckin and Coady (1999), task demands played critical role in vocabulary learning, since texts that were interesting for learners personally may yield better results. Ramos and Dario (2015) pointed out that there is no agreement on the amount of exposure to a word for incidental learning to occur, but a lot depends on other factors, such as word salience, its recognizability, and learners' interests. In this respect, if the topic or main idea of the text is familiar, learners have a greater possibility of correctly guessing the meaning of unknown words (Huang & Eslami, 2013). Moreover, tasks and texts need to be compelling enough so that both teacher and students will want to talk about them and revisit them repeatedly (Stahl, 2003).

Comprehension strategy of a text is to activate the learner's prior knowledge; therefore, if learners lack prior knowledge, conscious comprehension strategies cannot be activated (Stahl, 2003). Readers can make rapid connections between new and previously learned content and moreover they can read texts on a familiar topic more fluently than those on an unfamiliar topic (Hirsch, 2003). In this respect, domain knowledge enables learners to make sense of word combinations and lead them to choose the meaning among multiple possible word meanings (Hirsch, 2003).

Discourse Type

Vocabulary is a concept best clarified by the distinction made between high frequency vocabulary and low frequency vocabulary (Franco & Galvis, 2013). According to Brown et al. (1989), mostly vocabulary is learned in the context of ordinary communication which includes words to which we are exposed mostly in our daily lives (high frequency). Hwang and Nation (1995) subdivides words into two families; those words belonging to the first family account for more than eighty percent of words used in conversations, widely known texts such as newspapers, fiction books, and academic texts, whereas those belonging to the second family have a lower degree of appearance in these texts. Interest is crucial in the process of determining a word's discourse type. According to Franco and Galvis (2013), particular interest in certain domains also influence whether a word is classified as frequent or not, in other words the high frequency words of some individuals may not be the high frequency words of others (i.e. doctors´ language and teachers´ language).

Beck, McKeown and Kucan (2002) proposed a three-tiered model of vocabulary. *Tier 1* includes high frequency words to which an individual can be exposed to in everyday interactions and conversations. *Tier 2* words are the mid-range words that have high academic utility and generalizability across the curriculum (experiment, examine, create etc.)

Tier 1 type words, which are also referred to as *general discourse type*, include those that can be easily inferenced in contextual settings. Tier 2 and tier 3 type words, which are also referred to as intermediate discourse and specific discourse type respectively, include those that have high academic utility and usually have Latin roots. Academic language uses sophisticated and specific disourse type words that can block reading,comprehension, and learning (Snow, 2010). On the other hand, some students acquire academic vocabulary on their own, because their skills are strong enough to inference the meaning of the words. However, some of them need explicit instruction (Snow, 2010). Academic vocabulary can be taught explicitly, however for long-term retention they needed to be embedded in meaningful contexts rather than presented in lists (Snow, 2010). In this respect, words with high academic utility can be taught explicity with meaningful contexts in order to enhance EFL learners' vocabulary learning.

To sum up, previous studies showed that there are three main components of contextual vocabulary learning: context, learner and vocabulary. In the literature, learners' interest, attention, prior knowledge, discourse type, contextual clues and word frequency were explored and their effects on vocabulary learning were largely investigated. In this respect, it is crucial to explore how those attributes were affected by each other and as a result how they affected the process of contextual vocabulary learning. When these connections were revealed one of the difficult challenges for educational practitioners which is to determine what should be made explicit in teaching and what should be left implicit will be solved gradually.

The learner is one of the main components of contextual vocabulary learning, because the learning process is mostly affected by how the learner interacts with the context and vocabulary. Previous studies have revealed that the learner's interest, prior knowledge and attention were crucial in learning vocabulary. In contextual learning, the great emphasis is on incidental vocabulary learning. However, it is crucial to guide or give support to the learner explicitly in order to minimize limitations of incidental vocabulary

learning; therefore, contextual clues and multimodal glosses could play a critical role. The last component, vocabulary is the content that will be presented to the learner is one of the dynamics. Word frequency and type of the vocabulary were critical factors that needed to be taken into account in designing learning environments for promoting contextual vocabulary learning.

The gap in the literature is how the synergy between learner, context, and vocabulary should be in order to promote contextual vocabulary learning. There has been little research that conclusively identifies the combinations of methods for vocabulary learning. Moreover, previous studies mostly have indicated "texts" as context for vocabulary learning; however there are various opportunities that can be presented as context to the learners in order to promote contextual vocabulary learning.

2.2 Situated Learning Theory

Situated Cognition or Situated Learning which was first expounded by Brown et al. (1989) claimed that knowledge is linked to the activity, context, and culture in which it was learned. Later, social anthropologists Lave and Wenger (1991) called this process legitimate peripheral participation and proposed that participation in a culture of practice enable the learner to move from the role of observer to a fully functioning agent. In this respect, learning must take place in its context; as a result, students have a chance to search and find rational explanation for knowledge by interacting with the physical surroundings and social environment (Chen et al., 2009). According to Chen et al. (2009), such teaching methods which implicitly separate learning and situations will result in making students memorize conceptual knowledge and skills and incapable of applying them in different contexts or situations. Lonsdale, Byrne, Beale, Sharples and Baber (2004) supported the idea that by providing content and options that are tailored to the current context, more engaging learning experiences can be maintained.

2.2.1 Characteristics of Situated Learning Theory

Various critical characteristics of situated learning environments have been defined in previous studies (Herrington & Oliver, 2000, Young, 1995 and Chu et al., 2010). Herrington and Oliver (2000) defined nine critical characteristics to guide the development of situated learning environments (p. 4).

1. Provide authentic contexts which are physical environments that reflect the way the knowledge will be used.
2. Provide authentic activities which include tasks and sub-tasks that require students to complete the activities. These activities need to have real world relevance.
3. Provide access to expert performances and models or observation of real-life episodes as they occur.
4. Provide multiple roles and perspectives by providing more than one investigation and having opportunity of expressing different points of view
5. Provide collaborative activities which support collaborative success.
6. Promote reflection to enable abstractions to be formed. Provide authentic context and tasks which promotes act upon reflections.
7. Promote students to articulate their understandings
8. Provide scaffolding and coaching at critical times.
9. Provide authentic assessment within the tasks. Provide a set of tasks that make students effective performers and asses them in realistic environments and contexts.

Herrington and Oliver (2000) emphasized the authentic activities which had real-world relevance. In this respect, authentic tasks and sub-tasks were critical in situated learning environments which students had a chance to observe real-life episodes as they occured. Young (1995) listed four critical tasks for instructional design of situated learning environments as follows (p. 90):

1. Selection of situation or set of situations based on the knowledge that desired to be acquired.
2. Providing appropriate guidance for novices and experts for the realistic contexts based on the complexity of the tasks
3. Providing support for cooperating groups of students and enabling teachers to track the progress.
4. Authentic assessment in situated learning environment

Young (1995) and Herrington and Oliver (2000) had similarities including guidance and authentic assessment in authentic tasks. In this respect, while learning takes place in real life, tasks- situations, and assessments also should be in real contexts. Chu et al. (2010) also emphasized critical characteristics for instructional design in such situated learning environments, including selecting situations to apply practical knowledge, providing necessary guidance for novices in complex tasks, promoting teachers for following students' progress and applying assessments to evaluate the effectiveness of situated learning environments. In addition, Catalano (2015) pointed out the importance of understanding the situated nature of cognition and applying the principles of cognitive apprenticeship which were expert modeling, authentic activities, and different contexts that authentic activities can be transferred.

Situated Learning Theory has been effectively applied to Language Learning (Shih &Young, 2008), Distance Education (Catalano, 2015); Educational Technology course (Huang, Lubin & Ge, 2011). Various characteristic of situated learning environments were taken into account in various domains. In the study of Huang et al. (2011); a situated learning environment was created for Educational Technology course. As a situated learning model cognitive and sociocultural perspectives were taken into account. In this study, the authentic context was "parent-teacher" interview and students prepared all the materials needed for the parent-teacher conference as authentic task. Project artifacts were used as authentic assessments. Designing project artifacts required problem solving skills and as well as specific applications of computer skills in the

problem solving context. The authentic context was providing students with autonomy to make decisions about what software and skills to use. In this qualitative study, there were also problems due to the early exposure of pre-service teachers to the kinds of authentic activities and tasks they will encounter in the future. Although several students benefitted from this kind of learning environment, considerable amount of students felt uncomfortable, lost and frustrated. It should be noted that educators need to pay attention to managing students' feelings, and foster their positive attitudes of constructive learning.

In the study of Catalano (2015), efficacy of a situated learning environment for information literacy course was investigated. Eighty-five university students who took distance education library research course were randomly assigned to a traditional instruction group and a situated learning condition group. Situated learning condition was designed based on the principles of Situated Learning Theory which were expert modeling, scaffolding, authentic activity and problem-based assessments. Students were presented with realistic situations that they might face in real world, such as encountering a problem at human resources department and having to come up with solutions with reliable and digital sources. Results indicated that teaching models based on the principles of Situated Learning Theory have the potential of transferring knowledge to real-world contexts. In this study, transferring knowledge from instructional situation to its application to environments outside the classroom was one of the main purpose and promising results were found.

Previous studies in the literature were based on various situated learning models which had various characteristics. For instance, Shih and Young (2008) emphasized situated communication; therefore, they created immersive and communicative language learning activities with 3D virtual technologies. On the other hand, Catalano (2015) followed the principles of Herrington, Reeves and Oliver's (2006) model for distance education library research course and created problem-based scenarios to enable learners to solve realistic problems in situated learning environment. It can be concluded that

characteristics of situated learning theories differ in terms of subject domain or objective. It is crucial to create authentic and meaningful learning environments to prepare learners for real environment.

2.2.2 Designing Language Learning Environments based on Situated Learning Theory

EFL learners do not have the opportunity to authentic use of target language outside the classroom (Ozverir & Herrington, 2011). In this respect, a shift from translation exercises and grammar worksheets to purposeful and authentic use of language for some real-life goal is necessary for EFL learners (Roessingh, 2014). Situated Learning Theory which claimed that knowledge is linked to the activity, context and culture in which it was learned is well suited for creating meaningful and authentic contexts for language learning. Especially contextual vocabulary learning which supports the idea that vocabulary was mostly learned in the context of ordinary communication is well suited to the characteristics of Situated Learning Theory.

There were advantages and disadvantages of situated learning materials in language learning. Berardo (2006) summarized the advantages as (p. 64): "having a positive effect on student motivation, giving authentic cultural information, exposing students to real language, relating more closely to students' needs, supporting a more creative approach to teaching." In terms of disadvantages, Richard (2001) pointed out that authentic materials often contain difficult language (complex language structures, unneeded vocabulary items) which can often create problems for the teacher and students. In this respect, special preparation is necessary and it may be time consuming for teachers. For low level students, tasks should be well-designed unless they might be confused and demotivated (Guariento & Morley, 2001).

Designing language learning environments based on Situated Learning Theory is not an easy process and requires various dynamics to be taken into account. In the following

section, mostly stated components in the literature and their implications on instructional design process will be discussed elaborately.

Authentic Context

Brown et al. (1989) defined *authentic* as "coherent, meaningful and purposeful activities or in other words they are ordinary practices of the culture" (p. 34). According to McLellan (1994) authentic contexts can be a/an 1) actual work setting 2) virtual representation of the actual work environment 3) anchoring contexts such as a video or multimedia program (p.8). On the other hand, another approach was identified as "simulation" and "participation" (Radinsky, Bouillion & Gomez, 2001). *Simulation* was to create a simulation of a professional practice within the context of the classroom *Participation* was to create opportunities for students to participate in the actual work of a professional community. Under a participation model of authenticity, students participate in the actual work and engage directly in the real environment. Instructional implementation which simulates real-life situations were widely used in numerous studies (Hay, 1993; McLellan, 1996; Shih &Young, 2008; Winn, 1993). On the other hand, participation in actual work outside classroom was also used as instructional strategy in previous studies (Catalano, 2015, Sandberg, Maris, & de Geus, 2011).

There were conflicting opinions in the literature about determining which contexts and activities were accepted as authentic. In this respect, it is essential to make a distinction between authentic and inauthentic. Authentic texts for language learning were widely used as implications of Situated Learning Theory (Zahar, Cobb & Spada, 2001). According to Ozverir and Herrington (2011), learners' interactions with resources such as texts are one of the inauthentic situations. In these situations, learners were given some texts to read and right after comprehension question activities related to the text. Mishan and Strunz (2003) defined these kinds of tasks as "cosmetic authenticity". Consequently, these texts make the original purpose of a text secondary and do not create authenticity in tasks.

When discussing situated learning contexts, educators generally refer to instructional experiences inside classrooms; however, learning a language can be situated in different contexts (Egbert & Petrie, 2005). When authentic tasks are transferred to the classroom, their context is transmuted, and therefore, they become classroom tasks part of school culture (Brown et al., 1989). Using an authentic task is the only way that students act meaningfully and purposefully (Brown et al., 1989). Accordingly, meaningful and purposeful authentic contexts and tasks are essential while designing situated learning environments.

Another debate is between participation and simulation model of authentic contexts. Instructional designers who apply Situated Learning Theory by using electronic media were accepted as a further step away from real life work situations (Herrington & Oliver, 2010). Learning in real situations rather than simulated situations enables students to develop a stronger sense of immediacy and, consequently, enhances learning motivation and outcomes (Huang, Yang, Chiang & Su, 2016).

Authentic Tasks

Authentic tasks have played crucial role in designing language learning environments based on Situated Learning Theory. There are different opinions about what a task actually is in language learning. Oura (2011) made a distinction between target tasks and pedagogical tasks. Target tasks are tasks that students need to accomplish beyond the classroom, while pedagogical tasks are tasks which form the basis of the classroom activities during the instruction. Target tasks include borrowing library books, making flight reservation and so on. By contrast, pedagogical tasks include answering comprehension questions or fill in the blanks exercises. The main purpose of language instruction is to enable learners to accomplish target tasks in real world by using the target language. In this respect, in target based instruction the priority is not the language itself, but rather functional purposes of the language.

In situated learning environments, the priority is designing *authentic* target tasks. The task can be labeled as *authentic*, if it is related to real world needs. Authenticity of the task depends on whether or not a student is engaged in the task (Guariento, 2011). Authentic tasks enable learners to interact with the real language and content rather than the form; therefore, learners feel that they are learning a target language as it is used outside the classroom (Berardo, 2006). Authentic task should be well designed to scaffold the completion of the work at hand (Roessingh, 2014). The relationship between the task and the learner is also crucial; thus, what the learner perceives contributes to the learner's activities and learning (Brown et al., 1989). In this respect, learners' prior knowledge, familiarity to the task, interest, goals and needs play a crucial role in designing authentic tasks.

Learners who are familiar and comfortable in authentic learning settings are able to actively immerse in the authentic contexts (Herrington et al., 2006). Most important characteristic is the *topic* chosen. The topic, essepecially for young learners, relates to their current interests and motivations is crucial for engagement (Roessingh, 2014). Tasks must integrate learners' past and new knowledge through communicative and cognitive procedures (Zohoorian, 2015). Vocabulary and concept information must be embedded in interesting, motivating and personally relevant contexts that have the potential to engage learners in continuous, authentic-like work (Roessingh, 2014).

Ability is also another important factor that should be taken into consideration while designing authentic tasks. Authentic materials should be created according to students' ability (Berardo, 2006). Lower level students may feel frustrated, confused and demotivated with complex authentic tasks (Guariento & Morley, 2001).

Providing Appropriate Guidance

Providing appropriate guidance for learners for the realistic contexts is another essential component of Situated Learning Theory (Herrington & Oliver, 2000; Young, 1995). Teachers, contextual clues and assisted technologies can be used as facilitators at critical

times when a student is unable to complete the authentic task. Offering hints and reminders, giving feedback should be all integral to the learning situation (Herrington & Oliver, 2000).

Authentic tasks can be supported with context rich experiences in language learning environments. Computer or mobile technologies can be cost effective ways of accessing support at critical times. The multimedia capabilities and portability of mobile devices in particular can be used to support learners while they are engaged in the context. Students can access information or gather information using these devices regardless of time and location (Comas-Quinn, Mardomingo & Valentine, 2009).

Authentic Assessments

Authentic assessment is crucial in designing situated learning environments. Integrated assessments should be within the tasks (Herrington & Oliver, 2000; McLellan, 1993; Young, 1995). Herrington and Oliver (2000) pointed out that evaluations should not include formal tests, portfolios, reflections and so forth; assessment should be an integrated part of situated learning environment. In this respect, it is essential to provide a set of tasks that make students effective performers and asses them in realistic environments and contexts (Herrington, Oliver & Reeves, 2006).

2.2.3 Review of Situated Language Learning Studies

The main characteristic of situated learning environments is to create authentic context and authentic tasks which have real world relevance. There were various examples in language learning, for instance, Oura (2011) gave examples of authentic tasks including reading English language newspapers, magazines, even listening to popular music from the radio. In the study of Melvin and Stout (1987), students were sent to a city in a target culture and completed authentic tasks based activities. In the study of Shih and Yang (2008), a collaborative virtual environment was used for situated language learning environment to promote natural communication and interaction in the target language. In

another study of Yang (2011) an online situated learning environment was developed in order to engage students who learn English as a foreign language in the context of a big class to enable students and teachers to communicate synchronously and asynchronously both in class and after class. Comas-Quinn et al. (2009) created a mobile blog which students could use as an interactive repository for sharing examples of their cultural encounters with the location. In recent years there is a tendency to use virtual environments or technology enhanced authentic learning environments as authentic contexts.

Situated language learning studies were conducted in order to enhance different skills of language learning including communication skills (Shih & Young, 2008; Young, 2011), academic language (Zohoorian, 2015), vocabulary learning (Chen & Li, 2010; Huang et al., 2016), writing skills (Hwang et al., 2014). Situated learning environments were mostly evaluated in terms of learner engagement (Wicha & Temde, 2013; Yang, 2011), performance improvement (Sandberg et al., 2011); perceptions (Lee et al., 2005) and motivation (Ruso, 2007).

In the study of Shih and Young (2008), 3D (three-dimensional) virtual English classroom was designed as situated learning environment in order to promote communicative skills. Students were given opportunities to engage in various goal based activities in target language. This qualitative study showed that 3D virtual situated learning environments enable learners to learn language in context and develop communicative competence. The system was designed to meet the learners' needs including fun, realistic situations, challenges, a sense of community, goal-based scenarios, and a story centered curriculum. This kind of learning provided authentic communicative environment by enhancing advanced EFL students' interaction and immersion.

In another study, drama based context was developed in order to enhance communication synchronously and asynchronously (Yang, 2011). In order to enhance

communication, situated learning environment was created in the context of a big class, and it aimed to enhance students' emotional, cognitive and behavioral engagement. The benefit of drama in situated language learning is its focus on cognitive engagement with authentic communicative events that help students experience the language in various situations within the context of culture (Yang, 2011).

In the study of Lee et al. (2001), online situated learning environments were evaluated based on principles of Situated Learning Theory. Key design principles of Situated Learning Theory that they have stressed out were authentic activities in different contexts, expert scaffolding, different points of view, providing practical reflection, cooperation, clarification of thinking and coaching. Surveys and interviews were conducted in order to learn learners' opinions about these environments. Overall online situated learning environments were found to be satisfactory; however dynamic nature of web and language itself should be taken into account during the process.

Comas-Quinn et al. (2009) developed a webpage and blog as a situated learning environment which students could use as an interactive repository for sharing examples of their cultural encounters with the location. Students took photos, videos etc. related to foreign culture with their mobile devices and uploaded them to the cultural blog. Students were interviewed and given questtionnaires regarding their experiences. It was found that there was a low level of participation. The reason for low levels of participation was explained by students' less familiarity with new and mobile technologies than they had anticipated. They pointed out importance of supporting the learners throughout the process. According to feedbacks, learners had few opportunities to set their own goals, concentrate on their own interests and engage creatively in the learning experience.

Hwang et al. (2014) created a situated learning system to support elementary school students to practice and to improve their English as a foreign language writing skills. In this respect, one group visited real environment (familiar context) and engaged in

situated real time writing with their mobile devices. The contexts were classroom, cafeteria and playground. Moreover, students were engaged in peer commentary exercises with mobile devices in the same familiar context. Other group used a paper-and-pen-based method to accomplish writing activity with picture support in the classroom. Situated group outperformed control group in terms of writing tasks. According to Hwang et al. (2014), students had an opportunity to review and memorize vocabulary terms related to familiar contexts. Moreover, situated group wrote more sentences and described the target objects in detail and clearly.

Ruso (2007) investigated the influence of task based learning on EFL learners. Mostly liked tasks were watching a film and writing about it, finding the guiltiest character after reading a passage, completing a cloze test while listening to a song. Those tasks could be labeled as authentic tasks in which contextual learning was facilitated. Less liked tasks were working alone while doing exercises of the book. These tasks were a kind of pedagogical task that keep the learner apart from the real world. Moreover, results showed that if the tasks were almost the same, uninteresting and not creative, such as answering reference questions or finding the main ideas of paragraphs, students did not feel satisfied.

There were several studies who implemented principles of Situated Learning Theory in vocabulary learning (Chen & Li, 2010; Wicha & Temdee, 2013). Vocabulary learning studies that are based on Situated Learning Theory were contexts-aware systems which are also labeled as ubiquitous learning systems that detect location of the learners in order to provide authentic materials. Mobile technologies were used to detect learners' location and situation. Those studies will be presented elaborately in the section of "Integration of Mobile Learning and Situated Learning Theory in vocabulary learning".

To sum up, main components of contextual vocabulary learning are learner, context and the vocabulary. A model which guides the connection between those attributes is crucial for designing efficient vocabulary learning environments. In this respect, Situated

Learning Theory which has the characteristics of providing authentic context, authentic activities, and appropriate guidance for learners and authentic assessments is a well-suited theoretical basis for designing contextual vocabulary learning environments. Recent studies have showed that authenticity is mostly maintained through virtual environments or authentic texts in language learning. However, real world relevance should be quiet a lot to create meaningful learning environments. Students should be facilitated and guided by considering them as active learners who have the autonomy in situated learning environment. Technology enhanced learning environments can be used in this respect in order to enhance learning environment, improve authenticity or support novice/expert learners while completing the complex tasks. In this respect, a mobile learning tool is an optimal aid for this type of real-world related learning (Sandberg et al., 2011). The authenticity and mobility features of mobile devices highlight opportunities for contextualized, participatory and situated learning (Kearney et al., 2011).

2.3 The Use of Mobile Devices for Learning

Since the advent of wireless technology, various areas such as education, military and business have greatly benefited from these devices. The devices with wireless technology have become popular day by day. Mobile technologies which are portable devices can promote collection, process and analysis and moreover the high interactivity among users, which facilitates communication and collaboration (Su & Cheng, 2013). Portability of learners and the features of being more user centered and independent form location have promoted the usage of mobile devices for learning purposes. In this respect, a new phenomenon called mobile learning has begun in the recent years.

Mobile learning has a relatively short existence and it appears that 2005 was the year in which mobile learning became a recognized term (Berge & Muilenburg, 2013). An early definition of mobile learning was simply the use of a palm as a learning device; however, since then, attributes including pedagogy, technological devices, context, and

social interactions have been integrated into the definition of mobile learning (Berge & Muilenburg, 2013). Kukulska-Hulme (2005) stated: "Mobile learning is certainly concerned with learner mobility, in the sense that learners should be able to engage in educational activities without the constraints of having to do so in a tightly delimited physical location" (p. 1). Kukulska-Hulme (2009) emphasized not only physical mobility but also the opportunity to access people and digital resources regardless of location and time. Mobile learning focused on the portability of the device, mobility of the learner and the interaction of learners with mobile devices (Kukulska-Hulme, 2009).

As pedagogy has changed over time, its implications on mobile learning have changed as well. At first, the idea that knowledge is acquired through active participation in the learning process was accepted. Then, the idea that knowledge is developed through working on tasks and skills in authentic environments has become popular. In recent years, the idea that knowledge is co-constructed interdependently between the social and the individual is commonly-accepted approach in pedagogy (Berge & Muilenburg, 2013). Those changes in pedagogy have reflected on the use of mobile devices in learning. Today, context aware, authentic, and self-directed mobile systems are integrated in order to promote learner-centered pedagogical movement. Current popular mobile learning theories are "Cognitivism, Constructivism, Situated Learning, Problem-based Learning, Context Awareness Learning, Socio-Cultural Theory, Collaborative Learning, Conversational Learning, Lifelong Learning, Informal Learning as well as Activity Theory, Connectivism, Navigationism and Location-based learning" (Keskin & Metcalf, 2011).

As technology has changed over time, the capabilities of mobile devices have significant impacts on their implications in learning. In 1990s, personal digital assistants (PDAs) were the first multipurpose, handheld devices that could be utilized in the educational setting. However, the interest in PDAs decreased as smartphones offered the same application and Web functionalities, but with the added mobile-phone capability (Berge & Muilenburg, 2013). Moreover, tablet computers continued the trend toward greater

mobility. Although smaller hand-held devices were widely used in recent years (e.g. cell phones), the use of larger devices remained the same due to their larger screen sizes and higher processing power (Chang & Young, 2015). According to the review study of Sung, Chang and Yang (2015), most mobile learning studies used handhelds (73.3%; including cell phones, iPods or MP3 players, digital pens, pocket dictionaries, and CRSs), followed by laptops (26.7%; including laptops, tablet PCs, and e-book readers).

Tablets were commercially available in 2002 and they have become more and more popular since then (Haßler, Major, & Hennessy, 2016). Popularity of tablets has led to an interest in educational settings. Wang et al. (2015) listed advantages of using tablets in education as: mobility, user-friendly interface, embedded sensors, integrated system, multi-touch screen and haptic manipulation. Those features of tablets promoted educational practitioners to use them in learning environments. In the study of Wang et al. (2015), two applications for science learning were developed for tablets. Students were able to create objects by touching; drag them to set up their initial speed and then lift their fingers off the screen to release the objects and also students were able to control the magnitude and direction of gravity by tilting the tablet. Various features of tablets were included in order to create meaningful and realistic learning environment. Results indicated that those apps promoted learners' mental, physical and conceptual engagement in science learning. Clark (2013) investigated the effectiveness of a tablet application for vocabulary learning. While the control group completed a teacher-created worksheet, the experimental group performed the activities in mobile applications. Results indicated that students benefitted more from the use of the tablet application compared to the teacher made worksheets. Students were more motivated and engaged in and also they were able to practice the targeted skills more independently.

To sum up, mobile devices were widely used in teaching and learning due to being portable and authentic, promoting communication and interaction, and having personalization features. Changes in technology and pedagogy have influenced the implications in mobile learning environments. While in early times, PDAs were widely

used for mobile learning, nowadays mobile phones and tablets are widely used due to their portability and high capabilities. Tablets are still popular due to their larger screen sizes and higher processing power.

2.3.1 The Use of Mobile Devices for Vocabulary learning

Various technologies have been widely used to promote vocabulary learning of EFL learners. One of the critical issues in English-language education is developing modern assisted-learning technologies that promote effective English learning (Chen & Chung, 2008). The development of new technologies which provide personalized, portable and mobilized learning environments resulted in a shift from traditional classrooms to mobile learning environments (Chen & Chung, 2008).

Sandberg et al. (2011) conducted an experimental study which included three groups of primary school students as participants. The first group had classroom lessons in English about zoo animals and their characteristics. The second group took classroom lessons and worked with a mobile application in a public zoo. The third group also worked with a mobile application in a public zoo, but additionally they were allowed to take the mobile application home. The mobile application which was a kind of serious game consisted of two types of games: 1) worked in zoo situation and children were able to explore different animals by GPS (Global Positioning System) 2) allowed students to access different continents and the animals independent of the GPS-function. The experimental results showed that the group which took the mobile phone home improved the most in terms of vocabulary test scores (Sandberg et al., 2011). According to Sandberg et al. (2011) the learning that goes on at school which is a part of formal learning can be combined with informal learning in different contexts; thus, students can learn also outside the classroom. Moreover, Sandberg et al. (2011) suggested using mostly abstract vocabulary that it is not easy to comprehend for children and highlighting the word and the related picture on the screen at the same time.

In the study of Sun and Chang (2014), Taiwanese tertiary students evaluated a system developed for learning plants and their features in English. The system was location-based mobile learning system which promotes English learning. Maps, vocabulary items, related images and a position recognizing system were integrated into the mobile learning system. The majority of the students suggested that the content could be presented in the form of both text and image. For future use, the students suggested that the mobile system should be gamified, support audio guide, should be used in addition to reading texts, and the function of immediate translations or inquiries of online vocabulary should also be included in order to reduce the burden on learners. Moreover, it was suggested that vocabulary page should display words along with related text and definitions.

As for dissertations and master theses related to mobile vocabulary learning in Turkey, in the early years, the effects of using multimedia messages via mobile phones for improving language learners' acquisition of words were explored (Saran, 2009). A mixed method approach involving both quantitative and qualitative components was employed and three different groups were formed in order to investigate the comparative effectiveness of supplementary materials delivered through three different means: mobile phones, web pages, and printed materials. All participants provided positive feedback about the mobile learning application used in that study.

In the following years, 2D (two-dimensional) barcodes and QR (quick response) code technologies were used in order to provide multimodal information for printed materials and learning objects. Those studies conducted in classroom environments in which only portability feature of mobile phones were taken into account, instead of combining mobility and portability features. Agca (2012) investigated the effectiveness of text-plus-mobile phone learning using an integrated 2D barcode tag in a printed text. The learner scanned the tag with the camera of his mobile phone and found the related animation and audio information while reading the printed text. The results showed that supporting a printed textbook with camera-equipped mobile devices and 2D barcodes

linked to supportive information, might increase the effectiveness of learning. Moreover, in the study of Orhan Ozen (2013), a ubiquitous learning environment for English vocabulary learning for 4th grade students was developed. Learning objects were supported with QR codes with links to related instructional materials (videos, flash cards and sentences including the objects). Mixed method was conducted to gather deeper understanding of the system. Results showed that u-learning environment positively affected the students' English word capacity and participants stated that they used this environment easily, had fun and enjoyed the application. Celik (2012) conducted a familiar study in which a course book was integrated with mobile online dictionary software via smart phones and QR code that link the students to mobile online dictionary software.

There were three more studies which were also conducted in classroom settings. Zengin Unal (2015) investigated the differences in vocabulary achievement level of students between mobile-based and paper-based vocabulary notebooks in English language learning and they found out that mobile-based vocabulary notebooks had positive effects on students' vocabulary achievement. Moreover, in a recent study of Akkuzu (2015), a game-based application was developed and evaluated by students and teachers. The mobile application was developed to measure primary and secondary education students' vocabulary acquisition in English as a Foreign Language. Students played the mobile game in classroom setting. Results showed promising results in terms of motivation and academic achievement. In another recent study, the effects of multimedia glosses on second language listening comprehension and incidental vocabulary learning in a mobile environment was investigated (Cakmak, 2014). Three types of glosses including textual-only, pictorial only and textual plus pictorial were investigated. A listening application for mobile devices was developed. The participants' interaction with the listening text and glosses was tracked in order to examine the strategies they employed. Results showed that access to glosses facilitated recognition and production of vocabulary with the type of gloss having a nonsignificant effect.

Sung, Chang and Young (2015) conducted a meta-analysis to explore how effective mobile devices were for language learning based on 44 peer-review journal articles and doctoral dissertations and found out that the settings in the researches were mostly classroom. Similarly, mobile vocabulary learning studies in Turkey commonly focused on promoting classroom activities with multimedia glosses, QR codes, barcodes or mobile notebook supports. However previous studies showed that learning that take place in multiple settings produced a maximal learning effect by connecting formal (e.g. classroom) and informal learning (e.g. real-life situations) (Sung et al., 2015). In this respect, creating language learning environments out of the classroom by taking advantage of mobility of the devices which connect in-class and real-life activities is one of the gaps in mobile vocabulary learning literature.

2.4 Integration of Mobile Learning and Situated Learning Theory for Vocabulary Learning

According to Situated Learning Theory, "context" is one of the essential components in language education. Meaningful vocabulary learning can only be maintained when the learning progress is integrated into social, real-life and cultural contexts (Chen & Li, 2010). Mobile technologies which can support learners in learning without constraints of time or place by making connections between learning activities and real learning environments promoted authentic activities for contextualized vocabulary learning. Moreover, in contextual learning environments if the context surrounding the vocabulary was not useful for learners to correctly infer the meaning of words, mobile technologies can be used in order to enable learners to correctly guess the meaning of the words from the context (Sandberg et al., 2011).

Kearney, Schuck, Burden and Aubusson (2011) pointed out pedagogical perspectives of mobile learning which highlights three central features: authenticity, collaboration and personalization. Kearney et al. (2011) pointed out that "mobile learning episodes potentially involve high degrees of "task and process authenticity" as learners participate in rich and contextual tasks (setting, characters, tools), involving "real-life" practices"

(p. 10). The researchers analyzed more than 30 mobile leaning scenarios in recent mobile learning literature and unfortunately very few of these scenarios rated highly in the scales for authenticity. Most activities involved either some form of contrived context or activities that merely provided a simulation of reality. The authenticity feature of mobile learning highlights opportunities for contextualized, participatory and situated learning. Those opportunities can be maintained by integrating mobile technologies in real-word tasks which promote authentic activities regardless of time and location.

In recent years mobile studies in vocabulary learning moved from SMS-based learning to personalized and context-aware systems with the improvement of mobile technologies. Those systems were mostly based on Situated Learning Theory which suggested that context is an important consideration in vocabulary learning process for EFL learners. In these types of learning environments, suitable English learning materials that are related to the context were sent to the students by taking their features and location into account. In other words, these systems were helpful to provide authentic materials according to learner's charasteristics and location.

In the study of Huang, Yang, Chiang and Su et al. (2016), mobile devices with GPS technology were able to sense the location of students and provide them with appropriate learning material in real world contexts. So an experimental study was conducted just for one day. For the control group, a five-step vocabulary learning strategy combined with traditional learning tools were employed in a situational English vocabulary learning environment. For the experimental group, a five-step vocabulary learning strategy combined with the mobile learning tool was employed in a situational English vocabulary learning environment. The situational learning group stated that the functions of the mobile learning tool, such as automatically searching for new words and providing the meanings of new words, enabled the students to focus on understanding the meaning of new words and remembering new words without reference to a textbook or dictionary. Students found the learning method interesting and enjoyable. The novel

learning approach increased the appeal of learning and fulfilled the students' expectations (Huang et al., 2016).

Chen and Li (2014) designed a personalized context-aware vocabulary learning system for PDA devices. In this system, learner's location which was detected by wireless positioning techniques, learning time, English vocabulary abilities and leisure time were detected in order to effectively support English vocabulary learning in a school environment. Results indicated that the learning performance of learners who used personalized English vocabulary learning systems with context awareness outperformed learners who used personalized English vocabulary learning systems without context awareness. However, Chen and Li (2014) claimed that it was designed for informal learning and just used for two weeks, but if it had been integrated into classroom learning activities it would have facilitated vocabulary learning more.

Another context-aware system which is based on the principles of Situated Learning Theory was developed and evaluated by Wicha and Temdee (2013). An educational software which was named as situated English vocabulary and conversation learning system was developed to support Thai learners in the acquisition and retention of target English vocabulary and knowledge of conversation. 14 English communication knowledge topics related to four situated learning contexts were determined including market, farm, household and temple. The translation tool enabled the learner to translate English vocabulary to Thai and also see an image of the selected vocabulary. GPS technology is used in order to detect the location of the learners. Results showed increased engagement and learning performance and also higher satisfaction and motivation levels.

Situated mobile vocabulary learning studies were mainly based on context-aware systems that detect learner's location, learning time, individual English vocabulary abilities or leisure time in order to provide authentic language learning materials at the right place and at the right time. GPS function, QR codes and Bluetooth technologies

were widely used for the connection between real environment and authentic materials. In context aware learning environments, a list of target vocabulary is sent to learners in order to expose them to the target vocabulary in context. However, recent pedagogical approaches for vocabulary learning promote contextual vocabulary exploration for EFL learners that make them active learners while inferencing the meaning of the words. In this respect, in the present study, students were engaged in authentic activities in a real environment and a mobile system was used as supportive technology for providing contextual clues of vocabulary and instructions of the interactive experiments. Students were facilitated and guided as active learners who had the autonomy in situated learning environment. In this respect, mobile technologies can be used in order to enhance learning environment, improve authenticity and support novice/expert learners while completing the complex tasks in real environment.

CHAPTER 3

METHODOLOGY

This chapter presents purpose of the study and research questions, research design, participants, procedures of the study, setting and materials, pilot study, instrumentation, data collection, validity and reliability, and limitations of the study.

3.1 Purpose of the Study and Research Questions

The purpose of the present study was to investigate how mobile supported situated learning environment facilitate learners' contextual vocabulary exploration processes, task completion, and vocabulary learning. In this respect, research questions of the study are presented below:

Research Question 1. How does mobile supported situated learning environment facilitate contextual vocabulary exploration processes?

Research Question 2. How does mobile supported situated learning environment facilitate task completion?

Research Question 3. Is there a significant difference between pretest, posttest, and retention test scores in mobile supported situated learning environment?

Research Question 4. What are the experiences of learners concerning mobile supported situated learning environment?

3.2 Research Design

In the present study one group embedded mixed methods design was conducted. Mixed methods design is the combination and integration of qualitative and quantitative data and research in a single study (Creswell, 2013, p. 43). According to Clark and Creswell (2011), there are four types of mixed methods design including Triangulation Design, Embedded Design, Explanatory Design, and Exploratory Design. In the present study, Embedded Mixed Design was administered in which quantitative and qualitative methods were embedded within a design associated with one of these two methods. A quantitative phase within a larger qualitative phase was embedded.

The purpose of the quantitative phase of the study was to explore difference between pretest, posttest, and retention test scores in mobile supported situated learning environment. In this respect; pretest, posttest, and retention test were implemented and repeated measures statistical analyses were conducted in order to see the difference throughout the process. Moreover, tablet PC logs were gathered in order to explore which type of definitions (visual vs. dictionary definition) were preferred, how much time spent on experiments and which type of discourse were mostly looked up in mobile system. Descriptive statistics and frequency tables were used in order to present results of tablet PC logs.

Qualitative phase which was the larger part of the present study composed of two phases. In the first phase, qualitative data were gathered throughout the experimentation process. Students were recorded with video camera, retrospective reviews were conducted and they were observed during the experimentation process. In the second phase, students' experiences were gathered with semi-structured interviews at the end of the five-week period (See Fig 3.1).

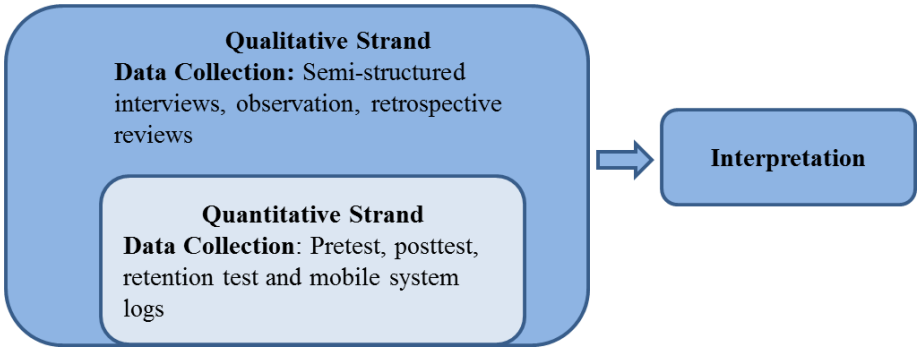

Figure 3.1 Research Design

3.3 Participants

Participants were 25 elementary level university students who were attending Basic English Department of METU before their undergraduate study. Students were from various departments of the university who have never been in METU Technology and Science Museum before. Participants were selected based on the data collected through a vocabulary pretest. Students with high pre-knowledge about the target vocabulary were removed in order to maintain purposeful sample of students. According to the pretests of the target vocabulary, number of correct answers of selected participants was varied from 15 to 57 among 79 questions (see Table 3.1).

Table 3.1 Target vocabulary pretest results

	N	*Min*	*Max*	*M*	*SD*
pretests	25	15	57	29.20	11.46

Among participants, while 16 of 25 students were female, 9 of them were male. Mean age of the students was 18, which ranges from 17 to 20. Departments of students at their high schools that they graduated from and their fields of interests were crucial, since interactive experiments were related to the field of Science in the present study. While 19 of students were from the department of "quantitative" at high school, six of them were from "equally–weighted" (see Table 3.2).

Table 3.2 Students' graduated departments at high school

	Quantitative	Equally-weighted	Total
f	19	6	25

On the other hand, even though they have graduated from "equally-weighted", they might be interested in the field of science. In this respect, their fields of interests were asked, 16 students stated that they were interested in Science. On the other hand, with the frequency of nine for each, students were interested in Social Science, Fine Arts and Sports Science. In terms of interest in Science experiments, 19 students stated that they were interested in science experiments.

Before the experiments, it was also essential to learn students' educational background of English as a foreign language and feelings about how they feel comfort with their language skills. In this respect, only 1 of 25 students attended preparatory class for English before. Moreover, seven students had taken English learning as a foreign language courses additional to the courses at their schools. When students were asked for sorting their comfort levels of skills including vocabulary, grammar, writing, reading, speaking and listening from most comfortable to least comfortable (1 to 6); speaking (*f*=10, 40 %) and vocabulary (*f*=7, 28%) were the skills that students mostly put in the sixth level of comfort. On the other hand, reading (*f*= 11, 44%) was the skill that students mostly put in the first level of comfort (see Table 3.3).

Table 3.3 Sorting comfort levels of skills in English learning as a foreign language

	Vocabulary		Grammar		Writing		Reading		Speaking		Listening	
Sequence	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
1	2	8	5	20	1	4	11	44	2	8	4	16
2	3	12	7	28	4	16	4	16	0	0	7	28
3	5	20	1	4	7	28	6	24	1	4	5	20
4	6	24	2	8	6	24	3	12	5	20	3	12
5	2	8	6	24	5	20	0	0	7	28	5	20
6	7	28	4	16	2	8	1	4	10	40	1	4

In the present study, tablet PC with touch screen was used as a supportive mobile technology in situated learning environment. In this respect, students were asked for ownership of mobile devices with touch screen and their previous usages of mobile devices in-class activities. All of the students had at least one type of mobile device with touch screen (see Table 3.4). When it is asked for how long they possessed a touch screen mobile device, while 13 students owned a mobile device with touch screen less than one year, one student owned for more than five years (see Table 3.5).

Table 3.4 Possession of mobile device with touch screen

Tablet PC		Laptop		Mobile Phone	
f	*%*	*f*	*%*	*f*	*%*
4	16	5	20	25	100

Table 3.5 Possession duration of mobile device with touchscreen

Years	f	%
less than 1 year	13	52
1-3 years	5	20
3-5 years	6	24
5 years and more	1	4
Total	25	100

In terms of in-class activities, only 5 of 25 students stated that they used mobile device in classroom activities with guidance of their teachers. While two students used tablet PC, two students used laptop and one student used mobile phone in-class activities (see Table 3.6). All of these students used mobile devices in English learning as foreign language course.

Table 3.6 Usage of mobile devices in-class activities

Tablet PC		Laptop		Mobile Phone		Total	
f	*%*	*f*	*%*	*f*	*%*	*f*	*%*
2	8	2	8	1	4	5	20

In terms of mobile application, only 3 of 25 students used mobile applications in classroom activities. Two of them were for English learning as a foreign language and one of them was for Chemistry. Mobile applications for EFL learning were used for dictionary support and facilitating communication skills.

3.4 Procedures of the Study

Before the study, target vocabulary was determined with two instructors from Basic English Department based on the curriculum of elementary level. Interactive experiments were chosen from METU Science and Technology Museum with regard to target vocabulary and steps of the experiments were designed by using target vocabulary with subject matter experts. Target vocabulary was separated according to discourse type including special discourse, intermediate discourse, and general discourse. The vocabulary which will be taught in-class activities during the experimentation process was determined in terms of eliminating in-class instruction effect. Then target vocabulary, the dictionary definitions, usages in sentences and related images and animations were prepared with subject matter experts. The sketches of animations and static images were designed and they were evaluated by subject matter experts in terms of appropriateness for Elementary level. Mobile vocabulary learning system which includes instructions of the experiments, visual and dictionary definition support with contextual sentences for each target vocabulary was developed in order to support contextual vocabulary learning in situated learning environment.

Academic achievement test was developed and administered to 20 elementary level university students as pilot study. A demographic questionnaire was developed to gather

demographic information and mobile device usage characteristics of participants and it was also administered to 25 students as pilot study and revisions were made according to feedbacks.

Before the actual study, pilot study was conducted in METU Science and Technology Museum with four elementary level students to evaluate mobile vocabulary learning system in terms of usability and content issues. In the actual study, firstly demographic questionnaire and vocabulary pretest were administered. Then five-week experimentation process began. Each day five students came to METU Science and Technology Museum and completed the experiments with the support of mobile vocabulary learning system one by one (see Figure 3.2, Figure 3.3). Every student was recorded with video camera and observation notes were taken during the experiments. Moreover, logs were recorded in mobile learning system to see details in mobile learning system. At the end of each experiment, retrospective reviews were conducted in order to understand how students interacted with experiments and explored contextual vocabulary. After five-week period, the same vocabulary test was administered as posttest and semi-structured interviews were conducted to gather experiences of the participants concerning mobile supported situated learning environment. Finally, six weeks after the experimentation process, the same vocabulary test was administered as retention test to explore gained vocabulary during the process. While procedure of the experiment was depicted graphically in Figure 3.4, procedure of the study was depicted in Table 3.7.

Figure 3.2 Interactive experiments with support of mobile vocabulary system-1

Figure 3.3 Interactive experiments with support of mobile vocabulary system-2

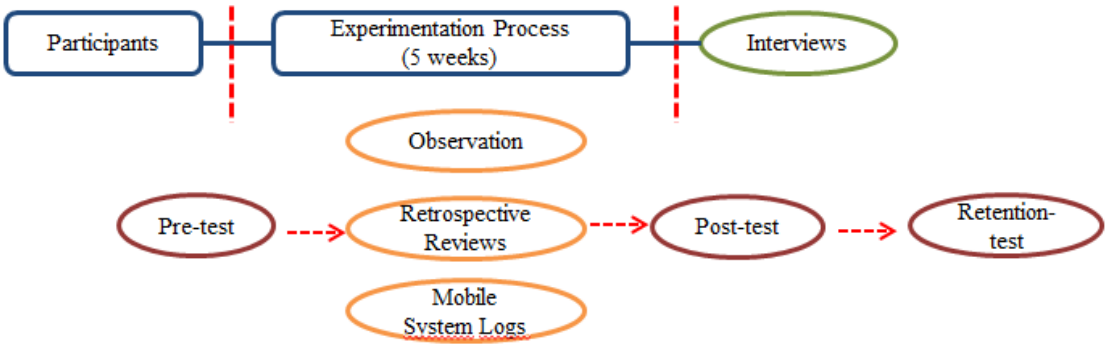

Figure 3.4 Procedure of the experiment

Table 3.7 Procedures of the study

Date	**Process**
February, 2015	The target vocabulary and related science experiments were determined based on the curriculum of Department of Basic English (Elementary Group) with subject matter experts.
March – April, 2015	Target vocabulary, the dictionary definitions, contextual sentences and related images and animations were prepared and evaluated by subject matter experts.
May, 2015	The sketches of animations and images were designed and they were evaluated by subject matter experts.
June, 2015	Development of mobile system began with the support of graphic designer by using Flash Adobe Professional program. Academic achievement test was prepared and evaluated under the guidance of subject matter experts.
July, 2015	Development of mobile system proceeded with the support of graphic designer. A questionnaire was prepared to gather demographic information and mobile device usage characteristics of participants. Questionnaire was administered to 25 students as pilot study and revisions were made according to feedbacks.
August, 2015	Development of mobile system proceeded with the support of graphic designer.

Table 3.7 (Continued)

August-September, 2015	Development of mobile system proceeded with the support of graphic designer. The mobile system was sent to subject matter experts and revisions were made according to the feedbacks. Academic achievement test was administered to 20 elementary level university students as pilot study and revisions were made according to the feedbacks. In the pilot study, four elementary level students used the mobile vocabulary system in METU Technology and Science Museum and revisions were made according to the feedbacks.
October, 2015	Pretests were administered. Real experiments began. Every student was recorded with video camera and observation notes were taken during the experiments. Mobile system logs were gathered for each experiment. At the end of the each experiment, retrospective review sessions and posttests were administered.
November, 2015	Experiments ended. Semi-structured interviews were conducted.
December, 2015	Retention test was administered.

3.5 Mobile Supported Situated Learning Environment

Mobile supported situated learning environment was designed based on the principles of Situated Learning Theory which were extracted to promote contextual vocabulary learning. The main characteristics were authentic context, authentic tasks, appropriate guidance, and authentic assessments. Participation approach was accepted to maintain authenticity. Under a participation model of authenticity, students participate in the actual work, engaging directly in the real environment. In the present study, a real environment was chosen as authentic context which is METU Science and Technology Museum. The museum provided interactive science experiments that mostly include high academic utility words which were also the target vocabulary in the curriculum of elementary level. In this respect, instructions of the experiments were written by using target vocabulary in order to promote learning words in its contexts and word functions in real environment. Instructions of the experiments were kinds of authentic tasks.

Authentic tasks are critical in situated learning environments which students have opportunity to observe real-life episodes. Authentic task is the only way that students act meaningfully and purposefully. In this respect, authentic tasks promote learners to learn functional purposes of the target vocabulary. Another important component is appropriate guidance in situated learning environment. In this respect, mobile vocabulary learning system was designed in order to facilitate learners during their contextual vocabulary exploration processes. The system provided the instructions of the experiments and also definition support for each target vocabulary. Definition support was maintained with multimodal presentations (visual+text and dictionary definition) in order to provide learners flexible and optional support. Mobility of the system was a cost effective way of accessing support at critical times. The last component was authentic assessment. Integrated assessment should be within the tasks. In this learning environment, authentic tasks were completed by learners as a result of understanding instructions in target language. In this respect, learners were observed in order to understand whether or not they understood and completed the tasks. Moreover, open-ended questions were embedded in mobile system, which can only be answered after completion of all authentic tasks. Those components will be explained elaborately in the following section.

3.5.1 METU Science and Technology Museum

The museum is a large, open space populated with hands-on science exhibits (see Figure 3.5). The building's free-form, workshop like structure contains several exhibits. Users of all ages and levels of scientific knowledge from exhibit to exhibit manipulate the devices and interact with the experiments. However, there is a lack of interactive guidance in the museum, therefore two guides work for telling individuals how to complete experiments correctly. The museum needs an interactive support for people to manage the experiments correctly and meaningfully.

Figure 3.5 METU Science and Technology Museum

3.5.2 Experiments in METU Science and Technology Museum

Five experiments associated with the target vocabulary were chosen among METU Science and Technology Museum experiments. These experiments were Free Fall, Depth Skinner, Wheel and Axle, Lever and Pythagorean Theorem. Steps of the experiments were authentic tasks that needed to be accomplished as a result of understanding instructions in target language. In this respect, it was crucial design steps appropriate for elementary level and target vocabulary. Two subject matter experts from Basic English Department and Foreign Language Education Department played crucial role to simplify sentence structures in order to regulate language level. Almost all of the instructions required accomplishing tasks in real environment which is one of the key characteristics of Situated Learning Theory.

In the experiment of Free Fall (see Figure 3.6), there are three balls with different masses, a device with magnetic sharp tip to hang the balls and a digital display which shows the fall time of the balls. The aim of this experiment is to show that when the objects left from the same height, their fall time and velocity are independent of their masses. In this respect, first of all the balls need to be hanged one by one to the magnetic

sharp tip which is at the top of the device. When the yellow button is pressed, the digital display shows the fall time. After the experiment is repeated three times with different balls, the student should note and see that the fall times of three different balls with different masses are the same. The steps of the experiment are:

1. Hang one of the balls to the magnetic sharp tip which is at the top of the device.
2. Each ball has different mass.
3. Press the green button. Read the digital display that shows the fall time.
4. Try the same process for the other ball. Compare the velocity and fall time of two balls

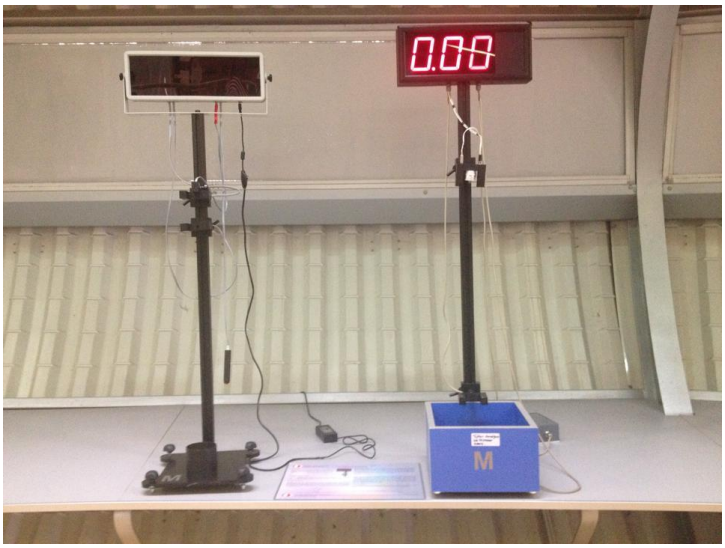

Figure 3.6 Free Fall Experiment

In the experiment of Wheel an Axle, there are three cylinders with different diameters connected to each other and a weight to be lifted. A wheel is attached to an axle so that these two parts rotate together in which a force is transferred from one to the other. In this experiment, the weight needed to be tied to the cylinders with different diameters and tried to be lifted by applying force. Different forces will be used and it will be rotated different number of times at each time, because of the difference in diameters of cylinders. Wheel an Axle is a kind of simple machine which is used in daily lives for

instance, water wells, fishing rods in which mechanical advantage is gained (see Fig 3.7). The steps of the experiment are:

1. Rotate the wheel and axle and lift the weight.
2. Tie the weight to the second cylinder which has a different diameter. Then lift the weight.
3. Now tie the weight to the third cylinder which has a different diameter. Then lift the weight.
4. When you used different cylinders:
   a) Did you apply the same amount of force?
   b) Did you rotate the wheel and axle the same number of times?

Figure 3.7 Wheel and Axle Experiment

In the experiment of Depth Skinner, there is a disc that can be rotated. After disc is rotated, student needs to stare at its center for twenty seconds. When student looks at his/her palm, he will notice that his palm is still turning, but in the opposite direction. It also appears to swell up or shrink. When he rotates the disc in the opposite direction, that time his palm will turn in the opposite direction from the way the disc was turning (see Figure 3.8). Our visual system is sensitive to inward and outward motion. If person

rotates the spiral in the other direction, it seems to be moving toward the person, the person then seems to be moving away when he/she look up. The steps of the experiment are:

1. Rotate the disc.
2. Stand two steps back. Then, stare at its center for twenty seconds. Look at your palm. Notice that your palm is still turning. Your palm appears to turn in the opposite direction. It also appears to swell up or shrink.
3. Now rotate the disc in the opposite direction.
4. Look at your palm again. Is the spinning pattern different from the first time? Explain.

Figure 3.8 Depth Skinner Experiment

In the experiment of Pythagorean Theorem, there are three squares: A, B and C. Square C is as big as Square A and B. These connected squares form a right triangle. In this experiment, first student needs to turn the object and fill the biggest square, C, with water. When C is filled, students need to turn the object so that the square A and B are filled with water. At the end, student needs to notice that the triangle between the squares is a right triangle (see Figure 3.9). The mathematical relationship is called

Pythagorean Theorem, in mathematical form it is written like: $a^2 + b^2 = c^2$. The steps of the experiment are:

1. Turn the object and fill the biggest square, C, with water.
2. When C is filled, turn the object so that the square A and B are filled with water.
3. Notice that the triangle between the squares is a right triangle.

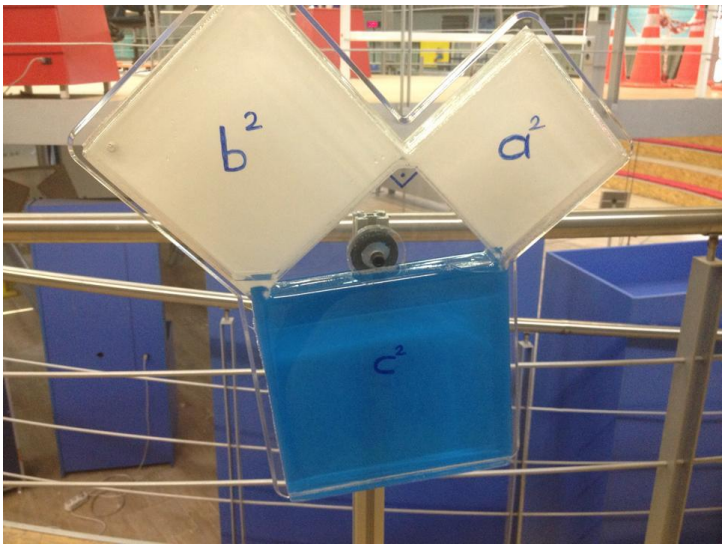

Figure 3.9 Pythagorean Theorem Experiment

In the experiment of Lever, there is a lever which is a simple machine used for moving heavy objects much easier by using less force (see Figure 3.10) . In this experiment, student needs to put two kilograms of weight to one unit left from the lever's center, then student needs to put one kilogram of weight to two units right from the lever's center. The lever tried to be kept in balance. In this lever, the fulcrum is located between the effort and the load. A good example of this kind of lever is See-Saw. The steps of the experiment are:

1. Put two kilograms of weight to one unit left from the lever's center.
2. Put one kilogram of weight to two unit right from the lever's center.
3. Try to keep the lever balanced.

4. Now use one and three kilograms of weight to keep the lever balanced.

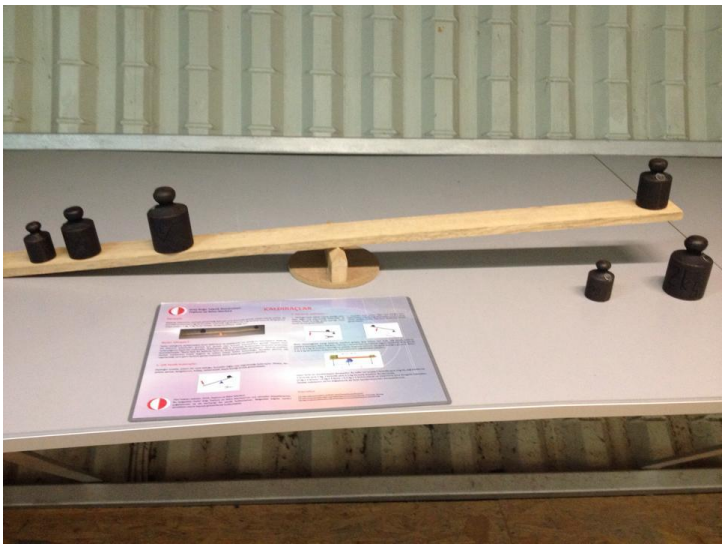

Figure 3.10 Lever Experiment

3.5.3 Target Vocabulary

Target vocabulary was the vocabulary which was used in the steps of each experiment in the museum. Every word in all steps of five experiments was considered as target vocabulary. Most of the target vocabulary was associated with the curriculum of Department of Basic English, METU. The vocabulary was presented in the mobile application both with dictionary definition and visual representation. Dictionary definition of each word and its contextual sentences were determined. In terms of visual definition, each word's definition was presented with animations or static images and with its contextual sentence. Dictionary definition of each vocabulary, usages in sentences, associated picture/animations were prepared and evaluated with six subject matter experts from Basic English Department and Foreign Language Education Department.

The target vocabulary was chosen from elementary level course book of Department of Basic English, METU and extra vocabulary was also included in order to explain steps

of the experiments. Target vocabulary in accordance with course books was shown week by week in Table 3.8. Experimentation process proceeded parallel with in-class activities. In this respect, students encountered the target vocabulary in situated learning environment by taking into account the time they will be taught in-class activities. Students need to see the target vocabulary for the first time in situated learning environment. In this respect, the target vocabulary which was in the first weeks of the curriculum was included in the first experiments of five-week experimentation period.

On the other hand, one of the research questions was associated with the discourse type of the vocabulary. In this respect, vocabulary was separated into three groups including general discourse (GD), intermediate discourse (ID) and specific discourse (SD) (see Table 3.9). General discourse type means that individual is familiar with that word and he might encounter frequently in his daily life. Specific discourse includes the words with high academic utility (scientific terms etc.). Intermediate discourse type includes the words which can be both specific and general discourse type. Determination of the discourse type was performed with subject matter experts from Basic English Department and Foreign Language Education Department.

Table 3.8 Target vocabulary and schedule in course book

Week	**GD**	**ID**	**SD**
Week 2	hang		
Week 3	different		weight
	same		
	tie		
Week 5		amount	velocity
Week 9		process	
Week 10		rotate	
Week 11	appear	apply	force
Week 12	happen		
	opposite	spin	device
Week 14	notice	keep sth. balanced	
	try	shrink	
	to fill with sth.	direction	
	lift		

Table 3.9 Discourse type of target vocabulary

General Dis.		Intermediate Dis.	Specific Dis.
stare	a number of times	seconds	center
each	then	palm	magnetic
steps back	turn	swell up	mass
time	still	pattern	digital
again	now	object	display
look	so that	sharp	unit
also	again	tip	lever
stand	when	amount	wheel and axle
other	use	process	cylinder
ball	which	rotate	diameter
press	hang	apply	disc
button	different	spin	triangle
green	same	keep sth. balanced	right triangle
read	tie	shrink	kilogram
show	appear		square
fall	happen		weight
compare	opposite		velocity
put	notice		force
between	try		device
left	to fill with sth.		
right	lift		
biggest	direction		
water			

3.5.4 Mobile Vocabulary Learning System

Mobile vocabulary system was developed as a supportive technology in situated learning environment. Appropriate guidance is one of the key characteristics of situated learning environments. In contextual vocabulary learning, there is a need to support learners in terms of minimizing limitations of incidental learning. One of those limitations is inferencing the meaning of the words incorrectly. In this respect multimodal definition support was embedded in each target vocabulary to enhance contextual vocabulary exploration processes. Multimodal presentation was preferred since previous empirical findings commonly pointed out the superiority of visual+text and dictionary definitions.

Mobile system was designed with Flash Professional program. The reason for choosing Flash program was to be flexible in designing animations and images. Several static images were gathered from “Shutter Stock” which maintains a library stock photos, vector graphics and illustrations. Vector graphics were chosen, since it was easy to make changes and turn them into animations. The researcher had subscription in “Shutter Stock”; therefore copyright issues were eliminated while using static vectors. In Flash program, *.fla* format was converted to *.apk* format to be worked in android system. Tablet PC was Expert easypad P10N with Android 4.1.2. The screen was 10.1 inches and 1024 x 600 pixel with touch screen.

The system had a database system which saves user’s name and surname, logs of every action and answers given to open-ended questions. Logs of every action included any action made by the user and the time of the event.

First of all the system asks user name and surname (see Figure 3. 11). The user cannot proceed without logging in with his/her name and surname.

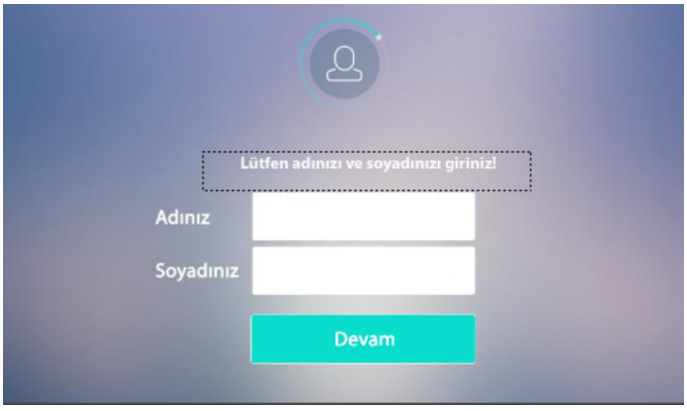

Figure 3.11 Log in page of mobile system

In the next page, instructions are given to tell the functions of the buttons, how many steps included in the experiment and what is expected to complete the experiment (see Figure 3.12).

Figure 3.12 Instructions page of mobile system

In the next page, the experiment is shown step by step. When the user presses any of the words, he/she encounters dictionary definition icon and visual definition icon (see Figures 3.13 and 3.14).

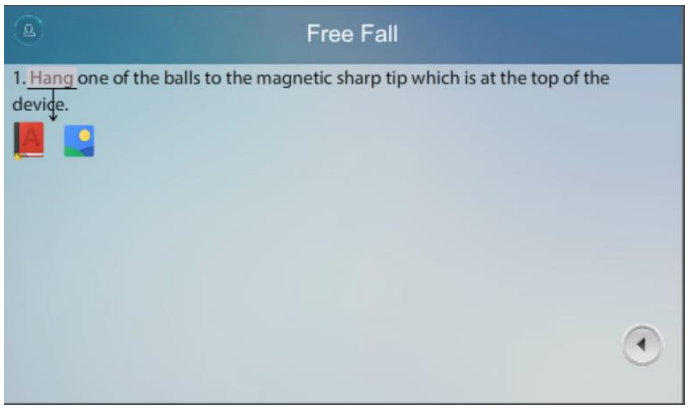

Figure 3.13 Visual and dictionary definition icons-1

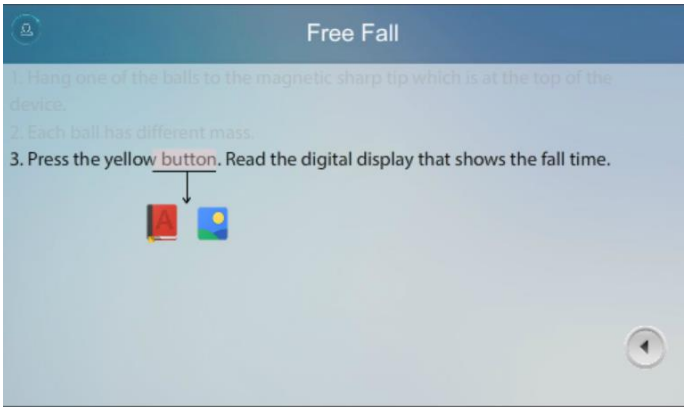

Figure 3.14 Visual and dictionary definition icons-2

There is a back button to go back whenever user wants on every page. If user presses visual definition icon, she/he can see a static image or animation that visualize the word with its contextual sentence (see Figure 3.15). The step of the experiment is also shown at the top with the word highlighted. After student looks up the definition and if he needs to link up to the step of the experiment, this function supports to understand the whole sentence more easily. Moreover, if user does not understand the visual definition, he can switch to the dictionary definition. If the visual representation is an animation, there is a "repeat" button to watch the animation repeatedly (See Figure 3.16).

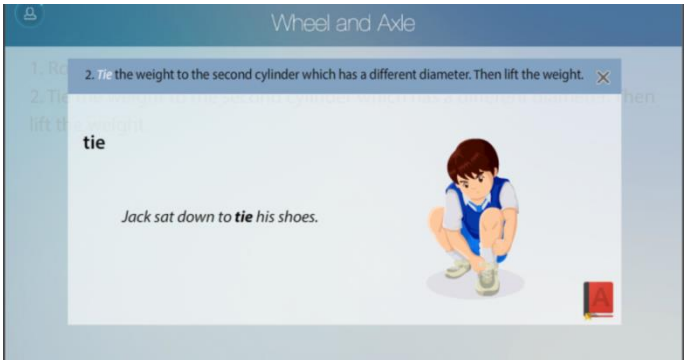

Figure 3.15 Visual definition with static image

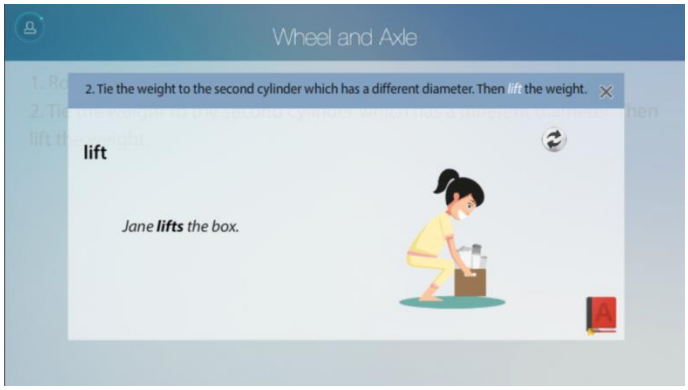

Figure 3.16 Visual definition with animation

Dictionary definition includes elementary level dictionary definition with its contextual sentence. Moreover, the step of the experiment is also shown at the top with the word highlighted to make connection with the experiment (see Figure 3.17).

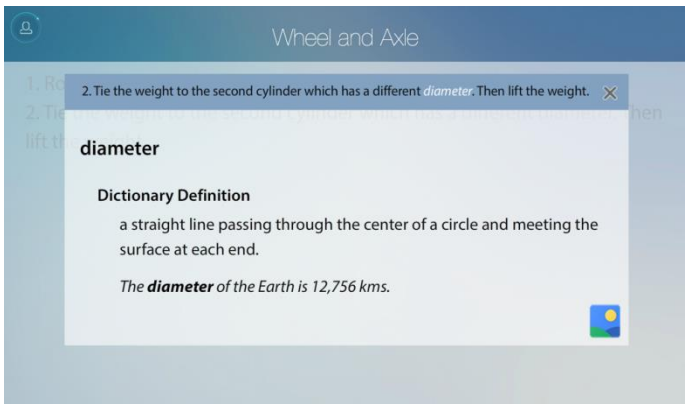

Figure 3.17 Dictionary definition in mobile system

After user passes all steps, he/she will encounter open ended questions as authentic assessments at the end. He needs to complete all steps of the experiment to answer these questions (see Figure 3.18). User needs to write the answers in textbox and save.

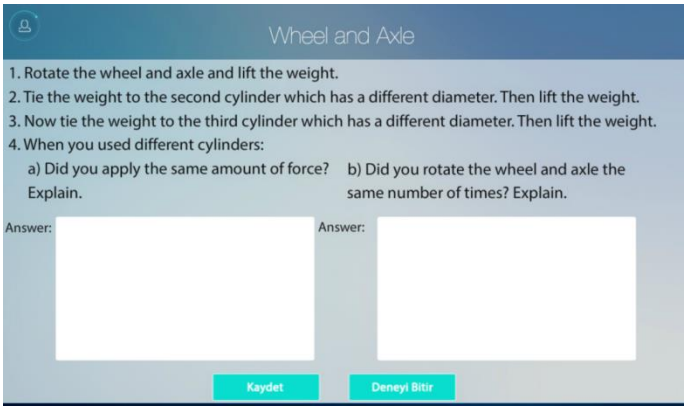

Figure 3.18 Open ended questions in mobile system

The system records every action of the student as the system activated. At the end, the system gives a report including the time tag of every action for each user. Researcher can send e-mail by copying the information, since it will be easier to work with desktop computer rather than tablet PC (see Figure 3.19).

Adı Soyadı [redacted]
Kayıt Tarihi: 2015-10-12 08:54:12
Kullanıcı LOGLARI:

SIRA NO İŞLEM TARİHİ İŞLEM SÜRESİ(SN) LOG AÇIKLAMASI

1 2015-10-12 08:54:12 61 Kullanıcı Sisteme Giriş Yaptı.
2 2015-10-12 08:54:21 9 Kullanıcı Yönerge Ekranından Deney Ekranına Geçiş Yaptı
3 2015-10-12 08:54:26 5 İkinci Cümle Ekranı
4 2015-10-12 08:54:30 4 Hang Seçim Ekranı
5 2015-10-12 08:54:31 2 Hang Animasyon Ekranı
6 2015-10-12 08:54:36 4 Deney Ekranı
7 2015-10-12 08:54:40 4 Device Seçim Ekranı
8 2015-10-12 08:54:40 1 Device Animasyon Ekranı
9 2015-10-12 08:54:52 11 Deney Ekranı
10 2015-10-12 08:54:53 1 Device Seçim Ekranı
11 2015-10-12 08:54:54 1 Device Sözlük Ekranı
12 2015-10-12 08:55:02 8 Deney Ekranı
13 2015-10-12 08:55:04 2 Mass Seçim Ekranı
14 2015-10-12 08:55:05 1 Mass Animasyon Ekranı
15 2015-10-12 08:55:12 7 Deney Ekranı
16 2015-10-12 08:55:16 4 Üçüncü cümle ekranı
17 2015-10-12 08:55:22 6 Dördüncü cümle ekranı
18 2015-10-12 08:55:25 3 Process Seçim Ekranı
19 2015-10-12 08:55:26 1 Process Animasyon Ekranı
20 2015-10-12 08:55:37 10 Deney Ekranı
21 2015-10-12 08:55:47 10 Velocity Seçim Ekranı
22 2015-10-12 08:55:48 1 Velocity Animasyon Ekranı
23 2015-10-12 08:55:52 4 Deney Ekranı
24 2015-10-12 08:55:53 1 Compare Seçim Ekranı
25 2015-10-12 08:55:54 1 Compare Animasyon Ekranı
26 2015-10-12 08:55:59 5 Deney Ekranı
27 2015-10-12 08:56:19 19 Hang Seçim Ekranı
28 2015-10-12 08:56:20 1 Hang Animasyon Ekranı
29 2015-10-12 08:56:23 3 Deney Ekranı
30 2015-10-12 08:56:24 2 One Seçim Ekranı
31 2015-10-12 08:56:25 0 One Animasyon Ekranı
32 2015-10-12 08:56:35 11 Deney Ekranı
33 2015-10-12 08:56:49 13 Digital Seçim Ekranı
34 2015-10-12 08:56:50 1 Digital Animasyon Ekranı
35 2015-10-12 08:56:52 2 Deney Ekranı
36 2015-10-12 08:57:10 18 Hang Seçim Ekranı
37 2015-10-12 08:57:11 1 Hang Animasyon Ekranı
38 2015-10-12 08:57:15 3 Deney Ekranı
39 2015-10-12 08:59:22 126 Mass Seçim Ekranı
40 2015-10-12 08:59:23 0 Mass Animasyon Ekranı
41 2015-10-12 08:59:28 6 Deney Ekranı
42 2015-10-12 08:59:32 3 Process Seçim Ekranı
43 2015-10-12 08:59:36 5 Process Animasyon Ekranı
44 2015-10-12 08:59:38 2 Deney Ekranı
45 2015-10-12 08:59:54 15 Deney bitir ekranı

Figure 3.19 Logs of the mobile system

3.6 Pilot Study

A one week pilot study was held with four students from elementary level at Basic English Department. Interviews were conducted to learn opinions of students about usability, instructional design, and visual design issues. Moreover, before the actual experiment it was essential to learn how long of each experiment lasts and how they interact with the system while performing the experiments. In this respect, four students came to METU Science and Technology Museum and following issues were confirmed according to their feedbacks and revisions were made in terms of visual design and instructional design issues:

- Font sizes were increased.
- The sizes of the arrow buttons that help to transit to the following step were increased.
- The size of the clicking area of text boxes in which name-surname and answers to open-ended questions were entered was too small, therefore they were increased.
- Animations in the visual definitions were shown only once; a "repeat" button was added to make animation play whenever the user wants.
- Buttons were added to transit from dictionary definition to visual definition and from visual definition to dictionary definition without going back to homepage.
- When user looked up a definition, he could not see its related step of the experiment. Although the user understands the definition of the word he cannot make connection with the step of the experiment immediately. In this respect, the step of the experiment was added in all definitions, so that the user can locate the word to the sentence immediately.

In the pilot study, there were implementation problems. The issues were as following:

- When tablet PC was given without any instruction, students did not know how to proceed, because they did not want to read the instruction page. In this respect,

before the actual study a brief introduction was administered and functions of the buttons were explained orally.

- Devices in the experiments were introduced to the students briefly because during the experiments they could not see some necessary basic parts of the devices. They lost time while searching them in the pilot study.
- The museum has no windows; therefore lighting was needed. However, it was understood that camera perspective was so important for the reflection of the light in dark environment. In the actual study, this issue was considered.
- Even though the museum was closed, in the case of the door left open, people tried to come in and distract the experimentation process. In the actual study, the doors were locked.

3.7 Data Collection Instruments

3.7.1 Demographic Information Questionnaire

The questionnaire was designed for gathering demographic information from participants. Moreover, their history of English learning as a foreign language, usages of mobile devices with touch screen and previous experiences about mobile educational applications in and out of classroom activities (Appendix A). In this respect, a questionnaire was prepared and sent to five subject matter experts to be evaluated. Subject matter experts were from Department of Foreign Language and Computer Education and Instructional Technology. The questionnaire was administered to 25 university students as a pilot study at Yıldız Technical University and opinions of the students were received in order to correct any misunderstandings.

3.7.2 Vocabulary Achievement Test

Academic achievement test was developed with elementary level instructor from Basic English Department and an academician from Foreign Languages Department. The test included all the words of the experiments with fill in the blanks questions (Appendix B). It was crucial to ask questions in different contexts from the experiments in order to see

transfer ability of learners. At first, 111 questions were determined related to target vocabulary with more than one alternative for several questions. Especially, words with high academic utility including square, wheel and axle, right triangle and so forth are not frequently used words in real life and also in academic tests; therefore their contextual sentences were chosen with caution. In this respect, the test was sent to six subject matter experts who were form Department of Foreign Language at universities of Middle East Technical University and Yıldız Technical University in order to check for accuracy in grammar and spelling and appropriateness for elementary level. Content-related evidence validity was used which can be obtained by having an expert to review the content and format of the instrument whether or not it is appropriate (Fraenkel &Wallen, 2006). According to feedbacks, especially questions with complex sentence structures were eliminated, because the possibility of answering question incorrectly due to not understanding the sentence structure instead of the vocabulary should be eliminated. It was crucial to design achievement test appropriate for elementary level and in the context different from the authentic activities. In this respect, 79 fill in the blank questions were determined. Then, the test was administered to 50 students from elementary level of English as pilot study for reliability analyses. For the reliability analyses, referred as internal consistency of the measurement, the most frequently employed method for determining internal consistency is the Kuder Richardson approach, particularly formulas KR-20 and KR-21 (Fraenkel & Wallen, 2006). KR-20 coefficient checks the internal consistency of measurements with dichotomous choices and does not require the assumption that all items are equal of difficulty (Fraenkel & Wallen, 2006). KR-20 coefficient was calculated which values from 0 to 1 for reliability. In this test, the results were coded as 1 and 0, in which 1 indicates the answer is "true" and 0 indicates the answer is "false". KR-20 coefficient was calculated with the formula below in Excel Program:

$$KR_{20} = \frac{K}{K-1}\left[1 - \frac{\sum pq}{S_x^2}\right] \quad (1)$$

In this calculation, 27% upper and lower groups were used which is one of the common calculations for KR-20 (Baykul, 2000). The letters used in the formula were explained below:

$p_i = (D_{upper} + D_{lower}) / (2 \cdot n \cdot 0.27)$

D_{upper}: the number of students in the upper group 27% who responded

D_{below}: the number of students in the lower group 27% who responded

q= 1-p

k = number of questions

s_x^2= variance of the total scores of all the people taking the test

The reported and expected reliability for achievement tests are typically .90 or higher (Fraenkel & Wallen, 2006). In the present study, KR-20 was found to be .91 which shows that the instrument has high internal consistency.

3.7.3 Interview Protocol

Semi-structured interviews were selected as another data collection method, because the amount of participants was quite small; this made it possible to observe them during the interview, and gave an opportunity to make the evaluation flexible. In this respect, researcher prepared an interview protocol based on five themes including students' general vocabulary learning processes, experimental process, vocabulary learning, mobile system and future suggestions (Appendix D). The themes were determined based on purpose of the study and related literature. Students' experiences were crucial concerning five-week experimentation period (negative and positive opinions, problems they encountered, their focus and interest during the experiments), vocabulary learning (retention issues and reasons for not learning meaning of the words), mobile system (content and usability issues) and future suggestions and also their general vocabulary learning processes (vocabulary learning strategy, vocabulary exploration processes). The

questions were evaluated by three subject matter experts before the experimentation process. Questions that were not clear and understandable were revised and especially, leading questions were eliminated according to feedbacks.

3.7.4 Observation Form

Students were observed during the interactive experiments in order to see how and when they used the system and how they managed the authentic tasks. In this respect, an observation form was prepared for every student (Appendix C). The tasks of each experiment were written and spaces were created for taking notes. If the student completed the task "+" sign was used, otherwise "-" was used. Additionally, each student was recorded with video camera not to miss any actions during experiments and they were crosschecked during the data analysis process. Moreover, camera records were used in retrospective reviews to make students watch their performances and express their thoughts after the experiments.

3.7.5 Retrospective Reviews

At the end of each experiment, retrospective reviews were conducted. Students were informed about think aloud sessions before the experiments. Students needed to watch their camera records while performing tasks and think aloud to tell their actions elaborately. The basic principle of this method is that potential users are asked to complete a set of tasks with the artefact tested, and to express their thoughts after working on the tasks (Vand Den Haak, De Jong & Jan Schhellens, 2003). Students watched their processes from camera records after each experiment and think aloud sessions were administered in order to gather thoughts of students and procedures they followed.

3.7.6 Mobile System Logs

User logs were used for exploring users' interaction with the mobile system. It was crucial to explore when and how students used the mobile system while performing

authentic activities. User logs helped to understand students' progresses in mobile application elaborately. Every action was recorded to the database of the application. Especially, how much time spent on each step of the experiment, which words they looked up and which type of definition they preferred (dictionary or visual definition) were all necessary to understand the dynamics of using mobile support technologies for contextual vocabulary learning. Moreover, answers to the open-ended questions were recorded for authentic assessment of target vocabulary.

3.8 Data Collection Process

In the present study, during the collection of the quantitative data and qualitative data different methods were implemented. In the quantitative part of the study, vocabulary achievement test as pretest, posttest, and retention test and mobile application logs were used. In the qualitative part of the study, observation, retrospective reviews and semi-structured interviews were used as data collection methods. The research questions and their related data collection methods were presented at Table 3.10.

Vocabulary achievement test was administered as pretest, posttest, and retention test in order to explore gained scores of learners in mobile supported situated learning environment. Since a vocabulary test including 79 questions would take too much time to complete, the test was divided into two parts and administered in two days for pretest and retention test. Posttests that include related vocabulary of that week's experiment were administered just at the end of each experiment. Those tests included 10-15 questions; therefore they could be administered in one day. Retention tests were conducted after six weeks from the experimentation process.

Mobile system logs gave information about when and how students used the mobile system while performing authentic activities. In this respect, while they were using the mobile application, the system recorded every action of each student automatically.

During the experiments retrospective reviews and observations were conducted by the researcher. Observations were administered by the researcher while student was performing authentic tasks. Observer took notes on observation form. Observer had a totally passive role. Moreover, students were recorded with stable video-camera just one meter behind them. Students were told to be relaxed and calm and it was explained that those records will not be shown to anyone else in the future. Camera records were used to support observation notes when researcher misses any action of the learner during the experiments.

Retrospective review which is a type of think aloud protocol was administered with each student just at the end of each experiment. Those reviews were helpful for gathering detailed information about the process. The points that can be missed during observation and camera records can be maintained through retrospective reviews. Retrospective reviews are preferred in complex tasks to concurrent think aloud protocol, because think aloud sessions while working on the task might have a negative effect on the task performance (Vand Den Haak et al., 2003). In this respect, after each experiment think aloud sessions were administered while students were watching their performances with camera records. Students told their thoughts and experiences elaborately.

Semi-structured interviews were conducted just at the end of five-week experimentation process. A good quality voice recorder was used in order to record those face to face interviews. Interviews were conducted in a quite office which took almost an hour for each student. 12 students were chosen as interviewees according to their performances during five-week experimentation process. Heterogeneity of the interviewees was crucial in order to gather information from all types of students, for instance who used the mobile system more frequently, who performed the tasks quickly or slowly or whose academic scores are high or low.

Table 3.10 Data collection methods

Research Questions	Data Collection Methods
1. How does mobile supported situated learning environment facilitate contextual vocabulary exploration?	Observation, user logs, retrospective reviews, semi-structured interviews
2. How does mobile supported situated learning environment facilitate task completion?	Observation, user logs, retrospective reviews, semi-structured interviews, feedback from the open ended questions
3. Is there a significant difference between pretest, posttest, and retention test scores in mobile supported situated learning environment?	Pretest, posttest, retention test
4. What are the experiences of the learners concerning mobile supported situated learning environment?	Semi-structured interviews

3.9 Validity and Reliability

The present study composed of two types of data including quantitative and qualitative data. In this respect, different approaches were used to address validity and reliability of quantitative and qualitative data. In terms of quantitative data, validity and reliability issues of academic achievement test were presented under Instrumentation section.

There are various approaches that can be used in order to address validity (trustworthiness) and reliability (dependability) of the data in qualitative research. Common validity issues in qualitative research include triangulation of information among different sources of data and receiving feedback from peers (peer review) (Simon, 2011).

Creswell (2012) stated that "In triangulation, researchers make use of multiple and different sources, methods, investigators to corroborating evidence" (p. 208). In the present study, the data were collected from various sources which were observation notes, retrospective reviews, interviews, video camera records and academic

achievement test. This variety increased the accuracy of the results and gave opportunity to capture different perspectives of research questions.

Peer review which was an external check throughout the research process gave opportunity researcher to see significant misunderstandings offered by peer debriefers (Creswell, 2012). In the present study, the dissertation was administered under two advisors and throughout the process dissertation committee which consists of two more academicians had opportunity to review the process and give advices to the researcher every six months.

Creswell (2012) recommended at least two of validity addressing methods in qualitative research designs, in this respect peer review and triangulation were administered as validity addressing methods in the present study.

Reliability (dependability) was addressed in several ways. First of all, a good quality voice recorder was used in order to record face to face interviews. Moreover, although transcription was performed by the researcher, the written form of the data was checked by an external audit to correct mistakes and misunderstanding that can be missed by the researcher. Moreover, the method of intercoder agreement was used based on the engaging multiple coders to analyze transcript data (Creswell, 2012). In this respect, to achieve acceptable levels of reliability, the process of coding text followed several steps: segmentation of text, codebook creation, coding, assessment of reliability, codebook modification, and final coding (Hruschka et al., 2004). Researcher studied with a colleague in coding, categorizing and thematizing procedures of data analysis. The colleague was a research assistant at Department of Educational Science whose study field includes qualitative research methods. First of all, the researcher and the second coder came together to discuss the processes of segmentation of text, codebook creation and coding. The second coder was informed about the study including purpose and problem statement of the study, interview questions and research method. Then, researcher and the second coder came together to discuss segmentation of text, codebook creation and coding based on the first interviewee's document. Although there were

different sub-themes and codes among coders, they discussed and agreed on same coding table. After sufficient agreement was achieved, two coders proceeded with two more documents individually by using last common coding table and they crosschecked. There were 12 documents of interviewees and inter-coder reliability was calculated with three documents. Intercoder reliability was calculated by dividing agreements to total number of agreements and disagreements (Miles & Huberman, 1994). Although new codes were added to the coding table, intercoder reliability score was .84 exceeded the 80% target recommended by (Miles & Huberman, 1994).

3.10 Limitations and Delimitations

There were several limitations and delimitations of the present study as the nature of research studies. First of all, participants of the study were limited to university students at Department of Basic English from METU and the number of the participants was 25, therefore generalization of the findings was limited. Another limitation is mobile application was designed for METU Science and Technology Museum and it cannot be used in other scientific museums or different educational settings. Moreover, experiments were parallel with in-class activities. Although target vocabulary in-class activities were excluded while exploring the differences between pretest, posttest, and retention test, exposure to the target language in-class activities might affect vocabulary achievement test results. Responses given by the participants in interview sessions were self-reported, since they might less likely to be honest in order to seem different. Lastly, students were observed and recorded with video camera during the experiments that might make them feel uncomfortable and act differently.

CHAPTER 4

RESULTS

This chapter presents the findings of the study. Quantitative and qualitative data were mixed and presented together in order to corroborate and investigate research questions from various perspectives. In the first part, overall results were presented in which the whole process (five-week period) was taken into account. In the second part, each experiment was investigated elaborately based on different data collection methods. Tablet PC logs gave results for which words were explored during the interactive experiments and which types of definitions were looked up in mobile vocabulary learning system. Moreover, the time spent on each step of the experiment and answers to open-ended questions at the end of the experiments were also presented based on these logs. In this respect, frequency tables of logs were created for each experiment. On the other hand, observation notes were presented in order to give information about task completion in real environment. After each experiment, students tried to remember what they did during the process and think aloud sessions were performed. These reviews were useful for gathering information about what students thought while performing the tasks and what really happened during the process. At the end of each experiment, pretest, post-rest and retention test results were presented in order to explore difference among them throughout the process. In the third part of the study, interview results were presented in two sections including students' general vocabulary learning processes and experiences of students concerning mobile assisted situated learning environment.

4.1 Overall Results

4.1.1 Difference between Pretest, Posttest, and Retention Test Scores when In-class Vocabulary Included

Repeated Analysis of Variance (ANOVA) was conducted in order to explore difference between pretest, posttest, and retention test during five-week period. In this analysis, the words that were taught in class activities were included in the scores of the students. In other words, the vocabulary in the curriculum of elementary level was included; therefore classroom instruction effect was not omitted. Vocabulary achievement test was administered repeatedly, before the experiments, just after and six weeks after the experiments. Assumptions of Repeated ANOVA are:

i. There is no dependency in the scores between participants,

ii. The dependent variable is normally distributed in the population for each level of the within subjects factor,

iii. Spherecity

The assumption of there is no dependency in the scores between the participants was met. In order to learn that the dependent variable is normally distributed in the population for each level of the within subjects factor, tests of normality and histograms were checked. Results showed that although the sample is small, it is normally distributed. Assumption of sphericty was checked with Mauchly's Test for sphericity and it was not significant ($p>.05$), therefore spherecity assumption was not violated.

Pretest, posttest, and retention test were coded with time factor. It was found that the main effect of time of measurement was significant F (2, 48) = 115.77, $p > .05$, $\eta^2 =$. 82 (see Table 4.1). The partial eta squared value obtained was .82. We can conclude that 82 % percent of the variance in vocabulary achievement scores was explained by time. Means and standard deviations of dependent variables were presented in Table 4.2.

Table 4.1 Repeated ANOVA summary table for the effect of time on vocabulary test scores (in-class vocabulary included)

Source	*SS*	*df*	*MS*	*F*	*p*	η^2
time	8709.30	2	4354.65	115.77	.00*	.82
Error(time)	1805.36	48	37.612			

*p<.05

Table 4.2 Means and standard deviations for three dependent variables

			95% Confidence Interval	
	M	*SD*	*Lower*	*Upper*
Pretest	29.20	11.46	24.47	33.93
Posttest	48.32	11.85	43.42	53.21
Retention test	54.52	12.66	49.29	59.75

Paired samples tests were conducted between pretest and posttest, posttest and retention test. The test resulted in a significant difference between pretest (*M* =29.20, *SD* =11.46) and posttest (*M* = 48.32, *SD* = 1.85) and posttest (*M* = 48.32, *SD* = 1.85) retention test (*M* = 54.42, *SD* = 12.67). Posttest was significantly higher than pretest, *t* (24) = -9.62, *p* >.05 and retention test was significantly higher than posttest, *t* (24) =- 3.39, *p* >.05 (see Table 4.3).

Table 4.3 Mean differences between dependent variables

	MD	*SD*	*SE*	*t*	*p*
pretest - posttest	-19.12	9.93	1.98	-9.62	.00*
posttest – retention test	-6.20	9.13	1.82	-3.39	.00*

*p<.05

4.1.2 Difference between Pretest, Posttest, and Retention Test Scores when In-class Vocabulary Excluded

Repeated ANOVA was administered again, however this time the words that were in the curriculum of elementary level of METU Basic English Department were excluded, therefore the instruction in classroom effect was disregarded.

The assumption of no dependency in the scores between the participants was met. In order to learn the dependent variable is normally distributed in the population for each level of the within subjects factor, tests of normality and histograms were checked and normality assumption was met. Assumption of sphericty was checked with Mauchly's Test for sphericity. Mauchly's Test was not significant (p>.05), therefore spherecity assumption was met.

The main effect of time of measurement was significant, F (2, 48) = 105.78, p <.05, η^2 =.81 (see Table 4.4). The partial eta squared value obtained in this test was .81. We can conclude that 81 % percent of the variance in vocabulary achievement scores was explained by time. Means and standard deviations were presented in Table 4.5.

Table 4.4 Repeated ANOVA summary table for the effect of time on vocabulary test scores (in-class vocabulary excluded)

Source		*SS*	*df*	*MS*	*F*	*p*	η^2
time	Sphericity Assumed	4018.88	2	2009.44	105.78	.00*	.81
error	Sphericity Assumed	911,787	48	18,996			

*p<.05

Table 4.5 Means and standard deviations for three dependent variables

	M	*SD*	*N*
Pretest	23.60	8.00	25
Posttest	37.12	7.94	25
Retention test	40.56	8.74	25

Paired samples tests were conducted between pretest posttest and posttest retention test (see Table 4.6). The test resulted in a significant difference between pretest (M =23.60, SD =8.00) and posttest (M = 37.12, SD = 7.94) and posttest (M = 37.12, SD = 7.94) and retention test (M = 40.56, SD = 8.74). Posttest is significantly higher than pretest, t (24)

= -9.81, p <.05 and retention test is significantly higher than posttest, t (24) = -2.59, p <.05.

Table 4.6 Mean differences between dependent variables

	M	*SD*	*SE*	*t*	*df*	*p*
Pretest - Posttest	-13.52	6.88	1.37	-9.81	24	.00*
Posttest –Retention test	-3.44	6.62	1.32	-2.59	24	.01*

*p<.05

Overall results showed that there was an improvement from pretest scores to posttest scores and from posttest scores to retention test scores. When the vocabulary that was taught in classroom activities were excluded, similar results were obtained. Interestingly, although no significant difference between posttest and retention test scores was expected, overall results indicated an increase from posttest to retention test scores. In this respect, repeated measurements should be investigated experiment by experiment to see the process elaborately.

4.1.3 Data from Logs of Mobile Vocabulary Learning System

Mobile Vocabulary Learning System logs were used in order to get information about frequency of words looked up in mobile system and time spent on each step of the experiments. In the following section, data logs were examined in order to understand how and when learners used the system.

Discourse type and Number of Words Looked up in Mobile System

The number of the words that looked up in mobile system might vary according to discourse type of the vocabulary. In order to examine the effect of discourse type factor on frequency of words looked up in mobile application, one-way analysis of variance (ANOVA) was conducted. Assumptions of ANOVA are independent observation, normality and homogeneity of variance. In this respect, independent observation assumptions was met, since observations within each sample were independent. For the

assumption of normality, normality tests and histograms showed that the populations from which the samples selected were normal. For the assumption of homogeneity of variance, Levene Test should be non-significant. This assumption was also met (F = 2.41, p >.05).

ANOVA was conducted in order to investigate the effect of discourse type on frequency of words looked up in mobile application (see Table 4.7). The factors were general, specific and intermediate discourse types. The ANOVA was significant, F (2, 82) = 14.80, p <.05). Post-hoc comparisons using the Tukey HSD test indicated that the mean score of Specific Discourse type group (M=14.44, SD =14.44) and Intermediate Discourse type group (M = 15.75, SD = 10.38) were significantly higher than General Discourse type group (M = 5.29, SD = 7.27).

Table 4.7 ANOVA summary table for the effect of discourse type on frequency of words looked up

	SS	*df*	*MS*	*F*	*p*
Between Groups	1959.56	2	979.78	14.80	.00*
Within Groups	5428.03	82	66.19		
Total	7387.60	84			

*p<.05

Table 4.8 Tukey HSD comparison for discourse types

Discourse Type		*MD*	*SE*	*p*	*95% CI* *Lower*	*Upper*
GD	ID	-10.45	2.33	.00*	-16.02	-4.89
	SD	-9.15	2.23	.00*	-14.47	-3.82
ID	GD	10.45	2.33	.00*	4.89	16.02
	SD	1.30	2.79	.88	-5.36	7.97
SD	GD	9.15	2.23	.00*	3.82	14.47
	ID	-1.30	2.79	.88	-7.97	5.36

*p<.05

Multiple comparisons showed that mostly looked up discourse type was intermediate discourse type (M=15.75) and the least one was general discourse type (M=5.29).

Moreover, students looked up the words which belong to specific and intermediate discourse type much more than general discourse type.

Frequency of Words Looked up and Time spent in Mobile Application

Frequency of words looked up and the time spent on each experiment in mobile application varied among experiments. When frequency of words looked up were compared among five experiments (see Table 4.9), the highest frequency was belong to Wheel and Axle (*f*=217), following Depth Skinner (*f* = 216). The least one was the Experiment of Lever (*f* =78). When the time spent on the experiments was compared among five experiments, Wheel and Axle was the most time spent experiment (310.48 sec) and least time spent belonged to Pythagorean Theorem (97.64 sec) (see Table 4.9). The experiment which had the highest frequency of looked up words was Wheel and Axle (*f* =217) which was also the most time spent experiment. Consistency between frequency of words looked up and the time spent could be seen at the Experiments of Depth Skinner and Free Fall which had the highest scores. While total time spent in Depth Skinner was 238.96 sec, frequency of looked up words was 216; and while total time spent on Free Fall was 244.4 sec, frequency of words looked up was 189. However, in the experiment of Lever, frequency of words looked up was 78, which was the lowest frequency and it was expected to have the lowest time spent score, but with 97.64 sec. of time spent, Pythagorean Theorem was the experiment that had lowest time spent score. However, the frequencies were so close to each other.

Table 4.9 Frequency of words looked up and total time spent for each experiment

Experiment	Frequency of words looked up	Total Time Spent
Free Fall	189	244.4
Wheel and Axle	217	310.48
Depth Skinner	216	238.96
Lever	78	147.68
Pythagorean Theorem	83	97.64

It is an expected result that the experiments that mostly time spent were the experiments that had the highest frequency of words looked up in mobile application. These results gave us overall tendency in mobile vocabulary learning system. Mostly looked up words were general discourse type and mostly time spent experiments were also the experiments that mostly words looked up during five-week period. Moreover, students spent most time on the first experiments, as time goes by frequencies of looking up words and time spent decreased.

4.1.4 Overall Results Presented Student by Student

Total time spent and total frequency of words looked up in mobile vocabulary learning system, task completion frequency in real environment and frequencies of correct answer to the open ended questions at the end of the experiments were listed student by student (see Table 4.10). On the other hand, demographic features including students' department that they graduated from at high school (equally weighted (EW) vs. quantitative), their sorting level of vocabulary among other language learning skills (vocabulary, reading, listening, grammar, speaking, and writing) in terms of their confidence feelings and whether or not they have interested in science experiments were also presented. Students sorted their confidence level among language learning skills from one to six that "1" indicates that vocabulary is his/her most confident field. Students were coded as S1, S2… and so forth.

Table 4.10 Overall results presented for each student

	Total Time spent	Total frequency of words looked up	Task completion frequency	Correct answer frequency	Department graduated	Vocabulary confidence sorting	Interest in science experiments
S1	1365	59	12	1	EW	5	-
S2	1082	59	15	2	quantitative	6	+
S3	1349	34	15	3	quantitative	3	+
S4	875	56	16	2	quantitative	4	+
S5	934	33	17	4	quantitative	2	+
S6	678	28	16	3	quantitative	4	+
S7	908	39	14	3	quantitative	5	+

Table 4. 10 (Continued)

	Total Time spent	Total frequency of words looked up	Task completion frequency	Correct answer frequency	Department graduated	Vocabulary confidence sorting	Interest in science experiments
S8	1335	43	15	3	quantitative	3	+
S9	1803	50	14	3	quantitative	1	+
S10	937	22	15	2	quantitative	3	+
S11	791	13	17	3	quantitative	4	+
S12	661	4	16	4	EW	6	+
S13	1047	34	14	3	quantitative	6	+
S14	869	12	18	4	EW	2	-
S15	892	27	15	2	quantitative	6	+
S16	1154	31	18	4	quantitative	3	+
S17	899	21	15	2	quantitative	1	+
S18	412	8	18	3	EW	4	+
S19	1006	47	13	1	quantitative	3	-
S20	929	15	18	3	quantitative	6	+
S21	1352	36	17	2	quantitative	6	+
S22	1906	38	10	1	EW	2	-
S23	911	26	18	4	EW	4	+
S24	959	9	14	3	quantitative	4	+
S25	921	39	13	2	quantitative	6	-

When overall results of students were examined and compared student by student, S1 was one of the students who spent most time and who looked up most words in mobile application. S1 had lower task completion frequency and just only replied one open-ended question correctly (see Table 4.10). On the other hand, S9 who was one of the students that spent most time in mobile system also had one of the highest frequency of words looked up in mobile system, high scores of task completion and correct answers to open-ended questions. S22 who spent most time in mobile application, was not one of the students who looked up most words in mobile system. However, her task completion frequency and correct answer frequency to open-ended questions were one of the lowest scores among 25 students. On the other hand, S12 and S18 who were the students that spent least time and looked up least words in mobile application had really high frequency of task completion and correct answers to open ended questions.

On the other hand S1, S12, S14, S18, S22 and S23 were the students who graduated from department of "equally weighted" at their high schools. They did not get any lectures about Science at high school. It was an expected result that they had lower scores of task completion and correct answer frequency. However, S12, S14, S18 and S23 had high scores of task completion and correct answers to open ended questions. Interestingly, although these students were from the domain of "equally weighted" they were interested in science experiments. Interest in science experiments could be one of the affective factors. S1, S14, S19, S22 and S25 were the students who were not interested in science experiments and they had low frequency of task completion and correct answers to open-ended questions.

Those results were not empirical findings, thus it is not appropriate to generalize them. On the other hand, these results give information about general tendency of students based on their interaction with the mobile learning vocabulary system, real world tasks and their personal features. In the next section, students' interaction with the situated learning environment and mobile vocabulary learning system were explored elaborately with retrospective reviews and observation notes. Moreover, at the end of the experimentation process, 12 students were interviewed based on their experiences about the five-week experimentation process and their vocabulary learning strategies and processes were gathered and presented.

4.2 Results of Each Experiment

User logs were gathered for the purpose of exploring which words were looked up in mobile application and how much time spent on each step of the experiment. Moreover, each experiment was composed of tasks that needed to be accomplished in real environment, METU Science and Technology Museum. In this respect, the tasks that needed to be done in the real environment were observed and notes were taken on observation forms. If student completed the task "+" sign was used, otherwise "-" was used. While the steps that needed to be followed in mobile application were named as

"step", the steps that needed to be accomplished in real environment were named as "task". In other words, several steps in mobile application just included information about the experiment, not an instruction to be done in real environment.

After students performed their tasks, they tried to remember what they did during the process and think aloud sessions were administered. These retrospective reviews were useful for gathering information about what students thought while performing the tasks and what really happened during the process. Students' vocabulary exploration processes were examined elaborately. At the end of each experiment, difference between pretest, posttest, and retention test scores was analyzed and presented.

4.2.1 Results of the Free Fall Experiment

Free Fall which was the first experiment of this five-week experimental process included the steps below that needed to be followed in mobile application:

1. Hang one of the balls to the magnetic sharp tip which is at the top of the device (Task 1)
2. Each ball has different mass.
3. Press the green button. Read the digital display that shows the fall time (Task 2).
4. Try the same process for the other ball. Compare the velocity and fall time of two balls (Task 3).

In this experiment first, third and last step were the tasks that needed to be completed in real environment. Students mostly opened visual definition in mobile system (see Table 4.11). On the other hand, S14 (f=0), S11 (f=2) and S24 (f=2) were the students who looked up least words in the system, whereas S1 (f=13), S2 (f=16), S4 (f=11) and S8 (f=11) looked up most words in mobile system.

In terms of time spent; S18, S17 and S6 spent least time on this experiment (see Table 4.12). On the other hand S22, S9 and S1 spent most time on this experiment. While S1 was one of the students who looked up most words in mobile system, she also spent

most time in mobile system. However, students who looked up least words in mobile application did not spent least time on this experiment.

Table 4.11 Frequency of words looked up by each student in the Experiment of Free Fall

Student	Dictionary definition	Visual definition	Total
S1	1	12	13
S2	6	10	16
S3	6	3	9
S4	3	8	11
S5	4	6	10
S6	1	8	9
S7	2	2	4
S8	3	8	11
S9	4	6	10
S10	0	6	6
S11	0	2	2
S12	3	1	4
S13	2	7	9
S14	0	0	0
S15	3	4	7
S16	5	5	10
S17	2	3	5
S18	2	1	3
S19	4	4	8
S20	2	4	6
S21	1	6	7
S22	3	7	10
S23	3	6	9
S24	1	1	2
S25	2	6	8
Total	63	126	189

Table 4.12 Time spent on each step of the Experiment of Free Fall

	Step 1 ***(sec)***	**Step 2** ***(sec)***	**Step 3** ***(sec)***	**Step 4** ***(sec)***	**Total time** ***(sec)***
S1	97	63	18	213	391
S2	139	27	41	50	257
S3	129	60	30	164	383
S4	56	23	44	106	229
S5	31	42	19	97	189
S6	88	14	0	40	142

Table 4.12 (Continued)

	Step 1 ***(sec)***	**Step 2** ***(sec)***	**Step 3** ***(sec)***	**Step 4** ***(sec)***	**Total time** ***(sec)***
S7	19	27	94	38	178
S8	54	45	50	157	306
S9	152	41	59	141	393
S10	63	17	33	118	231
S11	33	22	41	70	166
S12	31	42	19	97	189
S13	63	49	5	88	205
S14	37	3	30	112	182
S15	41	13	47	74	175
S16	53	19	45	157	274
S17	32	11	31	62	136
S18	24	4	9	68	105
S19	51	28	14	77	170
S20	84	21	26	148	279
S21	104	102	35	103	344
S22	284	1	182	105	639
S23	49	80	34	57	220
S24	26	22	15	98	161
S25	63	26	33	44	166
M	72.12	34.76	38.16	99.36	244.4

As it can be seen from Table 4.13 mostly looked up words were mass, device and sharp respectively. While mass and device were special discourse type, sharp was intermediate discourse type. Moreover, other words in the experiment including green, read, time, try, same, other and two were not looked up in mobile system. These words were all from general type of discourse.

Table 4.13 Frequency of words looked up in the Experiment of Free Fall

Word	**Dictionary Definition**	**Visual definition**	**Total Frequency**	**Discourse type**
hang	7	11	18	GD
each	5	0	5	GD
ball	1	6	7	GD
sharp	6	14	20	ID
magnetic	2	5	7	SD
tip	1	7	8	ID
device	9	17	26	SD

Table 4.13 (Continued)

Word	Dictionary Definition	Visual definition	Total Frequency	Discourse type
mass	9	18	27	SD
each	2	0	2	ID
compare	6	10	16	GD
top	**0**	**1**	**1**	**GD**
process	4	8	12	ID
velocity	7	11	18	SD
press	0	1	1	GD
fall	1	6	7	GD
which	1	0	1	GD
one	0	1	1	GD
display	2	8	10	SD
different	0	1	1	GD
show	0	1	1	GD
green	0	0	0	GD
read	0	0	0	GD
time	0	0	0	GD
try	0	0	0	GD
same	0	0	0	GD
other	0	0	0	GD
two	0	0	0	GD
Total	63	126	189	

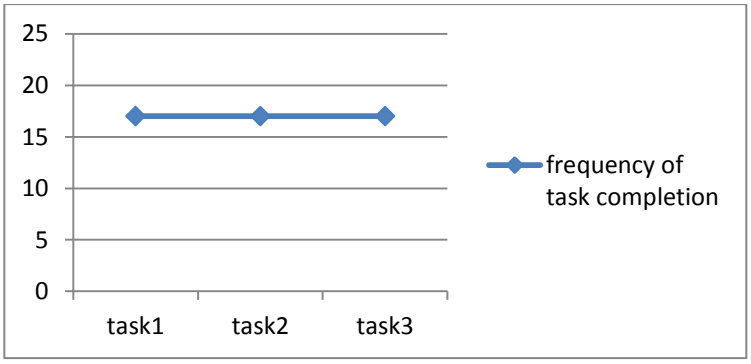

Figure 4.1 Frequency of task completion in the Experiment of Free Fall

All tasks which were first, third and last steps of the experiment were completed by 17 students out of 25 students (see Figure 4.1). Each step of the experiment will be explored and presented elaborately in the following section in order to understand which factors

contribute to the process of contextual vocabulary exploration and task completion in mobile supported situated learning environment.

First Step of the Free Fall Experiment

In the experiment of Free Fall, the first step was "Hang one of the balls to the magnetic sharp tip which is at the top of the device". This step was the second most time spent step among the other steps with 72.12 sec (See Table 4.12). Students looked up the words of hang, magnetic, sharp, tip and device frequently; therefore this step might take much time. While S22, S9 and S2 spent the most time; S7, S18 and S24 spent least time on this step. S2 was also one of the students who looked up most words in this step. This task was completed by 17 students (see Figure 4.1). Students who could not complete the task correctly were S1, S2, S7, S9, S15, S19, S22, and S25. S2, S9 and S22 were also the students who spent most time on this step.

Retrospective Review Results

Retrospective reviews gave clues about underlining reasons and problems learners encountered during the process and students' contextual vocabulary exploration processes elaborately. Common problem of students who spent most time on this step was that they just tried to understand the meaning of the words from the static images or animations, without reading the related sentence. There was a monster in the related visual of the word "sharp" and related sentence was "That monster has a big mouth full of sharp teeth". Students did not read the related sentence and they just tried to understand the word from the visual and consequently made incorrect inferences. It was the first experiment and the first step throughout five-week period, therefore students could not get used to this learning environment.

> *I did not know the meanings of "hang" and "device" words. When I looked up the meaning of "hang", I thought as "asmak" in Turkish equivalence and I especially did not understand the meaning of "sharp" in the word group of*

"magnetic sharp tip". When I looked up the meaning of "sharp", I thought as "teeth". (S9)

"Hang'in" ve "device'ın" anlamını bilmiyordum. Anlamına bakınca bana "asmak" kelimesini ifade etti. "Magnetic sharp tip"te de "sharp" kısmını özellikle anlamadım. "Sharp"a bakınca diş gibi düşündüm. (S9)

I had problem with first sentence. Here, there is a monster in the picture; does "sharp" mean "teeth"? I thought the "sharp" word relates to "teeth". (S22)

İlk cümlede takıldım. Burada resimde canavar var, "sharp teeth" diş mi demek? Ben "sharp"ı dişle bağlantılı gibi düşündüm. (S22)

Moreover, two students had problems with the sentence structure. In the second part of the first step, there was a "which" clause that students could not understand the sentence even though they have learned this grammar issue before in classroom activities. Although the steps of the experiments were prepared with instructor of elementary level, language skills might vary among students.

I dwelled on the second part of the first step: "which is at the top of the device". I have understood as "which device is at the top?" I had problem with that one. (S20)

Bu ilk basamakta ikinci kısımda takıldım: "which is at the top of the device". "Which is at the top of the device"'ı "hangisi aracın en üstünde" olacak tarzında anladım. Bununla sorun yaşadım. (S20)

Even though several students did not understand the meaning of "magnetic sharp tip", when they saw the end of the sentence, "at the top of the device", they searched somewhere to hang the ball at the top of the device. Finally, they found the magnetic sharp tip, therefore a contextual learning environment helped them to find out and complete the task correctly. Those contextual clues are very crucial for contextual

vocabulary learning. Real environment which includes various rich contextual clues plays critical role to support learners to guess the meaning of the word from the context.

> *It was said that "magnetic sharp tip" was "at the top". When I looked up, I have looked for what is sharp at the top and it caught my attention. I got all the words from the device without looking up their definitions. (S12)*

> *"Magnetic sharp tip" için "at the top" diyor ya yukarıya bakınca hani sivri olan ne var o şekilde dikkatimi çekti. Kelimelerin hepsinin anlamına bakmadan düzenekten çıkardım. (S12)*

Students in the study followed different strategies to accomplish the tasks. As several of them preferred to see all the steps of the experiments at the beginning, they were able to complete the tasks only after they understood the entire experiment. Students' preferences and strategies might vary while performing authentic tasks; therefore it is crucial to present a flexible environment.

> *I didn't understand the meaning of several words which were "hang", "device" and "sharp" in the first step. It was hard for me to understand "magnetic sharp tip". I didn't understand "sharp" word especially. When I checked up to fourth step I understood the first step better. (S3)*

> *İlk basamakta bazı kelimeleri anlamadım. Bunlar "hang, device ve sharp". "Magnetic sharp tip" i anlamakta zorlandım. "Sharp" kelimesini özellikle anlamadım. Dördüncü basamağa kadar açınca birinci basamağı daha iyi anladım. (S3)*

Second Step of the Free Fall Experiment

Second step included only information about the experiment which was "Each ball has different mass"; therefore students spent least time on this step (34.76 sec). They did not need do anything in real environment. They looked up the word of "mass" (*f*=27) and "different" (*f*=1). Students who spent least time on this step were S14 and S18 and who spent most time were S21, S23 (see Table 4.12).

Retrospective Review Results

In the second step, the visual definition of "mass" was a visual showing that mass does not change no matter if you are on Earth, or the Moon. However several students thought that the meaning of mass is the term of "gravitation" or "weight", because again they did not examine the visual and read its contextual sentence carefully. One of the disadvantages of contextual learning environments is possibility of guessing the meaning of words incorrectly. Although mobile vocabulary definition support was designed for minimizing this limitation in the present study, several students focused on completing the tasks quickly and did not place attention on visuals and their contextual sentences.

> *I looked up the definition of "mass". I got it better with the visual definition. It means "ağırlık". Aaaa… here weight changes but mass doesn't change. Then "mass" means "kütle". I misunderstood. (S24)*
>
> *"Mass" kelimesine baktım. "Mass"i resimde daha iyi anladım. Ağırlık demekmiş. Aaa burda ağırlık değişiyor kütle değişmiyor. O zaman kütle demek. Yanlış anlamışım. (S24)*
>
> *It stated that it is not affected by gravity. "Mass" word means "gravity". (S17)*
>
> *Yer çekiminden etkilenmemiş diyor. "Mass" kelimesi "yerçekim" demek.(S17)*

Even though several students did not know the meaning of the word, they understood that there was no instruction to do in the real environment; therefore they did not attempt to look up the meaning of the word. In this respect, when there is no interaction with the real environment or nothing to do in real environment, students do not pay attention and do not find it necessary to look up the meaning of the words. Students need to see consequences of their every action in situated learning environment; otherwise they skip those steps and results in not learning meaning of the words. S18 who is also one of the students who spent least time on this step stated as:

I didn't know the meaning of "mass" word but I understood that this step did not make you do something; therefore I didn't find it necessary to look up its definition. (S18)

"Mass" kelimesini bilmiyordum ama bu basamakta bir şey yaptırmadığını anladığım için bakma gereği duymadım. (S18)

Third Step of the Free Fall Experiment

In the third step, students should "Press the green button. Read the digital display that shows the fall time". They spent only average 38.16 sec which shows that they mostly know the meaning of the words in this step (See Table 4.12). This is the step that students spent secondly least time. Students just looked up the words of press (*f*=1), fall (*f*=7), show (*f*=1) and display (*f*=10) (see Table 4.13). While S6, S13 and S18 spent least time on this step, S22 and S7 spent most time. Eight students who were S1, S2, S7, S9, S15, S19, S22, and S25 could not complete the task correctly.

Retrospective Review Results

Although students spent less time on this step, there were eight students that could not accomplish the task in real environment. All students knew the meaning of word group of "press the green button". Unfortunately, they could not complete this step correctly due to not completing the previous steps. When steps are connected to each other, skipping of them might result in not completing all following tasks.

Because I didn't hang the ball in the previous step, nothing showed up when I pressed the button. (S9)

Üçüncü basamakta topu asmadığım için buttona basınca bir şey çıkmadı.(S9).

It states that watch the fall time on digital display. Although I pressed the yellow button, I could not see anything. (S25)

Dijital ekranda düşüş zamanını izle diyor. Bastım sarı buttona ama bir şey göremedim. (S25)

Moreover, the definition of "display" was given with digital alarm clock in mobile application and the visual looks like the digital display in the real environment; therefore students understood the meaning of the word and reflected to the real environment more easily. In these situations, if the representation of the word in the mobile application and the real environment resembles much, students easily inference the meaning of the word and use it in the authentic context.

> *Then, it told me to press the yellow button. I didn't know the meaning of "display". When I looked at the visual I didn't understand. However, the alarm clock in the visual was similar to that one; therefore I guessed the meaning. (S16)*
>
> *Sonra sarı buttona bas diyordu. "Display"ın anlamını bilmiyordum. "Display"in görseline bakınca anlamadım ama orada gördüğüm alarm buradakine benziyordu. Öyle çıkardım. (S16)*

Students who spent least time also completed the task correctly. They mostly knew the meaning of the words before, so they needn't to look up the meanings in mobile application. Students who have high pre-knowledge about target vocabulary accomplished the authentic tasks more easily. Although they already knew the meaning of the words, they had opportunity to use them in various contexts.

> *Fall time means "düşüş zamanı". I did not look up the meaning. (S18)*
>
> *"Fall time" düşüş zamanı demek. Anlamına bakmadım. (S18)*
>
> *The sentence with pressing the yellow button was easy. It was the easiest sentence for me. (S6)*
>
> *"Sarı button"a basma cümlesi kolaydı. Benim için en kolay cümle buydu. (S6)*

Fourth Step of the Free Fall Experiment

In the last step, students needed to try the previous processes for all of the balls and reply the open ended question. The step was "Try the same process for the other ball. Compare the velocity and fall time of two balls". Students spent average 99.36 seconds on this step which was the most time spent step (see Table 4.12). There was an open-ended question; therefore students might spend most time on this step. In this step, students looked up the meanings of compare (*f*=16), process (*f*=12) and velocity (*f*=18).

Retrospective Review Results

Eight students, who also could not complete the previous tasks, could not try the same process for the other balls and therefore they could not complete this task correctly. Students who spent most time were S1 and S3 and who spent least time were S7, S6 and S25. Students who spent less time had skills of inferencing meaning of the words from various contexts. First they tried to inference the meaning from the sentence, later they used the alternatives. Real authentic environment promoted them in contextual guessing. Those students used the mobile system efficiently by not looking up meaning of each word in the system. This resulted in not distracting learners from the authentic environment.

> *I think the meaning of "compare" was "karşılaştırmak". I tried to guess from the sentence without looking up the meanings, it was patchy. I tried to guess the meaning from the device or sentence. (S6)*
>
> *"Compare" karşılaştırmaktı sanırım. Çok anlamlarına bakmadan cümle içinden çıkarmaya çalıştım, yarım yamalak. Cümleden, düzenekten çıkarmaya çalıştım. (S6)*

In the experiment of Free Fall, the open ended question was "Try the same process for the other balls. Compare the velocity and fall time of two balls". The answer was "velocity and fall time of all the balls are the same". 16 students replied this question correctly. Several students (S1, S2, S7, S9, S15, S19, S22 and S25) who did not

complete the previous steps could not answer the question correctly. In some cases, if student do not know the meaning of one word in a sentence, he cannot understand the whole sentence and the instruction. Especially, abstract words which are not easily inferenced from the context might cause this problem.

> *It was asked to try the same thing on the other balls. All of them were 29 seconds. I didn't understand "compare velocity" part even from the visual. I knew the meaning of "fall time". I wrote the answer as "29 seconds", however I did not understand the meaning of "compare". (S5)*

> *Soruda diyor ki "try the same" aynı şeyi diğer toplarda dene. Hepsi 29 saniyeydi. "Compare velocity" kısmını görselden de anlamadım. "Fall time" anlamını biliyordum. Cevap olarak 29 saniye yazdım, ama "compare" kelimesinin anlamını anlamadım. (S5)*

One of the reasons for not inferencing the meaning of the words correctly is again not reading the contextual sentence of visual definition. Free Fall was the first experiment and students did not get used to this new learning environment. Several of them could not use the mobile system efficiently due to novelty effect. Moreover, it was not an easy process for those novice learners to inference the meaning of the word and use it in different context. This transfer process is a further step and might be complex for novice learners. In this respect, students who do not have this kind of ability might have some problems.

> *Especially "compare" word was not easy for me to understand. "Compare" means to get something bigger I guess. I looked up mostly visuals in Tablet PC. Visuals were actually in different context. It is different in this application, but you apply to a different situation. You make association. It was confusing for some words. You are actually trying to apply to different context what you have learned here. (S4)*

"Compare" kelimesinde özellikle zorlandım. "Compare'in sanırım büyültmek anlamı var. Tablette daha çok görsellere baktım. Görseller aslında farklı bir bağlamda. Burada başka bir şey ama orada başka bir şeye uyguluyorsun. Çağrışım yapıyorsun. Bazı kelimelerde kafamı karıştırıyor. Burada öğrendiğini başka yere uygulamaya çalışıyorsun aslında. (S4)

One of the students found out that the "V" symbol of velocity comes from its meaning in English. This is a kind of meaningful learning which is one of the main purposes of the present dissertation study.

It was asked to try to do the same thing with other ball. I looked up the definition of "compare velocity". "Velocity" means "hız" in Turkish equivalence. I guess the "V" abbreviation comes from there. (S16)

Son basamakta aynısını bir daha yapmayı dene diyordu diğer topla. Burada "compare velocity"e baktım. "Velocity" hız demek sanırım ve "velocity" de kullandığımız "V" de oradan geliyor galiba. (S16)

Difference between Pretest, Posttest, and Retention Test Scores

One of the main purposes of these experiments was to promote improvement in vocabulary achievement scores throughout the process. In this respect, repeated measures design was conducted for each experiment in order to explore differences between pretest, posttest, and retention test scores.

For the experiment of Free Fall, in order to learn the dependent variable is normally distributed in the population for each level of the within subjects factor, tests of normality was conducted. Results of Kolmogorov-Smirnov and Shapiro-Wilk should be non-significant, however normality assumption could not met. In this respect, Friedman test as non-parametric test was administered (see table 4.15). The results of Friedman Test indicated that there was a significant difference in vocabulary achievement scores across the three time points (pretest, posttest, and retention test), $\chi^2 = (2, n=25) = 32.31$,

p<.05. Inspection of median values showed an increase in vocabulary test scores from pretest (MD=7.00) to posttest (MD=11.00) and to retention test (MD=15.00).

Table 4.14 Means and standard deviations for dependent variables

	N	*M*	*SD*	*Min*	*Max*	*MD*
pretest	25	7.12	3.14	2.00	15.00	7.00
posttest	25	11.24	4.09	3.00	19.00	11.00
Retention test	25	14.48	5.12	2.00	22.00	15.00

Table 4.15 Friedman Test for the experiment of Free Fall

N	25
χ^2	32.31
df	2
p	.00*

*p<.05

Wilcoxon signed ranked test was administered as post-hoc tests to compare the three time points individually (see Table 4.16). Time 1 was compared with Time 2 and Time 2 was compared with Time 3 and to reduce Type 1 error, new alpha level was determined as .05/2= .025. Wilcoxon signed ranked test indicated significant difference in vocabulary achievement scores between pretest posttest, z=-3.95, p<.025, with a large effect size of r=.59. There was also a significant difference between posttest and retention test, z=-.3.11, p<.025 with a large effect size of r= .44.

Table 4.16 Wilcoxon signed ranked test for the experiment of Free Fall

	posttest - pretest	retention test - posttest
Z	-3.95	-3.11
p	.00*	.00*

* p<.025

Interestingly, it is expected that posttest scores is higher than pretest scores and there is no significant difference between posttest and retention test scores. However, in this experiment, the scores got higher across time, even for the retention test which was

conducted after six weeks from the experiments. This can be explained by that this experiment was the first experiment of the experimentation process and students did not get used to the mobile system and this new kind of learning environment. In this respect, novelty effect might influence the scores.

4.2.2 Results of the Wheel and Axle Experiment

In the experiment of Wheel and Axle, there were four steps that needed to be followed. First three steps were also the tasks that needed to be accomplished in the real environment. The last step included two open-ended questions about the experiment.

Step 1: Rotate the wheel and axle and lift the weight. (Task 1)

Step 2: Tie the weight to the second cylinder which has a different diameter. Then lift the weight. (Task 2)

Step 3: Now tie the weight to the third cylinder which has a different diameter. Then lift the weight. (Task 3)

Step 4: "When you used different cylinders:

a) Did you apply the same amount of force?
b) Did you rotate the wheel and axle the same number of times?"

Time spent on first and third steps was almost close to each other (see table 4.17). Third step was almost the repetition of the second step; therefore students spent least time (40.8 sec) on this step. Students spent most time on the last step, because there were two open ended questions which were "When you used different cylinders: a) did you apply the same amount of force? b) Did you rotate the wheel and axle the same number of times?" Second step also took average 69.84 seconds, because there were a few unknown words that needed to be explored in this step. These words were "tie, cylinder, diameter, lift" (see table 4.18). Mostly looked up words in mobile application were "rotate, wheel and axle, tie, apply, amount, lift and force". While "wheel and axle" and "force" were specific discourse type; "rotate, amount, apply" were intermediate

discourse type. “Lift” and “tie” were general discourse type. Students mostly looked up visual definitions of the words in mobile application (see Table 4.19). While S2, S1 and S7 looked up most words in mobile application; S12, S18 and S24 looked up least words in mobile application. On the other hand, S9 and S22 spent most time in this experiment with the seconds of 548 and 474 respectively. Although S9 and S22 did not look up many words in mobile application; they spent considerable time during the experimentation process. On the other hand, S18 and S12 who were the students who looked up least words in mobile application were also the students who spent least time in mobile application.

Table 4.17 Time spent on each step of the experiment of Wheel and Axle

	Step 1 ***(sec)***	**Step 2** ***(sec)***	**Step 3** ***(sec)***	**Step 4** ***(sec)***	**Total time** ***(sec)***
S1	23	95	61	204	383
S2	92	87	31	137	347
S3	35	66	32	322	455
S4	50	46	41	81	218
S5	42	53	20	155	270
S6	32	49	34	112	227
S7	45	66	41	140	292
S8	25	108	33	218	384
S9	79	70	135	190	474
S10	31	22	8	199	260
S11	22	44	33	111	210
S12	8	80	16	63	167
S13	61	84	47	252	444
S14	48	33	23	231	335
S15	36	46	26	163	271
S16	47	79	42	172	340
S17	66	93	27	90	276
S18	23	20	13	57	113
S19	76	52	53	76	257
S20	29	51	45	127	252
S21	110	81	24	171	386
S22	71	213	76	188	548
S23	50	31	87	112	280
S24	28	76	34	176	314
S25	44	92	38	85	259
M	46.92	69.48	40.8	153.28	310.48

Table 4.18 Frequency of words looked up in the Experiment of Wheel and Axle

Word	Dictionary Definition	Visual definition	Total Frequency	Discourse type
rotate	14	19	33	ID
wheel and axle	9	18	27	SD
weight	1	5	6	SD
tie	10	15	25	GD
second	0	2	2	GD
cylinder	4	10	14	SD
different	2	3	5	GD
diameter	3	15	18	SD
third	0	1	1	GD
amount	7	15	22	ID
apply	6	17	23	GD
same	0	2	2	GD
lift	3	14	17	GD
force	5	11	16	SD
explain	3	0	3	GD
number of times	1	2	3	GD
Total	68	149	217	

Table 4.19 Frequency of words looked up by each student in the Experiment of Wheel and Axle

Student	Dictionary definition	Visual definition	Total
S1	2	14	16
S2	10	10	20
S3	6	5	11
S4	5	6	11
S5	2	4	6
S6	0	6	6
S7	2	13	15
S8	4	9	13
S9	3	6	9
S10	1	5	6
S11	1	2	3
S12	0	0	0
S13	3	8	11
S14	5	1	6
S15	3	3	6
S16	1	9	10
S17	5	4	9
S18	0	1	1

Table 4.19 (Continued)

Student	Dictionary definition	Visual definition	Total
S19	5	6	11
S20	1	4	5
S21	4	7	11
S22	1	10	11
S23	1	7	8
S24	2	0	2
S25	1	9	10
Total	68	149	217

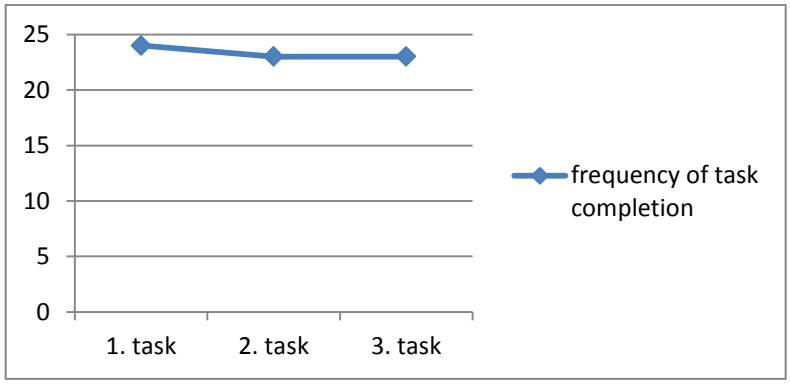

Figure 4.2 Frequency of task completion in the experiment of Wheel and Axle

The tasks of this experiment were completed by almost all of the students. While first task was completed by 24 students, second and third tasks were completed by 23 students (see Figure 4.2).

First Step of the Wheel and Axle Experiment

First step which was "Rotate the wheel and axle and lift the weight" completed by 24 students. It was also the task that has the highest frequency of task completion rate in this experiment (see Figure 4.2). "Rotate" was the word that had the highest frequency of looking up in mobile application (see Table 4.18). "Wheel and axle" was the second word that had the highest frequency of looking up rate in mobile application.

Retrospective Review Results

Students who spent least time (S11, S12) on this step mostly did not look up the meaning of the words. Moreover, these students had ability to guess the meaning of the words form the experimental setup by using contextual clues. Looking up definition of each word in mobile system causes spending time and distracting the learner from contextual guessing.

> *I didn't look up the definition of any word. I didn't know the definition of "axle". It says "rotate the wheel", "tekerleği çevir". Axle must be the handle that we use to turn the wheel. I inferenced from the experimental setup. It means "çıkrık" in Turkish equivalence when integrated I guess. (S11)*

> *Baktığım kelime olmadı. "Axle" ın anlamını bilmiyordum. "Rotate the wheel" diyor, tekerleği çevir. "Axle" tekerleği çevirmek için kullandığımız sap olmalı. Deney düzeneğinden çıkardım. Birlikte Türkçe anlamı olarak çıkrık anlamı var sanırım. (S11)*

S17 was the only student who could not complete this task correctly. She did not understand the first step until she proceeded to the third step. Although she understood the meaning of the first step later, she did not want to turn back. In the present study, steps of the experiments were presented step by step, however several students preferred to see all the steps at the beginning. In this respect, it is crucial to design flexible platforms to give opportunity to learners navigate through tasks.

> *It was not written clearly that I need to rotate. I found it by guessing. I first opened the first two steps, and then I understood that I need to rotate in the third step. I did not think to go back to the beginning to rotate although I understood later. (S17)*

> *Çevirmem gerektiği açıkça bir şekilde yazmıyordu. Tahmin ederek buldum. Önce ilk ikisini açtım. Çevirmem gerektiğini üçüncüde anladım. Başa dönüp çevirmeyi de düşünmedim, sonradan anlamama rağmen. (S17)*

Several students understood the first task after they read the third and fourth tasks. Interestingly, S1 who was one of the students that spent most time on previous experiment was one of the students who spent least time with 23 seconds on this step (see Table 4.17). S1 and S3 preferred to open the following steps and then turned back. They read the words and sentences repeatedly and then understood the task.

> *After I opened the second sentence, I turned back to the first one. I didn't understand "lift" at the beginning. I understood the meaning when I saw the second sentence. After looking the words and sentences repeatedly, I felt like I needed to do like this. (S1)*
>
> *İkinci cümleyi açtıktan sonra ilkine geri döndüm. Başta "lift" kelimesini anlamadım. Anlamını ikinci cümleye geçince anladım. Kelimelere ve cümlelere tekrar tekrar bakınca, böyle yapmam gerektiğini hissettim.*
>
> *When I saw all the steps as a whole, I understood. After I opened first two steps I turned back to the first step. I prefer like this. (S3)*
>
> *Basamakları bütün olarak gördükçe anladım. Zaten ilk ikisini açtıktan sonra birinci basamağa döndüm. Böyle tercih ediyorum. (S3)*

Several students found this experiment easier than the experiment of Free Fall. Easiness depended on the number of the known words in experiment and giving an opinion when they first looked at the experimental setup. In this respect, it can be concluded that contextual clues are crucial for inferencing the meaning of the words. If setup is too complex or students encounter excessive number of unknown words, they feel frustrated and demotivated.

> *This experiment was easier than the other one. The number of words that I know the meaning was much more. Other experiment was a hard one. Moreover, I can understand this experiment. I did not do it before, but there are some kits and you need to rotate. It is easy to have an opinion. (S4)*

Bu deney diğerlerine göre daha kolaydı. Bildiğim kelimeler biraz daha fazlaydı. Diğer deney biraz ağır gelmişti. Bir de bu deneyi anlayabiliyorum. Deneyi daha önce yapmadım ama birkaç aparat var ve çevirmemiz gerekiyor. Fikir yürütmesi kolay bir deneydi.(S4)

This experiment was easier for me. The vocabulary was familiar in this experiment. (S20)

Bu deney daha kolaydı benim için. Kelime bilgisi bana yakındı. (S20)

This experiment was easier than before. There were much more words which I don't know the meanings in the previous experiment. It was hard to understand them. In this experiment, it was easier to inference the meanings of the words form the sentences, because the number of the unknown words is less (S3).

Bu deney öncekine göre kolay geldi. Önceki deneyde bilmediğim kelime daha fazlaydı. Onları anlamakta zorlandım. Bu deneyde, kelimelerin anlamını cümleden çıkarmak daha kolaydı, çünkü bilmediğim kelime sayısı azdı. (S3)

Students mostly understood the meaning of "wheel and axle", but several of them could not remember Turkish equivalence of the word. In other words, students experienced meaningful learning. Although they have seen this specific discourse type word with high academic utility before in their science classes at high school, they might not remember Turkish equivalence of it.

Wheel and axle was that mechanism. It is one of the simple machines that we have seen in the science class before. I didn't remember the Turkish equivalence of it. (S2)

"Wheel and axle" şu düzenek demekmiş. Fen dersindeki basit makinalarda görmüştük ama Türkçesi aklıma gelmedi. (S2)

Wheel and axle was that thing. I didn't look up its definition. You can guess it from the mechanism. (S18)

"Wheel and axle" şu şeymiş. Anlamına bakmadım, düzeneğe bakınca tahmin edilebiliyor. (S18)

Several students with high science pre-knowledge accomplished the authentic tasks and inferenced the meaning of the words easily. Familiar topics and experimental setups support learners to accomplish the tasks and make them associate with their preknowledge. "Wheel and axle" is one of the subjects at high school that students from quantitative department mostly encountered.

In the experiment I rotate the smaller one less and the bigger one more. It was about science. Rotate means "döndürmek" in Turkish equivalence. "Weight" means "ağırlık" in Turkish equivalence. I thought "axle" is like "aks" word in Turkish. I sensed and understood. (S24)

Deneyde küçüğü daha çok çevirdim büyüğü daha az çevirdim. Bu işte fizikteki şey. "Rotate" döndür demek. "Weight" ağırlık demek. Türkçede aks var ya. Hissettim ve anladım. (S24)

I understood that I should rotate it after a while. We are trying to transfer a weight from one place to another. I guess it is asked for to compare forces we applied. (S17)

Çevirmem gerektiğini sonradan anladım. Ağırlığı bir yerden bir yere taşımaya çalışıyoruz. Muhtemelen yapmamızı istedikleri şey uyguladığımız kuvveti karşılaştırmamız. (S17)

Second and Third Steps of the Wheel and Axle Experiment

Second and third steps were similar to each other which were "Tie the weight to the second cylinder which has a different diameter. Then lift the weight" and "Now tie the weight to the third cylinder which has a different diameter. Then lift the weight". While students spent average 69.48 sec on the second task, they just spent 40.8 sec on the third task. Repetition of the words and tasks resulted in less time spending. Task 2 and task 3

were completed by 23 students. S22 who could not complete the second task also could not complete the third task. On the other hand S17, who was the only student who could not complete the first task, also could not complete the second task; but she completed the third task; because she understood the experiment when she came to the third task.

Retrospective Review Results

S22 who spent most time on these steps lifted the weight with her hands instead of lifting by rotating the wheel and axle. When she encountered an unknown word, she was confused. Moreover, the visual in mobile system was an animation that a girl is lifting a box with her hands. Students needed to transfer what they have learned to a new context. This transfer ability make students learn word functions in different contexts. However, novice learners do not have this kind of ability, therefore they encounter problems.

> *I understood the first sentence. I didn't understand the second one because of the "cylinder" word. I was confused there. When I saw the third step I went back to the beginning. I lifted weights with my hand. (S22)*
>
> *İlkini anladım. İkincisinde şu kelime yüzünden bir şey anlamadım. "Cylinder" kelimesi yüzünden. Benim orada kafam karıştı. Üçüncü soruyu görünce başa geldim. Ağırlıkları elimle kaldırdım. (S22)*

S13 who was the other student who could not complete the third task just tied the weight to the first cylinder instead of third cylinder. S13 had problems with sense of direction. Although she understood the task correctly, she could not accomplish it. In this respect, authentic assessments should be administered very carefully and teachers needed to pay attention whether or not students cannot accomplish the tasks due to language issues.

> *I passed the weight from second cylinder to third cylinder. I started counting from this direction first, and then I started to count from this way. (S13)*
>
> *Burada ikinci silindirden üçüncü silindire geçirdim. Çünkü ilk başta buradan saymaya başladım, sonradan buradan saydım. (S13)*

Fourth Step of the Wheel and Axle Experiment

The last step included two open ended questions which were "When you used different cylinders:

a) Did you apply the same amount of force?
b) Did you rotate the wheel and axle the same number of times?"

The correct answer of first question was "I did not use the same amount of force, because cylinders have different diameters". Students spent most time on this step with average of 310.48 seconds. Writing the answers to open-ended questions might take much time. While S22, S9 spent most time on this step; S12 and S18 spent least time. The first question was answered by 15 students correctly; on the other hand second question was answered by 13 students correctly. S4, S6, S8, S10, S13, S17, S19, S21 and S22 could not answer the first question correctly. S12 and S18 who spent least time and who looked up less the meaning of the words replied the open ended questions correctly.

Retrospective Review Results

For the first question, while one of the students understood the force as energy and replied the question as "did you use the same amount of energy?" and one of them replied as "did you feel the weights same when you passed to different cylinders?" Definition of force was explained with the concept of energy in dictionary definition, therefore several students were confused and the concepts of energy, force and weight were interlaced. It would be better to create contextual sentences simpler and not including various similar concepts; otherwise students might make wrong inferences.

> *There was something like "energy" in the dictionary definition of "force". There came to my mind. I combined force, energy and work. (S1)*
>
> *Enerji diye bir şey vardı, "force" kelimesinin sözlük anlamında vardı. Oradan aklıma geldi. Kuvvet güç enerji hepsini birleştirmişim. (S1)*

Each time cylinder passed to other side it seemed as the weight getting lighter (S22)

Her defasında silindir diğer tarafa geçtiğinde hissettiğim ağırlık biraz daha azaldı (S22)

Several of the students understood the meaning of force as "pushing", because in the animation of the visual definition there was a man trying to push a box and using force. The reason for this misunderstanding was that student did not read the contextual sentence of the animations and they just tried to understand the meaning of the words from the animation. In this respect, they could make wrong inferences.

In question A, I looked up the definitions of "force" and "amount". I thought the meaning of force as "to push". I actually dwelled on this question. (S8)

A şıkkında "amount" ve "force"un anlamlarına baktım. İttirmek gibi düşündüm "force" kelimesini. Burada aslında çok takıldım. (S8)

Students generally understood the first question and replied it correctly. Replies to those questions give clues about how students accomplished the previous tasks and their accuracy level of contextual vocabulary guessing. Those questions are kind of authentic assessments that can only be replied after completion of all tasks.

In question A, it is mentioned that with this weight the mechanism can move. I didn't use the same force on each cylinder because their diameters were different. (S15)

A şıkkında bu ağırlıkla bu mekanizmanın hareket edebileceğinden bahsediyordu. Her silindirde aynı gücü harcamadım çünkü çapları farklıydı. (S15)

It asks for when you use different cylinders do you use same amount of force. (S20)

Farklı silindirleri kullandığında eşit miktarda mı güç kullandığını soruyor. (S20)

Several students could not compare the forces they used; because they did not complete the previous tasks. S22 who spent most time on this step and also who could not complete the second and third tasks could not answer the first question correctly. S17 and S13 who had the problems in the previous tasks also could not answer this question correctly as an expected result. Although these students understood the questions, they could not answer them.

> *It was asked for whether or not you applied the same force. While I was answering I couldn't compare the forces. I didn't rotate the previous ones, therefore I could not reply. (S17)*
>
> *Sorularda aynı şiddette mi güç uyguladınız diyordu. Cevaplarken de öncekisinde çevirmediğim için karşılaştırma yapamadım. O yüzden cevaplayamadım. (S17)*
>
> *Since I lifted it up with my hand at the beginning steps, I could not associate this question. I didn't go back to previous steps. (S22)*
>
> *İlk basamaklarda elimle kaldırdığım için bu soruyu bağdaştıramadım. Bir daha da geri dönmedim. (S22)*

For the question B the answer was: "I rotated the wheel and axle different times at each time. The cylinder with small diameter was rotated much more than the other cylinders with different diameters". Almost half of the students could not reply the question B correctly who were S1, S2, S4, S10, S11, S15, S17, S19, S20, S21, S22 and S25. S13 who had problems in completing the previous tasks answered this question correctly, because she could compare two cylinders instead of three cylinders and this situation did not affect the result. However, S17 and S22 who had problems in previous task could not reply this question correctly.

Students mostly understood the question as "did you spend same time?". Students did not look up the meaning of the word of "time" due to trusting their pre-knowledge. However, words might have different meanings and this might lead individuals to wrong

inferences. The word “time” has various meanings and students need to get support from mobile vocabulary system in order to use the exact meaning of the word.

> *In the other question, whether or not all of them lifted up at the same time was asked and I said “no”. (S11)*
>
> *Diğerinde de aynı zamanda mı çıktı hepsi diye soruluyordu. Ben de hayır dedim. (S11)*
>
> *It is asked in question B whether or not I lifted the cylinders up at the same time. (S15)*
>
> *B şıkkında bu silindirlerin hepsinde eşit zamanda mı yukarıya çektin diyordu. (S15)*
>
> *It is asked that whether the rotating durations are the same. (S20)*
>
> *Döndürme süreleri aynı mı diyordu. (S20)*

Several students replied the question correctly just based on their high pre-knowledge. Familiarity to subject make learners inference the meanings of the words correctly. Moreover, students had opportunity to see the mechanism in real environment even though they have encountered this mechanism excessive number of times.

> *“Number of times” means “kaç defa döndürdün” in Turkish equivalence. I remember this experiment from high school science class. Our teacher was teaching it on the blackboard. I didn’t see the mechanism in real life but it’s something about gain in force and loss in path. I will study these subjects, because my department is civil engineering (S24).*
>
> *“Number of times” Türkçe olarak kaç defa döndürdün diyor. Lisede fizik derslerinde hatırladığım bir deney. Hoca tahtada anlatıyordu. Gözümle görmedim ama kuvvetten kazanç yoldan kayıp falan. Bölüm de inşaat mühendisliği, bunlarla uğraşacağım. (S24)*

Difference between Pretest, Posttest, and Retention Test Scores

One of the main purposes of these experiments was to promote improvement in vocabulary achievement scores throughout the process. In this respect, repeated measures design was conducted for each experiment in order to explore differences between pretest, posttest, and retention test scores.

In the experiment of Wheel and Axle, tests of normality was conducted in order to learn the dependent variable is normally distributed in the population for each level of the within subjects factor. Results of Kolmogorov-Smirnov and Shapiro-Wilk should be non-significant, however normality assumption could not met. In this respect, non-parametric test was conducted. Friedman test is the non-parametric alternative to one-way repeated measures analysis of variance. The results of Friedman Test indicated that there was a significantly difference in vocabulary achievement scores across three time points (pretest, posttest, and retention test), χ^2 (2, n=25) = 32.02, p < .05 (see Table 4.20). Inspection of median values showed an increase in vocabulary scores from pretest (*MD*=1.00) to posttest (*MD*=7.00) and to retention test (*MD*=8.00).

Table 4.20 Means and standard deviations for dependent variables

	N	*M*	*SD*	*Min*	*Max*	*MD*
pretest	25	2.08	2.48	.00	8.00	1.00
posttest	25	6.00	2.95	.00	11.00	7.00
Retention test	25	8.36	3.95	2.00	14.00	8.00

Table 4.21 Friedman Test for the experiment of Wheel and Axle

N	25
χ^2	32.02
df	2
p	.00

Wilcoxon signed ranked test was conducted as post-hoc tests to compare the three time points individually (see Table 4.22). Time 1 was compared with Time 2 and Time 2 was

compared with Time 3 and to reduce Type 1 error, new alpha level was determined as .05/2= .025. Wilcoxon signed ranked test indicated significant difference in vocabulary achievement scores between pretest posttest, z=-4.09, p < .025, with an effect size of r=.58, indicating a large effect size of using Cohen (1988) criteria of .1=small effect, .3=medium effect, .5=large effect. Wilcoxon signed ranked test also indicated significant difference in vocabulary achievement scores between posttest and retention test, z=-2.89, p < .025, with a large effect size (r= .41).

Table 4.22 Wilcoxon signed ranked test for the experiment of Wheel and Axle

	Posttest-Pretest	Retention test-Posttest
Z	-4.09	-2.89
p	.00*	.00*

* p<.025

The results showed similar findings with regard to the first experiment which was Free Fall. It is generally expected that posttest is higher than pretest and there is no significant difference between posttest and retention test scores. However in this experiment, the scores get higher across time, even for retention test which was conducted after six weeks from the experiments.

4.2.3 Results of the Depth Skinner Experiment

In the experiment of Depth Skinner, there are four steps and six tasks that needed to be followed and completed:

1. Rotate the disc (Task 1)
2. Stand two steps back (Task 2). Then, stare at its center for twenty seconds (Task 3). Look at your palm (Task 4). Notice that your palm is still turning. Your palm appears to turn in the opposite direction. It also appears to swell up or shrink.
3. Now rotate the disc in the opposite direction (Task 5)
4. Look at your palm again (Task 6). Is the spinning pattern different from the first time?

As it can be seen at Table 4.23 that visual definition was mostly preferred (*f*=150) among students in the experiment of Depth Skinner. Mostly looked up words were "palm, swell up, shrink" respectively. These words were all intermediate discourse type. Moreover, other words in the experiment which were "look, now, first, time" were not preferred to be looked up in mobile system. These words were all from general discourse type.

Table 4.23 Frequency of words looked up in the experiment of Depth Skinner

Word	Dictionary Definition	Visual definition	Total Frequency	Discourse type
disc	0	1	1	SD
rotate	4	13	17	ID
stand	3	9	12	GD
step back	3	9	12	GD
still	1	0	1	GD
turn	0	2	2	GD
then	1	0	1	GD
stare	5	14	19	GD
center	0	2	2	GD
palm	9	20	29	ID
notice	2	6	8	GD
appear	6	14	20	GD
direction	2	6	8	ID
swell up	10	18	28	ID
shrink	10	17	27	ID
spin	3	6	9	ID
pattern	6	11	17	ID
explain	1	0	1	GD
second	0	1	1	ID
twenty	0	1	1	GD
look	0	0	0	GD
now	0	0	0	GD
first	0	0	0	GD
time	0	0	0	GD
Total	66	150	216	

When students were compared in terms of frequency of words looked up in mobile application; S4, S9 and S19 had the highest scores (see Table 4.24). On the other hand, S12 did not look up any of the words and S18 looked up only one word entire of the

experiment. S11, S14, S20 and S24 also looked up the meaning of the words less according to other students (*f*=3).

Table 4.24 Frequency of words looked up by each student in the experiment of Depth Skinner

	Dictionary definition	**Visual Definition**	**Total**
S1	1	15	16
S2	7	4	11
S3	4	4	8
S4	9	9	18
S5	2	7	9
S6	0	8	8
S7	0	10	10
S8	2	11	13
S9	10	10	20
S10	0	5	5
S11	1	2	3
S12	0	0	0
S13	3	4	7
S14	3	0	3
S15	3	7	10
S16	0	6	6
S17	1	5	6
S18	0	1	1
S19	10	9	19
S20	0	3	3
S21	2	7	9
S22	0	9	9
S23	2	4	6
S24	3	0	3
S25	3	10	13
Total	66	150	216

When total time spent was compared among students; S18, S12 and S6 spent least time respectively (see Table 4.25). S9, S22 and S8 spent most time on mobile application respectively. When the time spent and frequency of words looked up were taken into account together, S9 had the highest scores on each of them. However, while S22 spent most time, he just looked up only nine words in the application. On the other hand, while

S18 and S12 looked up least words in mobile application, they also spent least time in mobile system. In the next part, the experiment was explored step by step and results were supported with retrospective reviews.

Table 4.25 Time spent on each step of the experiment of Depth Skinner

	Step 1 ***(sec)***	**Step 2** ***(sec)***	**Step 3** ***(sec)***	**Step 4** ***(sec)***	**Total time** ***(sec)***
S1	13	122	12	132	279
S2	18	117	8	71	214
S3	3	124	42	84	253
S4	12	98	15	71	196
S5	10	95	31	29	165
S6	10	71	7	50	138
S7	3	132	14	65	214
S8	19	194	15	104	332
S9	8	307	18	100	433
S10	6	60	24	181	271
S11	4	66	11	93	174
S12	11	47	18	44	120
S13	13	108	13	68	202
S14	4	63	23	118	208
S15	5	61	4	197	267
S16	16	144	11	115	286
S17	17	128	14	152	311
S18	4	31	3	24	62
S19	18	186	14	67	285
S20	3	37	48	120	208
S21	18	106	20	88	232
S22	10	190	21	164	385
S23	9	106	8	89	212
S24	5	102	31	148	286
S25	10	95	62	74	241
M	9.96	111.6	19.48	97.92	238.96

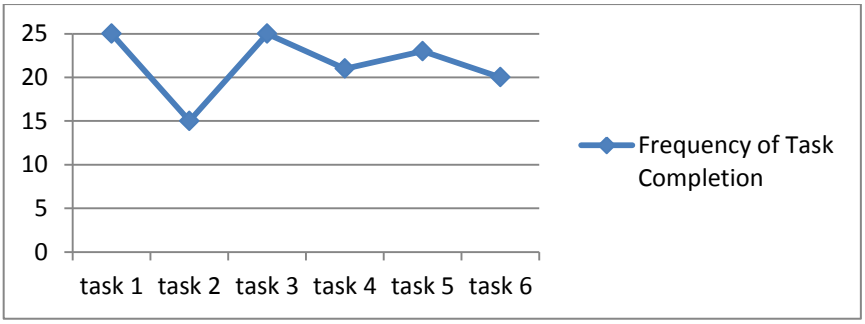

Figure 4.3 Frequency of task completion in the experiment of Depth Skinner

There were six tasks that needed to be completed in real environment (see Figure 4.3). While first and third tasks were completed by 25 students, second task was completed by only 15 students with the lowest frequency.

First Step of the Depth Skinner Experiment

First step of Depth Skinner was "Rotate the disc" which included instruction to perform in real environment. Students spent an average time 9.96 seconds on this step in mobile application, which was also the least time spent step according to other steps (See Table 4.25). While "rotate" was looked up 17 times, "disc" was looked up only one time in the mobile application; therefore students did not spend much time on this step. Among the students, S8 with 19 seconds and S2, S19 and S21 with 18 seconds spent most time on this step. S3, S7 and S20 spent least time with three seconds on this step (see table 4.25).

Retrospective Review Results

According to retrospective reviews, students exposed to the word of "rotate" in the previous experiment of "Wheel and Axle"; therefore they mostly recalled the meaning of that word. On the other hand, several of them (S8, S21) looked up the meaning of the word to be sure. These students were the students who spent most time on this step. However, this step was completed by all of the students. One of the reasons might be encountering the target vocabulary repeatedly which resulted in retention of that words.

I knew the meaning of "rotate" from the previous experiment. I checked it again to be sure. As soon as I saw the animation of Earth, I immediately got it". (S8)

Rotate'in anlamını önceki deneyden biliyordum. O yüzden sadece emin olmak için baktım. Dünya animasyonunu görünce hemen anladım. (S8)

I have done the first part. I looked up the meaning of "rotate". Actually I remembered the meaning of the word but I checked it again to be sure. (S21)

İlk kısmı yaptım. "Rotate"e baktım. Aslında daha önceden hatırlıyordum ama emin olmak için baktım. (S21)

Second Step of the Depth Skinner Experiment

Second step included a few instructions to accomplish in real environment and give general progress in the experiment. The step was: "Stand two steps back (Task 2). Then, stare at its center for twenty seconds (Task 3). Look at your palm (Task 4). Notice that your palm is still turning. Your palm appears to turn in the opposite direction. It also appears to swell up or shrink". In this step palm (*f*=29), swell up (*f*=28), and shrink (*f*=27) were the mostly looked up words in this experiment (see Table 4.23); therefore students spent most time (111.6 sec) on this step (See Table 4.25). Among the students, S9 spent 307 seconds with highest time spent score, S18 and S20 with 31 and 37 seconds respectively spent least time on this step. S9 was also the student who looked up the meanings of the words mostly in mobile application and S18 and S20 were the students who looked up least words entire of the experiment. In terms of task completion, second task "Stand two steps back" was completed by only 15 students (see Figure 4.3). The students who could not complete this task correctly were S1, S3, S7, S8, S9, S10, S13, S17, S19 and S21. Although the frequency of task completion of this step is less, only 12 students looked up the meaning of the words which were "stand" and "step back" (see Table 4.23). Moreover, S9 who mostly looked up the words and spent most time in the application could not complete this task correctly. On the other

hand, students who looked up the meaning of the words less completed this task correctly (S11, S14, S20, S24).

The next task of this step was “Then, stare at its center for twenty seconds (Task 3)”. The word of “center” was looked up just two times in his experiment. This task was completed by all of the students (see Figure 4.3).

The last task of this step was “Look at your palm. Notice that your palm is still turning. Your palm appears to turn in the opposite direction. It also appears to swell up or shrink”. “Palm”, swell up and shrink” were the words that were mostly looked up in mobile application with the frequencies of 29, 28 and 27 respectively (see Table 4.23).Those words were specific and intermediate discourse type, since students were unlikely encounter in their daily lives. This task was completed by 21 students (see Figure 4.3). S4, S12, S10 and S24 did not complete the task correctly. Interestingly, S12 and S24 were the students who looked up least words in the mobile system, and S4 was one of the students who most frequently looked up the words.

Retrospective Review Results

S8 did not complete this task correctly; however she understood the whole sentence. She did not perform the task, because she was already two steps back from the disc. In this respect, just focusing on outcomes might be misleading. Teachers should follow the progress of students throughout process for situated assessments.

> *As I was already standing two steps back, I did not step back again. (S8)*
>
> *Zaten iki adım uzakta olduğum için iki adım daha geri gitmedim. (S8)*

According to the results, even though several students understood the sentence, they could not do it just because of focusing on completing the experiment. Several students were in the state of flow while performing the tasks and they mostly did not place attention on the tasks or target vocabulary.

Aa… it said that stand two steps back! I thought there are more two steps to complete. Seriously I know the meaning of it now. I just focused on completing the experiment. (S17)

Aa… iki adım geri adım at demiş. İki adım daha var gibi bir şey anladım. Cidden şu an anlamını biliyorum. Sadece deneyi bitirmeye odaklanmışım. (S17)

Although several students understood the meaning of the words, they could not transfer it to the new context. Participants of this study are novice learners; therefore their transfer ability might be not enough. Moreover, they just focus on completing the tasks quickly, however they need to pay attention and focus on transferring.

I looked up the meaning of "stand". I didn't understand the meaning of "two steps back". Although I understood the meaning of the word, I couldn't associate with the experiment. Does it want us to look from two steps back? I have understood it correctly now, but I didn't apply. (S8)

"Stand"e baktım. "Two steps back"i anlamadım. Aslında kelimeyi anladım ama deneyle bağdaştıramadım. İki adım geriden bakmamızı mı istiyor? Şimdi doğru anladım ama uygulamadım. (S8)

Second task of this step was completed by all of the students. Although there were several unknown words, contextual clues in the sentece facilitated students to inference the meaning of the words correctly.

It said that wait for 20 seconds for something there. We were going to look at the center of it for 20 seconds. I think "center" means "orta" in Turkish equivalence. "Stare" means "odaklanmak" and "bakmak". I guessed the meaning from the sentence. (S16)

Orada 20 sn bir şey için bekle diyordu. 20 sn ortasına bakacaktık. Şimdi sanırım "center", "orta" demek. "Stare" "odaklamak" ve" bakmak" demek. Cümleden anlamını tahmin ettim. (S16)

Only one of the students (S18) instead of staring for 20 seconds, he stared just a few seconds because he thought that this experiment does not work on him and no need to wait for 20 seconds. This student was also one of the students who spent least time on this step and looked up least words in the mobile application.

> *I didn't look at it for 20 seconds but I looked for three seconds. I knew this experiment before and it doesn't work on me. It would not work on me even I have looked at it for 20 seconds. (S18)*
>
> *20 sn değil üç sn kadar baktım. Ben bu deneyi biliyorum işe yaramadığını da biliyorum. 20 sn baksam da işe yaramayacaktı. (S18)*

S4, S12, S10 and S24 could not complete this task correctly. Interestingly, S12 and S24 were the students who looked up least words in mobile system, and S4 was one of the students who most frequently looked up the words. Retrospective reviews gave clues about this situation. Although S4 looked up the meaning of the words, he did not understand the meanings correctly and could not complete the task correctly. On the other hand, S12 did not look up the meaning of the words and tried to guess the tasks from authentic environment. Experimental setup was familiar for here; therefore she did not follow the instructions properly. However, high familiarity has a disadvantage that students do not attempt to look up the meaning of the words and they cannot learn consequently.

> *I didn't look up the definition of "palm". I directly looked at the screen and thought that same thing will happen. With the direction of lines you can guess what will happen. While it is rotating, everything else rotates in the opposite direction. As a result the same thing can happen in a flat surface, so I did not need to do it. I also did not look up the meanings of "swell up" and "shrink", I thought I will see blurry. (S12)*
>
> *"Palm"ın anlamına bakmadım. Ben direkt ekrana baktım aynı şeyin olacağını düşündüm. Çizgilerin yönlerinden insan ne olacağını az çok anlıyor hani döndüğü*

zaman diğerleri farklı yöne dönüyor. Sonuçta düz bir zemine odaklandığınızda yine aynı şey yaşayabilirsiniz. O yüzden yapmaya ihtiyaç duymadım. "Swell up" ve "shrink" kelimelerine de bakmadım. Bulanık görecektim herhâlde. (S12)

While several students saw the patterns of shrinking or swelling up when they looked at their palms, several of them could not see any pattern. This situated learning environment does not aim to promote science skills; therefore it is not essential whether or not they see any patterns.

I didn't know the meanings of "swell up" and "shrink". I guessed the meaning as getting bigger or smaller. My palm would get bigger and smaller I guess. I suppose I saw, yes. (S2)

"Swell up", "shrink" hiç bilmiyordum. Büyümek ve küçülmek diye düşündüm. Avuç içimiz sanırım büyüyüp küçülüyor. Sanırım gördüm evet. (S2)

I looked at my palm. I did not know the meaning of "palm", but I looked up the meaning of it. Then, my palm seemed to be rotating in the opposite direction, but I couldn't see any shrinking or swelling up. (S6)

Avcuma baktım. Palm'ı bilmiyordum anlamına baktım. Sonra avcunun içi diğer tarafa dönüyor gibi göründü. Elim diğer tarafa dönüyor gibi gözüktü, ama öyle büzülme şişme göremedim. (S6)

Moreover, when several students saw the words of "opposite direction", they thought that they needed to turn the disc in the opposite direction. However, they should see that their palm was turning in the opposite direction the disc was rotating. Turning the disc in the opposite direction was the next step of this experiment; therefore they got surprised when they saw the same task in the following step.

I think it said that rotate the disc in the opposite direction and I passed to the other step. It states the same thing in the third step, therefore I was surprised. (S13)

Ters yöne döndür dedi sanırım ve diğer adıma geçtim. Üçüncü adımda da aynı şeyi diyordu, o yüzden şaşırdım. (S13)

Third Step of the Depth Skinner Experiment

The next step was "now rotate the disc in the opposite direction". This step included words that were included in the previous steps, therefore student needn't to look up any of the words and they just spent average 19.48 seconds. This task was completed by 23 students (see Figure 4.3). S3 and S19 did not complete the task correctly. S19 was one of the students who most frequently looked up the words in mobile application; however she still could not complete the task.

Retrospective Review Results

Although S3 understood the meaning of the sentence, he found it unnecessary to complete. He was in the opinion that he will not see any pattern in his hand in the following steps, too. He was demotivated to proceed to the following steps.

I did not complete the third step, because nothing happened in the previous step; therefore I thought nothing will happen in this step, too. I did not find it necessary to rotate. I could not see anything when I looked at my palm. (S3)

Üçüncü basamağı yapmadım. Çünkü birincide olmayınca ikincide de olmaz diye düşündüm. Döndürme gereği duymadım. Elime baktığımda bir şey göremedim. (S3)

As stated before, several students were surprised when they encountered the same task twice in an experiment, because they already rotated the disc in the opposite direction in the previous step.

When I saw the "opposite direction", I understood it as to rotate it in the opposite direction. However, it was the repetition of the second step; therefore I was surprised. (S16)

"Opposite direction"ı görünce ters yöne çevirmek gibi anladım. Ancak ikinci basamağın tekrarıydı, bu yüzden şaşırdım. (S16)

Fourth Step of the Depth Skinner Experiment

The last step was "Look at your palm again. Is the spinning pattern different from the first time?" which included an open ended question, thus students spent their time for writing the short answer. It took average 97.92 sec (see Table 4.25) which was the second mostly time spent step. This task was completed by 20 students although it was the repetition of the previous steps.

Retrospective Review Results

S3, S4, S10, S12, S24 could not complete the task. While S4 was one of the students who mostly looked up the words in the system; S12 and S24 were the students who did not prefer looking up meanings of the words in mobile system. S4 missed one of the previous steps, therefore she could not complete this task. On the other hand, S24 did not look up the meaning of "pattern"; therefore she could not accomplish the task.

I looked at the disc whether or not there is a difference. I couldn't answer it correctly because I just looked at disc. (S24)

Diskte bir farklılık var mı diye baktım ancak diske baktığım için doğru cevaplayamadım. (S24)

I rotated it to the left and then right. I thought what the difference was asked, so I didn't look up the meaning of "pattern". (S4)

Bir sağa bir sola çevirdim, ne fark var şeklinde soruyor sandım. "Pattern"ın anlamına bakmadım. (S4)

Although most of the students stated that they did not know the meaning of "spinning pattern", the word of "spin" was looked up by only nine students and "pattern" was looked up by 17 students. Students mostly tried to understand the sentence from the

words of “different time”. In this respect, they mostly replied the question as “what was different from the first time?” The answer should be: “Yes it is different. My palm appears to turn in the opposite direction from the way the disk is rotating and my palm appears to swell up or shrink”. While several students could see the pattern of swelling up, several of them saw the pattern of shrinking. 21 of 25 students answered this question correctly. However, most of the students did not understand the meaning of “spinning pattern”, therefore they replied as “what was different from the first time?” However, those students replied correctly.

> *I understood the sentence form “different from the first time”. I didn’t understand the meaning of “spinning pattern”. I thought that what the difference was from the first time. (S1)*
>
> *Cümleyi “different from the first time”dan anladım. “Spinning pattern”ı anlamadım. İlk zamankine göre ne farklılık oldu şeklinde anladım. (S1)*

S1, S3, S18, S24 could not answer the open ended question correctly. Some of the students could not see anything on their palms, because they also did not complete the previous steps and several of them did not understand the meaning of the sentence. S18 did not reply correctly and although he understood the meaning of the sentences he did not follow the steps correctly. S18 thought that this experiment does not work on him. S24 could not answer because he did not look up the meaning of the palm in the previous steps and could not follow the instructions correctly. Interestingly, these two students were the students who did not prefer looking up the meaning of the words.

> *Then, I said that it is not working on me. “It does not work on me”. (S18)*
>
> *Ben de üzerimde işe yaramıyor dedim. "It does not work on me" . (S18)*
>
> *When I saw “palm”, I guessed as looking at the surface of the disc. I did not look at my hands. I looked at the disc whether or not there was a difference. I couldn’t answer it correctly because I just looked at disc. (S24)*

Ben "palm" kelimesini gördüğümde diskin yüzeyine bakılacağını düşündüm. Ellerime bakmadım. Bir fark var mı yok mu diye diske baktım. Doğru cevaplayamadım, çünkü sadece diske baktım.(S24)

Several students who followed the steps properly and understood the sentences correctly could not see any difference on their palms. However, their replies were labeled as correct, because they understood the process and completed the tasks correctly.

It was asking whether or not there was a difference in terms of figures, I did not see any difference. (S7)

Elinizde sekil olarak bir değişiklik gördünüz mü diye soruyordu, ben bir değişiklik göremedim.(S7)

Difference between Pretest, Posttest, and Retention Test Scores

One of the main purposes of these experiments was to promote improvement in vocabulary achievement scores throughout the process. In this respect, repeated measures design was conducted for each experiment in order to explore differences between pretest, posttest, and retention test scores.

For the experiment of Depth Skinner, in order to learn the dependent variable is normally distributed in the population for each level of the within subjects factor, tests of normality was conducted. Results of Kolmogorov-Smirnov and Shapiro-Wilk should be non-significant, thus in this data normality assumption could not met. In this respect, non-parametric test was conducted. Friedman test is the non-parametric alternative to one-way repeated measures analysis of variance. The results of Friedman Test indicated that there was a significantly difference in vocabulary achievement scores across three time points (pretest, posttest, and retention test), $\chi 2 = (2, n=25) = 32.67$, $p < .05$ (see Table 4.27). Inspection of median values showed an increase in vocabulary test scores from pretest (*MD*=5.00) to posttest (*MD*=10.00).

Table 4.26 Means and standard deviations for dependent variables

	N	*M*	*SD*	*Min*	*Max*	*MD*
pretest	25	5.56	2.63	1.00	12.00	5.00
posttest	25	10.00	3.59	3.00	18.00	10.00
Retention test	25	10.12	4.06	2.00	18.00	10.00

Table 4.27 Friedman Test for the experiment of Depth Skinner

N	25
χ^2	32.67
df	2
p	.00

Wilcoxon signed ranked test was conducted as post-hoc tests to compare the three time points individually (see Table 4.28). Time 1 was compared with Time 2 and Time 2 was compared with Time 3 and to reduce Type 1 error, new alpha level was determined as .05/2= .025. Wilcoxon signed ranked test indicated significant difference in vocabulary achievement scores between pretest and posttest, z=-4.25, p< .025 with an effect size of r=.60, indicating a large effect size of using Cohen (1988) criteria of .1=small effect, .3=medium effect, .5=large effect. However there was no significant difference in vocabulary achievement scores between posttest and retention test, z=-.-29, p>.025.

Table 4.28 Wilcoxon signed-rank test for the experiment of Depth Skinner

	posttest - pretest	posttest-retention test
Z	-4.25	-.29
p	.00*	.76

*p<.025

Interestingly, different from the first two experiments, there was no significant difference between posttest and retention test. While students' vocabulary achievement

scores improved after the experiments, retention test scores remained stable after six weeks.

4.2.4 Results of the Pythagorean Theorem Experiment

Pythagorean Theorem consists of three steps and only first two steps give instructions to be completed in real environment. Last step which consists of high academic utility words gives information about the experiment. The steps of the experiment are:

1) Turn the object and fill the biggest square, C, with water.
2) When C is filled, turn the object so that the square A and B are filled with water.
3) Notice that the triangle between the squares is a right triangle.

Second step was the step that students spent least time, 24.6 sec (see table 4.29). This step was the repetition of the first step; therefore students did not need to look up meaning of any word or spend time to inference the meaning. Students spent most time on the third step, because there were a few unknown words including "notice", and "right triangle". Students spent average 47.36 sec. While S1, S9 and S16 spent most time, S6 and S18 spent least time.

Table 4.29 Time spent on each step of the experiment of Pythagorean Theorem

	Step 1 ***(sec)***	**Step 2** ***(sec)***	**Step 3** ***(sec)***	**Total Time** ***(sec)***
S1	43	27	105	175
S2	39	19	54	112
S3	14	21	78	113
S4	45	16	52	113
S5	46	29	41	116
S6	12	13	22	47
S7	10	30	24	64
S8	24	27	52	103
S9	25	49	94	168
S10	20	21	34	75
S11	33	12	20	65
S12	23	22	18	63
S13	25	14	37	76
S14	12	16	22	50

Table 4.29 (Continued)

	Step 1 ***(sec)***	**Step 2** ***(sec)***	**Step 3** ***(sec)***	**Total Time** ***(sec)***
S15	13	14	47	74
S16	35	27	100	162
S17	26	28	39	93
S18	12	11	9	32
S19	30	50	63	143
S20	6	22	64	92
S21	55	31	68	154
S22	42	37	28	107
S23	17	30	23	70
S24	16	17	53	86
S25	19	32	37	88
M	25.68	24.6	47.36	97.64

In this experiment, students again mostly preferred to look up visual definition of the words in mobile application (see Table 4.30). Students who looked up most words were S1 and S4 with frequency of eight words. S1 was also the student who spent most time in mobile application. S12 and S18 did not look up any words in mobile application. S18 was also one of the students who spent least time on this experiment.

Table 4.30 Frequency of words looked up by each student in the experiment of Pythagorean Theorem

Student	**Dictionary definition**	**Visual definition**	**Total**
S1	1	7	8
S2	3	3	6
S3	2	2	4
S4	4	4	8
S5	0	3	3
S6	0	2	2
S7	0	4	4
S8	0	2	2
S9	2	3	5
S10	0	2	2
S11	1	2	3
S12	0	0	0
S13	1	2	3

Table 4.30 (Continued)

Student	Dictionary definition	Visual definition	Total
S14	1	1	2
S15	2	2	4
S16	1	3	4
S17	1	0	1
S18	0	0	0
S19	2	3	5
S20	0	1	1
S21	2	4	6
S22	0	3	3
S23	0	1	1
S24	1	1	2
S25	0	4	4
Total	24	59	83

As it can be seen from Table 4.31 that "triangle, notice, square" were the words that mostly preferred to be looked up in mobile system. While "notice" was general discourse type, "triangle" and "square" were specific discourse type. On the other hand "water" and "so that" words which are widely encountered daily lives were not looked up in mobile application.

Table 4.31 Frequency of words looked up in the experiment of Pythagorean Theorem

Word	Dictionary Definition	Visual definition	Total Frequency	Discourse type
object	0	1	1	ID
square	4	11	15	SD
fill sth. with	3	10	13	GD
notice	10	13	23	GD
triangle	4	14	18	SD
right triangle	3	7	10	SD
between	0	1	1	GD
biggest	0	1	1	GD
turn	0	1	1	GD
water	0	0	0	GD
so that	0	0	0	GD
Total	24	59	83	

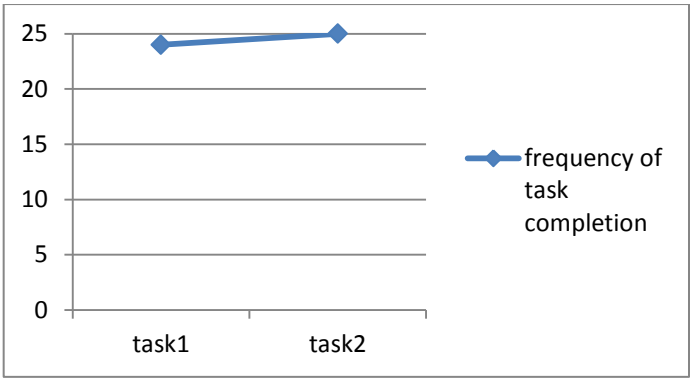

Figure 4.4 Frequency of task completion in the Experiment of Pythagorean Theorem

There were two tasks that needed to be completed in this experiment (see Figure 4.4). While first task was completed by 24 students, second task was completed by all of the students.

First Step of the Pythagorean Theorem Experiment

Frist step and also the first task was "Turn the object and fill the biggest square, C, with water". This task was completed by 24 students (see Figure 4.4). Only one student (S22) could not complete this task. Average time spent on this step was 25.68 sec. (see Table 4.29). Students who spent most time on this step were S21, S5, S4 and S1. On the other hand, S20 and S7 spent least time on this step. S1 looked up most words in mobile application; therefore it was an expected result that she spent most time on this step. Students mostly did not know the meanings of "square" and "fill sth. with" and mostly looked up the meaning of those words. These words are specific and intermediate discourse type.

Retrospective Review Results

S22 who could not complete this task had problem with sentence structure. The main purpose of the present study is to promote vocabulary learning, instead of grammar issues. However, grammar issues might result in completing authentic tasks incorrectly. Although S22 understood the meaning of the words, she understood the sentence as

"turn from C" instead of "turn C and fill with water"; therefore she could complete the task.

> *At first, it said that turn it from C. The biggest one is C. I should fill it with water. (S22)*
>
> *İlkinde C'den döndür diyor. En büyüğü C. Su ile doldurmalıyım. (S22)*

Students who spent least time on this step already knew the meaning of the words in this step. In this respect, they did not learn any new word; however they had opportunity to use word functions in real environment.

> *I knew the meanings of the words before. (S20).*
>
> *Kelimelerin anlamlarını önceden biliyordum. (S20)*

Although most of the students completed the task correctly, several of them understood the meaning of square as box, canister or area. They just focused on finishing the experiment, instead of focusing on the definitions in mobile system. One of the disadvantages of contextual learning environments is inferencing meaning of the words incorrectly, however at least some degree of conscious attention on target vocabulary is necessary.

> *I looked up the definition of "square". It was a kind of box. I turned it and then filled it with water. (S1)*
>
> *"Square"e baktım. Kutu gibi bir şey. Çevirdim ve suyla doldurdum. (S1)*
>
> *I thought the meaning of "square" is some kind of water tank. I thought it as the biggest water tank. (S16)*
>
> *"Square"in anlamı su deposu gibi bir şey. En büyük su deposu gibi düşündüm. (S16)*

Several students associated the experiment with their pre-knowledge. This experiment, Pythagorean Theorem was about the formula of $a^2+b^2=c^2$, since several students remembered that formula and completed the authentic tasks meaningfully.

I thought it's about $a^2+b^2=c^2$ formula that we have seen in university entrance exam. "Square" was something like "kare". (S5)

Bu deney, $a^2+b^2=c^2$ formülüyle ilgili. Üniversite sınavında gördüğümüz formül. "Square" kare gibi bir şeymiş. (S5)

Second Step of the Pythagorean Theorem Experiment

Second step was "When C is filled, turn the object so that the square A and B are filled with water". This task was completed by all of the students (See Figure 4.4). Students spent average 24.6 seconds on this task, since it was the least time spent step in this experiment. S18, S11 and S6 spent least time on this step (see table 4.29). On the other hand, S19 and S9 spent most time on this step.

Retrospective Review Results

This task was the repetition of the first task; therefore student did not need to look up the meaning of the words in the system and spent least time consequently. Multiple exposures to the target vocabulary facilitated retention of target vocabulary.

I have filled A and B, after C. I did not look any definition in this step. (S21).

C'den sonra hemen A ve B'yi doldurdum. Bu cümlede kelimeye bakmadım (S21)

It was similar to previous step, I filled A and B. (S25)

Bu önceki adıma benziyordu. A ve B'yi doldurdum. (S25)

Students who spent most time on this step preferred to open all of the steps of the experiment before performing this task. This step was the repetition of the first step; therefore student found meaningless to fill again the squares of A and B. In this respect, they proceeded with following steps and turned back.

Although I did the first step, I did not do the second step immediately. After I opened the third one, I filled A and B. I could not be sure because it was weird to do the same thing (S9).

İlki yapmama rağmen ikinci de hemen yapmadım. Üçüncüyü açtıktan sonra A ve B'yi doldurdum. Emin olamadım, çünkü aynı şeyi yapmak saçma geldi (S9).

Third Step of the Pythagorean Theorem Experiment

The last step was "Notice that the triangle between the squares is a right triangle". Although there was no task to complete in real environment or open-ended question to reply in this step, students spent most time on this step (see Table 4.31). "Notice, triangle, right triangle" were the words that mostly looked up. This step included several specific discourse type words with high academic utility.

Retrospective Review Results

Although several students looked up the meaning of "triangle" and understood the meaning correctly, several of them did not look up the meaning of "right triangle" due to trusting their pre-knowledge. In some cases, preknowledge related to the word might result in misleading. In this step, the word of "right" has different meaning when it combined with "triangle". In this respect, students inferenced the meaning of "right triangle" as triangle at their right sides of their body or true triangle.

I didn't understand this sentence even though I knew the meanings of all words. I thought "right triangle" as "true", the same as the previous one; therefore I did not look up the meaning of it. (S11)

Bütün kelimelerin anlamını biliyorum olmama rağmen cümleyi anlamadım. "Right triangle"ı doğru, bir öncekiyle aynı üçgen gibi düşündüm. Bu yüzden bakmadım onun anlamına. (S11)

I looked up the meaning of "triangle" which means "corner" or "triangle". I thought as fill the triangle which is at the right side. (S21)

Şu "triangle"a baktım. Köşe demekmiş ya da üçgen demekmiş. Sağ üçgeni doldurun gibi anladım. (S21)

I did not look up the meaning of "right triangle". I thought it as the triangle which is at the right side. We knew the meaning of "right" before and we looked up the meaning of "triangle" before, and then we combined them in our minds. (S19).

"Right triangle"ın anlamına bakmadım. Sağdaki üçgen gibi düşündüm. "Right"ın anlamını biliyorduk, "triangle"ı anlamına bakmıştık yukarda ve kafamızda birleştik. (S19)

Students who spent least time on this step preferred contextual guessing the meaning of the words. Several students had skills of contextual vocabulary learning and they did not tend to get support from mobile vocabulary system. They used the contextual clues from the authentic environment. S18 saw a right angle in the experimental setup and guessed the meaning of "right triangle" by using those contextual clues.

I did not know the meaning of "right triangle", but I guessed. I can guess from the environment. It is "right triangle" or "equatorial triangle". I looked at the experimental setup and saw the right angle and I thought it was "dik üçgen". (S18)

"Right triangle"ı bilmiyordum da tahmin ettim. Ben tahmin edebiliyorum ortamdan. "Right triangle" ya eşkenardır ya da dik üçgendir. Deney düzeneğine de baktım orada bir tane dik açı gördüm. Dik üçgen dedim demek ki. (S18)

Students who spent most time on this step were S1, S16 and S9 (see Table 4.29). Retrospective reviews gave clues about underlying reasons that caused spending time. S1 focused on one unknown word and could not understand the whole sentence. Interestingly, she did not prefer looking up the meaning of other words. S16 who had high pre-knowledge about subject domain, still could not understand the sentence.

Excessive number of unknown words and abstract words that are not easily inferenced might make studens feel frustrated although the subject domain is familiar.

> *I did not understand the meaning of "notice"; therefore I spent time. I did not look up the meaning of "triangle". I did not understand the meaning of this sentence. (S9)*
>
> *"Notice"'i anlamadım, bu yüzden zaman harcadım. "Triangle" anlamına bakmadım. Bu cümleyi anlamadım. (S9)*
>
> *In this experiment, the total of these two areas fills this area. It is about Mathematic. I understood the experiment when I saw the setup, but I could not integrate it. (S16)*
>
> *Bu deneyde ikisinin toplamı alanı dolduruyor burada. Matematikle ilgili. Ben zaten düzeneği görünce deneyi anlamıştım ama birleştiremedim. (S16)*

Difference between Pretest, Posttest, and Retention Test Scores

One of the main purposes of these experiments was to promote improvement in vocabulary achievement scores throughout the process. In this respect, repeated measures design was conducted for each experiment in order to explore differences between pretest, posttest, and retention test scores.

For the experiment of Pythagorean Theorem, in order to learn the dependent variable is normally distributed in the population for each level of the within subjects factor, tests of normality was conducted. Results of Kolmogorov-Smirnov and Shapiro-Wilk should be non-significant, thus in this data normality assumption could not met. In this respect, Friedman test as non-parametric test was administered (see Table 4.33). The results of Friedman Test indicated that there was a significantly difference in vocabulary achievement scores across three time points (pretest, posttest, and retention test), χ^2= (2, *n*=25) = 30.20, *p*< .05. Inspection of median values showed an increase in vocabulary

test scores from pretest (*MD*=6.00), to posttest (*MD*=11.00), but no improvement from posttest (*MD*=11.00) to retention test (*MD*=11.00).

Table 4.32 Means and standard deviations of dependent variables

	N	*M*	*SD*	*Min*	*Max*	*MD*
pretest	25	6,40	2.92	2.00	13.00	6.00
posttest	25	10.48	2.08	6.00	13.00	11.00
retention	25	10.92	1.52	8.00	13.00	11.00

Table 4.33 Friedman Test for the Experiment of Pythagorean Theorem

N	25
χ^2	30.20
df	2
p	.00

Wilcoxon signed ranked test was administered as post-hoc tests to compare three time points individually (see Table 4.34). Time 1 was compared with Time 2 and Time 2 was compared with Time 3 and to reduce Type 1 error, new alpha level was determined as .05/2= .025. Wilcoxon signed ranked test indicated significant difference in vocabulary achievement scores between pretest posttest, z=-3.99, $p < .025$, with a large effect size of r=.56. There was no significant difference between posttest and retention test, z =-.82, p>.025.

Table 4.34 Wilcoxon signed ranked test for the experiment of Pythagorean Theorem

	posttest - pretest	retention - posttest
Z	-3.99	-.82
p	.00*	.41

* p<.025

According to quantitative results, it is an expected result that there is an increase from pretest to posttest scores and it is also expected that retention scores do not decrease as time goes by. Even though six weeks passed after the experiments, the retention scores

are still similar to posttest scores. The results of this experiment were consistent with the previous experiment, Depth Skinner.

4.2.5 Results of the Lever Experiment

Last experiment was Lever which included four steps that needed to be followed and these all steps consisted of tasks that needed to be done in real environment:

Step 1. Put two kilograms of weight to one unit left from the lever's center.
Step 2: Put one kilogram of weight to two units right from the lever's center.
Step 3: Try to keep the lever balanced.
Step 4: Now use one and three kilograms of weight to keep the lever balanced.

As it can be seen from Table 4.35, visual definition (*f*=57) was mostly preferred in the experiment of Lever. Lever (*f*=24), keep sth. balance (*f*=18) and unit (*f*=15) were the words that mostly preferred to be looked up (see Table 4.35). While "unit" and "lever" were specific discourse type, "keep sth. balance" was intermediate discourse type. On the other hand, "two, try, now, use and kilogram" were not looked up in mobile application. Among these words, only "kilogram" was specific discourse type, the others were general discourse type which means they are widely used in daily activities.

Table 4.35 Frequency of words looked up in the experiment of Lever

Word	Dictionary Definition	Visual definition	Total Frequency	Discourse type
one	0	1	1	GD
left	2	4	6	GD
right	0	1	1	GD
put	1	2	2	GD
unit	3	12	15	SD
lever	7	17	24	SD
center	2	5	7	SD
keep sth balance	5	13	18	ID
five hundred	0	1	1	GD
from	1	0	1	GD
weight	0	1	1	SD
hand	0	0	0	GD

Table 4.35 (Continued)

Word	Dictionary Definition	Visual definition	Total Frequency	Discourse type
Two	0	0	0	GD
try	0	0	0	GD
now	0	0	0	GD
use	0	0	0	GD
kilogram	0	0	0	SD
Total	21	57	78	

In the experiment of Lever, the least time spent step was the second step which was "Put one kilogram of weight to two unit right from the lever's center." This step was the repetition of the previous step, therefore students spent just average 22.36 seconds (see Table 4.36). While S9 (335 sec) and S21 (236 sec) spent most time, S16 (92 sec) and S17 (83 sec) spent least time in this experiment. Students spent avarage147.68 seconds in this experiment. It is much more less than Free Fall and Depth Skinner.

Table 4.36 Time spent on each step of the experiment of Lever

	Step 1 *(sec)*	Step 2 *(sec)*	Step 3 *(sec)*	Step 4 *(sec)*	Total time *(sec)*
S1	44	19	14	60	137
S2	56	14	22	60	152
S3	42	46	35	22	145
S4	44	35	22	18	119
S5	79	28	79	8	194
S6	32	14	38	44	128
S7	35	21	76	28	160
S8	66	30	41	73	210
S9	72	21	81	161	335
S10	13	24	14	49	100
S11	32	23	94	27	176
S12	18	18	56	30	122
S13	48	13	27	32	120
S14	20	15	30	29	94
S15	16	14	8	67	105
S16	44	14	11	23	92
S17	12	36	9	26	83
S18	17	26	37	20	100
S19	46	23	56	26	151

Table 4.36 (Continued)

	Step 1 ***(sec)***	**Step 2** ***(sec)***	**Step 3** ***(sec)***	**Step 4** ***(sec)***	**Total time** ***(sec)***
S20	19	26	19	34	98
S21	57	20	113	46	236
S22	77	25	73	52	227
S23	26	27	11	65	129
S24	17	10	53	32	112
S25	22	17	26	102	167
M	38.16	22.36	41.8	45.36	147.68

In this experiment, students again mostly preferred to look up visual definition of the words (see table 4.37). S4 with the frequency of eight and S1, S2, S7 and S9 with frequency of six were the students who looked up most words. On the other hand, S12 and S15 did not look up any words in mobile application and S17, S20 and S24 looked up just one word in mobile application.

Table 4.37 Frequency of words looked up by each student in the experiment of Lever

Student	**Dictionary definition**	**Visual definition**	**Total**
S1	0	6	6
S2	3	3	6
S3	1	1	2
S4	4	4	8
S5	2	3	5
S6	0	3	3
S7	1	5	6
S8	1	3	4
S9	2	4	6
S10	0	3	3
S11	0	2	2
S12	0	0	0
S13	1	3	4
S14	1	0	1
S15	0	0	0
S16	0	1	1
S17	0	0	0
S18	1	2	3
S19	2	2	4
S20	0	0	0

Table 4.37 (Continued)

Student	Dictionary definition	Visual definition	Total
S21	0	3	3
S22	0	5	5
S23	0	2	2
S24	0	0	0
S25	2	2	4
Total	21	57	78

As it can be seen at Figure 4.5, task 3 and task 4 were completed by 24 students .Task 2 was the task that rarely completed with the frequency of 17. Moreover, task 1 was completed by 19 students. Although students completed the task 1 and task 2 rarely, they mostly completed task 3 and task 4.

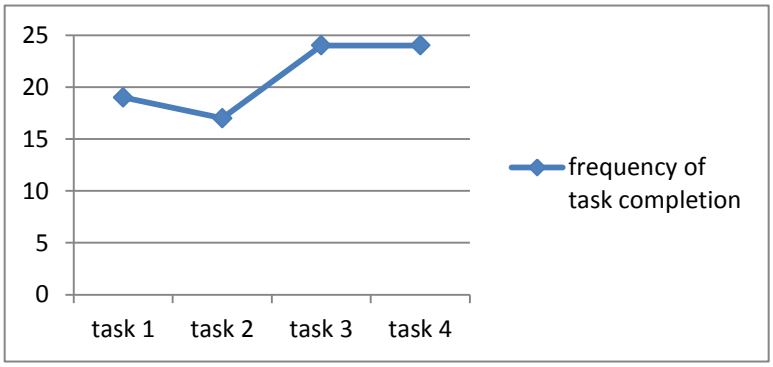

Figure 4.5 Frequency of task completion in the experiment of Lever

First Step and Second Step of the Experiment of Lever

Step 1 which was also the task 1 was "Put two kilograms of weight to one unit left from the lever's center". Six students who were S1, S6, S8, S13, S22, and S24 could not complete this task. Step 2 which was also the second task was "Put one kilogram of weight to two units right from the lever's center". The least time spent task was second task, because this task was the repetition of the previous task (see Table 4.37). S1, S5,

S6, S8, S11, S13, S22, S24 could not complete this task. Students who could not complete the first task also could not complete this task due to their similarity.

Retrospective Review Results

Students who could not complete this task became confused with other meanings of the words. "unit" has different meanings, for instance measurement unit or station. In this respect, they did not get support from mobile vocabulary learning system. For instance, S11 guessed the meaning of unit as measurement unit of weight. On the other hand, S24 guessed the meaning as unit of work, "dentist unit". Those misunderstandings resulted in learning the target vocabulary incorrectly and moreover not accomplishing the authentic tasks correctly. In this respect, students needed to be promoted to use mobile system support to minimize those limitations.

> *In the second step, I used all of the weights. In the second step, I thought that 500 gr as 1 kg. I understood the meaning of "two units" as "use two units". I guessed the meaning of "unit" as "measurement unit", therefore I used all of them. (S11).*
>
> *İkinci basamakta tüm ağırlıkları kullandım. İkinci basamakta ben şu 500'ü de 1 kg zannettim. "Two units"i ben iki birim kullan şeklinde anladım. Burada "unit" derken ağırlık birimi olarak düşündüm. O yüzden hepsini birden kullandım. (S11)*
>
> *In the second sentence, it stated that put two kgs of weight on the center of this mechanism, the center of this "unit". As my mother is a dentist, I thought unit as "dentist unit". Not like a unit in a book, but unit that something done, so I did not look up the meaning of that word. (S24)*
>
> *İlk cümlede iki kg'ı şunun ortasına koyun anladım. Bu "unit"in ortasına. Annem dişçi olduğu için ben "ünite" gibi düşündüm. Bir şey yapma ünitesi. Kitaptaki "ünite" gibi değil de. Bir şey yapma "ünitesi" gibi. Üzerinde bir şey yapılan. O yüzden anlamına bakmadım. (S24)*

It stated that put two kg of weight and leave the first unit. I thought the meaning of left word as "leave". (S1).

İki kg ağırlığı koy dedi ve birinci üniteyi bırak demiş. "Left" kelimesini bırakmak olarak düşündüm. (S1)

Students mostly understood the meaning of "lever", but several of them could not remember Turkish equivalence of the word. In other words, students experienced meaningful learning. Although they have seen this specific discourse type word with high academic utility before in their science classes at high school, they might not remember Turkish equivalence of it.

I looked up the definition of "lever". It is that mechanism. However, I don't know the exact Turkish equivalence of it. (S2)

"Lever"a baktım. Bu demekmiş. Tam Türkçe adını bilmiyorum ama. (S2)

"Lever" was that mechanism. Turkish equivalence of it is "kaldıraç" I guess, but I am not sure. (S18)

"Lever" şu düzenekmiş. Türkçesi de "kaldıraç" sanırım ama emin değilim. (S18)

Several students did not put the weights on right locations first, however when they looked up the third step and understood that they needed to keep the lever balance, they read carefully and put the weights on right locations. In his respect, their interest to the science and their pre-knowledge about the subject domain might be crucial to accomplish the authentic tasks. Moreover, pre-knowledge promotes them to correct their mistakes throughout the process.

This was not a complex experiment. I have interest on such devices since I am a civil engineer. I thought there will be only one on the left. I got it when it asked to balance the device in the third step. (S3)

Bu zor bir deney değildi. İnşaat mühendisi olduğum için bu tür aletlere ilgim var. Şu solda sadece bir tane olacak diye düşündüm. Üçüncü basamakta dengeleyin deyince oradan çıkardım. (S3)

When I saw "lever's center" I put the weight on the center of the mechanism. When I understood that it will not be balanced I corrected it. (S15)

"Lever's center"'ı görünce, ağırlığı mekanizmanın merkezine koydum. Ancak dengenin sağlanmayacağını anlayınca düzelttim. (S15)

Third Step of the Experiment of Lever

In the third step, they needed to "try to keep the lever balanced". This step was completed by 24 students. S25 was the only student who could not accomplish this task. Students spent average 41.8 seconds which was one of the highest time spent in this experiment.

Retrospective Review Results

S25 was the only student who could not complete this task. According to retrospective review she understood all the meaning of the words; however she did not read the instruction of the task carefully. She just focused on completing the task. She did not place attention on the word of "try", therefore she did not try to keep the lever balanced.

"Keep the lever balance", I didn't do this step. I looked up the visual and understood that it was about balancing something. If it asked for trying to keep it balanced, I would make effort to keep it balance. (S25)

"Keep lever balanced". Bu adımı yapmadım. Görseline baktım ama. Dengede tutmakla ilgili bir şey olarak anladım. Dengede tutmaya çalışın deseydi çabalardım. (S25)

On the other hand, while several students knew the meaning of balance before, several of them guessed the meaning from experimental setup or used mobile application. As stated before, several of them corrected their mistakes in the previous steps by going

back when they saw this step. When a step gives instruction to complete in real environment, students can see their consequences of their actions and correct their mistakes. Situated learning environment provides them feedback authentically.

> *I didn't know the meaning of "balance", but I learned that it means "denge" in Turkish. (S2)*
>
> *"Balance"ı bilmiyordum ama Türkçede denge olduğunu öğrendim. (S2)*
>
> *I corrected first two steps as I saw this step. (S15)*
>
> *İlk iki basamağı bu basamağı görünce düzelttim. (S15)*

Fourth Step of the Experiment of Lever

Last step was "Now use one and three kilograms of weight to keep the lever balanced". Students spent most time on this step, even though there was no open ended question to be replied (see Table 4.36). Students were going to try to keep the lever balanced with three weights; therefore three weights might take much time.

Retrospective Review Results

Only one student (S25) who also could not accomplish the previous task did not complete this task similarly. The reason was the same as she explained before; she did not try to keep the lever balanced due to not reading the sentences carefully.

Moreover, other students performed this task correctly. They tried to keep the lever balanced with weights and they had opportunity to use the word in the context which promotes long-term retention.

> *I used weights. When it was not balanced, I changed the locations of weights to keep the lever balanced (S6).*
>
> *Ağırlıkları kullandım. Yerini değiştirdim dengede olmayınca. Dengesini sağlamaya çalıştım. (S6)*

It tells us now to keep the lever balanced by using 1 kg and 500 gr. (S22)

Şimdi bir kg ve 500 gr'ı kullanarak dengede tutmaya çalışın diyor. (S22)

Difference between Pretest, Posttest, and Retention Test Scores

One of the main purposes of these experiments was to promote improvement in vocabulary achievement scores throughout the process. In this respect, repeated measures design was conducted for each experiment in order to explore differences between pretest, posttest, and retention test scores.

For the experiment of Lever, in order to learn the dependent variable is normally distributed in the population for each level of the within subjects factor, tests of normality was conducted. Results of Kolmogorov-Smirnov and Shapiro-Wilk should be non-significant; however normality assumption could not be met. In this respect, Friedman test as non-parametric test was conducted (see Table 4.39). The results of Friedman Test indicated that there was a significantly difference in vocabulary achievement scores across three time points (pretest, posttest and retention test), χ^2= (2, n=25) = 16.59, $p < .05$. Inspection of median values showed an increase in vocabulary scores from pretest (*MD*=8.00) to posttest (*MD*=12.00).

Table 4.38 Means and standard deviations for dependent variables

	N	*M*	*SD*	*Min*	*Max*	*MD*
pretest	25	8.04	3.19	2.00	12.00	8.00
posttest	25	10.60	1.82	6.00	12.00	12.00
Retention test	25	10.64	1.60	7.00	12.00	12.00

Table 4.39 Friedman Test for the Experiment of Lever

N	25
χ^2	16.59
df	2
p	.00

Wilcoxon signed ranked test was conducted as post-hoc tests to compare the three time points individually (see Table 4.40). Time 1 was compared with Time 2 and Time 2 was compared with Time 3 and to reduce Type 1 error, new alpha level was determined as .05/2= .025. Wilcoxon signed ranked test indicated significant difference in vocabulary acquisition scores between pretest posttest, z=-3.52, $p < .025$, with a large effect size of r =.50. There was no significant difference between posttest and retention test, z= -.09, p >.025.

Table 4.40 Wilcoxon signed ranked test for the Experiment of Lever

	posttest – pretest	retention test – posttest
Z	-3.52	-.09
p	.00*	.93

* p<.025

According to quantitative results, it is an expected result that there is an increase from pretest to posttest scores and it is also expected that retention scores do not decrease as time goes by. Even though six weeks passed after the experiments, the retention scores are still similar to posttest scores. The results of this experiment were consistent with the previous experiments, Depth Skinner and Pythagorean Theorem.

To sum up, data from various sources were integrated in order to in-depth understanding of contextual learning processes and task completion during five-week period. In the next section, interview results will be presented in order to get better understanding of research questions.

4.3 Interview Results

Themes and sub-themes were designated after data analysis of interview results. Interview results were presented in two sections including general vocabulary learning processes and experiences of students concerning mobile assisted situated learning environment. The interviewed students were S1, S4, S6, S12, S13, S14, S16, S18, S19, S20, S21 and S25. Among those students, S1 was one of the students who had the highest frequency of words looked up and spent most time in mobile application. On the

other hand, S12 and S18 were one of the students who looked up least words and also spent least time in mobile application. S6 was also one of the students who looked up least words in mobile application.

4.3.1 General Vocabulary Learning Processes

In this part of the study, students' general vocabulary learning processes were presented in order to learn overall tendency of their vocabulary exploration processes and problems encountered while learning vocabulary. The results were categorized under the themes of reasons of vocabulary learning problems; vocabulary learning strategy and vocabulary exploration process while reading text (see Table 4.41).

Students mostly complained about forgetting the meaning of the words quickly, having difficulty in memorizing words and not knowing how to study vocabulary. This result brought the question of vocabulary learning is whether or not a memorizing issue. Two students pointed out that their beginning age for language learning was too late. On the other hand, being not interested and not practicing were also given as reasons for vocabulary learning problems.

When students were asked for vocabulary learning strategies, the highest frequency was belong to writing the meanings of the words and memorization. Secondly they stated watching subtitled TV series in English language. Although four of them followed memorization strategy; the other strategies can be a kind of contextualized learning. While two of them used mobile app, one of them followed the strategy of learning with analogies.

The last theme was vocabulary exploration processes while reading text. Half of the students first tried to understand the word from the sentence, and then looked up the meaning when they encountered with an unknown word while reading text. Two of them preferred looking up dictionary definition immediately and one of the students preferred

stop reading when he/she faced an unknown word while reading a text. One of the students preferred looking up the words that belong to specific discourse type.

Table 4.41 Students' general vocabulary learning processes

Themes	f	Sub-themes
reasons of vocabulary learning problems	3	Forgetting quickly
	4	Memorizing problem
	2	Don't know how to study
	2	Beginning age for learning is too late
	1	Not interested
	1	Not practicing
vocabulary learning strategy	2	Using mobile app
	3	Watching subtitled TV series in English language
	4	Writing the meanings of the words and memorization
	3	Learning usages in sentences
	1	Learning usages in sentences by using analogy
vocabulary exploration process while reading text	6	First try to understand the word from the sentence, and then look up the meaning
	2	Looking up dictionary directly
	1	Stop reading
	1	Looking up only the specific discourse type words

4.3.2 Experiences of Learners Concerning Mobile Supported Situated Learning Environment

In this part of the study, experiences of learners concerning five-week experimentation process, mobile system, learning issues and future suggestions were presented with sub-themes and statements of the students.

Students' views about experimentation process were gathered and categorized under the themes of positive opinions, negative opinions, reasons of the problems faced during the process, relationship between interest and experiments and focus of students (see Table 4.42).

Table 4.42 Students' experiences concerning experimentation process

Positive Opinions		
Sub-themes	**f**	**Statements of Students**
Having fun, interesting, different	6	"It was so fun. I have learned several words and at the same time it was fun." "Experiments were interesting and learning words from them was so different."
Long term retention	6	"Visuals are generally more easily recalled, but when we read a book, it is never recalled in long-term." "When I saw *hang* word as I was reading a text in class, I remembered the visual in app in which woman was hanging the clothes. I have visual memory, thus that comes first to my mind."
Contextual learning	5	Alternative context: "When you cannot find out the meaning of the word, you try to guess the meaning from the experimental environment. It is a working method." "I could not find out the meaning of several words from the dictionary definition. However, the meanings can be guessed from the visuals already, thus it is beneficial." Promotes learning vocabulary with sentence: "Normally, I was translating the sentence word by word, and in normal conditions maybe I could not find out the meaning of the word. However, now I am looking the whole sentence which is much more easier."
Incidental Learning	3	"In my opinion, it is efficient for vocabulary learning, because I could not learn and I could not memorize words before, but now one can learn or memorize unintentionally, it is better."
Learning by doing	6	"Learning by using is beneficial, we also learn Turkish in this way." "Learning by doing facilitates long-term retention."
Being parallel with lectures is reinforcement	2	"It is beneficial because the vocabulary relates to our lectures." "Due to my English level is low, I learned a lot of words and I have seen the words in quizzes later in class."

Table 4.42 (Continued)

Negative Opinions		
Sub-themes	**f**	**Statements of Students**
Vocabulary and sentence structure problems	4	"It was difficult when you did not know the related sentences in mobile app." "The sentence structures in the steps of the experiments were difficult for my English level. There were imperative sentences. If the sentences were simpler, it would be better." "I had difficulties with several experiments, since there were so many unknown words. The number of unknown words could be less. There were many words that I do not know their definitions. It was difficult for me, especially at the beginning."
The shortness of the experimentation period	2	"I do not know how it will contribute to English knowledge with only five experiments, but if it will be every week and three times a week, it would be much more beneficial." "If the experiments last longer, it could facilitate long-term retention, however they are too short. Five experiment is too less. In my opinion I could learn more easily if they would be more."
Difficulty of creating these environments	3	"For instance, how could they be used in the lectures? There is no experimental environment. At that time, will it be adapted to classroom environment? I think creating these experiment environments is difficult." "How many students are there who could access these kinds of environments? How could they do the experiments?"
Not appropriate for everyone	1	"Efficiency can vary from person to person. It is beneficial for me due to my visual memory. It cannot be the same for everyone."
Visuals are inefficient	1	"Moreover, the visuals were inadequate for me; I could not guess the exact meanings of the words from the visuals."
Reasons of the problems encountered during the experiments		
Sub-themes	**f**	**Statements of Students**
Anxiety, sense of direction problems	1	"… because of the problems that I had in prep class here. I have learning anxiety which has just began. I saw the consequences of it in the experiments. I had problems due to my point of view which is the feeling of not learning in any way." "When you look first, it seems obviously, but I made mistakes due to my sense of direction problems"
Experiments that have excessive number of unknown words	5	"I had problems with the first experiments. I suppose my vocabulary has improved as time goes by, then I began to understand gradually." "I had problems with several experiments. In the first experiments, there were excessive number of unknown words however in the last experiments, there were not."

Table 4.42 (Continued)

Complexity of the experimental setup	5	"I had problem with the first experiment, thus the experimental setup was too complex. However I suppose I'm getting better gradually, because I think it is because of experimental setup."
Not reading the contextual sentences of the visuals	1	"I tried to understand the visual without reading related sentence, and later I began to look up the sentences which are near the visuals and I have began to understand."
Just focusing on completing experiment without paying attention	2	"First I focused on completing the experiment and hurried up, thus I did not pay attention."
Not using the alternatives of the definitions	1	"First I was looking up the visual definition, the visuals seemed easier, afterwards I got used to, I passed to dictionary definition and it seemed more meaningful. Then, I began using alternatives."
Misunderstanding the meanings of the words	2	"I misunderstood the meaning of the several words, thus I could not complete the experiments completely."
Relationship between experiments and interest		
Sub-themes	**f**	**Statements of Students**
Interest does not affect	2	"I do not think that interest affects the outcomes". "Experiments do not include formula or technical knowledge, thus it does not affect."
Having fun because of interest	2	"I had fun during the experimental process due to my science interest, I did not get bored and I suppose it affected the results." "I would get bored if I was not interested. I do not like English anyway; otherwise I would not complete the experiments."
More easily form cause and effect relationship	1	"I would understand the causes and effects; it can be effective in that way."
Having idea because of interest	2	"I mostly guessed the meanings from the experimental environment. If there was something that I do not know, I would have difficulties." "I had an idea by thinking on the experiment instead of dealing with reading due to my interest to the experiments. In this respect, interest could be beneficial."

Table 4.42 (Continued)

Focus of Students		
Sub-themes	**f**	**Statements of Students**
Vocabulary for completing the experiments	3	"Words are more important; because you can complete the experiments if you know the meanings of the words." "Of course words, otherwise you cannot complete the experiments."
Experiments because of flow	6	"Actually, it should be words, however experiments. Before I came here my purpose was learning vocabulary, however when I saw the experiments I could say that I was in flow."
Vocabulary because looking up definitions is intriguing	2	"The words were also intriguing; therefore I wondered what they mean. My focus was looking up the definitions of the words." "Learning the meaning of the words, the purpose of the experiments was that. While doing the experiments, I wanted to learn the meaning of the words, it was fun."
Experiments because you can complete without knowing vocabulary	1	"In my opinion my focus was experiments, because you can complete the experiments without looking up the definition of the words, you can understand from experiments."

When students' positive opinions about overall experimentation process were taken into account, they found it entertaining, interesting and different. Moreover, they pointed out contextual learning, thus they had the chance of having alternatives to explore meaning of the words. Contextual learning, one of the main characteristics of situated learning environments, was one of the positive parts of this study. They could look up the dictionary definition or visual definition of the words both and also they had opportunity of learning from the experimental environment. Students emphasized long-term retention with frequency of six as a positive part of the study. Interestingly, they pointed out that the visuals used in mobile application were supportive for long-term retention. One student stated that for the word of "hang", she remembered the visual used in mobile system in which a woman hanging the clothes to dry. Six students focused on incidental learning, one of the key characteristics of situated learning environments. They emphasized on learning without intention. Six students focused on learning by doing which was also one of the main characteristics of situated learning environments.

Moreover, two students found the process beneficial for being parallel with lectures. The vocabulary they learned during the experimentation process was reinforcement for the lectures. When they saw the same vocabulary in their lectures and quizzes, they were motivated.

Students' negative opinions about entire of the five-week period were listed as vocabulary and sentence structure problems in mobile system, shortness of the experimentation period, difficulty of creating these environments, being not suitable for everyone, excessive number of words and inefficiency of visuals. Students mostly stated that they encountered unknown words in dictionary definitions and contextual sentences of visuals; therefore they could not understand the sentences correctly. Especially, they claimed excessive number of unknown words in first experiments. Moreover, they claimed about the sentence structures used in the steps of the experiments. Three students pointed out the difficulty of creating these kinds of environments and claimed that it was not possible for everyone to access. While, one student found the visuals in mobile application inefficient, one of them stated that this kind of learning was not appropriate for everyone.

When opinions of students were gathered concerning reasons of problems they faced during the experiments, they listed as anxiety, sense of direction problems, problems with the experiments that have much unknown words, complexity of the experimental setup, not reading the contextual sentences of the visuals, just focusing on completing experiment without paying attention, not using the alternatives of the definitions, misunderstanding the meanings of the words. Students mostly claimed about the complexity of experimental setup and excessive number of unknown words used in definitions and steps of the experiments. Especially, they found the setup of the first experiment (Experiment of Free Fall) complex. Students tried to guess the meaning of the words from the visual without reading its contextual sentence, therefore they guessed incorrectly. Two students stated the problem of just focusing on completing experiment without paying attention and trying to do the experiments quickly.

When students' opinions about relationship between experiments and interest were asked, only two of them stated that interest does not effect. According to them, completing these experiments does not require pre-knowledge about the experiments. On the other hand, two of them had fun because they were interested in science and they said that otherwise they would get bored. Two students had opinion about the experiment because of interest, thus they had opportunity to guess the meaning of the words from the experimental environment. One student emphasized forming cause and effect relationship easily because of interest.

Lastly, focus of students while performing the tasks was asked. Six of them stated that their focus was experiments and they were in flow while performing the tasks. On the other hand, three of them focused on vocabulary to complete the tasks; otherwise it was not possible to accomplish them. One student focused on experiments because it was easy to complete the tasks without knowing the meaning of the vocabulary. Interestingly, two students found interesting to look up the meaning of the words in mobile vocabulary learning system.

Table 4.43 Students' opinions concerning learning issues

Retention		
Sub-themes	**f**	**Statements of Students**
Visuals facilitate retention	2	"It is recalled visually in long-term. The experiments were very good." "When you read from a book or computer environment, the possibility of forgetting that knowledge is high without visuals."
Interesting and entertaining, so facilitate retention	2	"For instance, when our teachers tell a story or something entertaining or interesting we learn more easily and recall in long-term, the same thing happened."
If not practiced and used, cannot be recalled in long term	5	"I think it teaches well, however unless you practice, it is not meaningful. If we practice the same vocabulary a few times, it will be recalled in-long term."
Not effective in long-term	1	"It can be effective for one or two months, however not in long-term."
If the experiments go parallel with lectures it can facilitate retention	1	"We saw the vocabulary later in the lectures; we could claim that they are parallel to each other. I recalled the words directly. Exposing in class also facilitated retention."

Table 4.43 (Continued)

Vary from person to person	2	"In my opinion, visually learning is better for me, thus I guess I will not forget. However, it can vary from person to person."
Remembers every word he learned	1	"Long-term recall of vocabulary. I remember every word that I have learned there."
Reasons for not learning the meanings of words		
Sub-themes	**f**	**Statements of Students**
Problems with new meanings of two words when they were combined	2	"When we combined two words, a new meaning occurred. However, in my opinion we reproduce a new meaning based on our pre-knowledge and it cannot be true all the time, so we do not understand occasionally."
Inadequacy of the visuals in mobile application	3	"I tried to guess the meaning of the word from the visual in the experiment of last week, but I could not understand the visual."
not knowing several words used in definitions and contextual sentences	5	"Sometimes, I do not understand the definitions in English due to not knowing or understanding the meaning of words used in the definitions."
trying to guess without looking mobile app (due to pre-knowledge)	2	"…due to my pre-knowledge. For instance, there was "left" word there, I thought it as *leave, give up.* However it means "sol". I did not look at the app, and could not understand due to my pre-knowledge."
not reading the contextual sentences of visuals	1	"If I did not read the related sentence and at the same time the visual was irrelevant, I thought lots of things. When I looked at those visuals, utterly different things came to my mind at that point."
complexity of the experimental setup	1	"I was confused due to complexity of the experimental setup."
Simplicity of the experiments, thus looking up less word in system and learning incorrectly	1	"When the experiment is easy, you look up less words in app and try to guess. However, it can be wrong."

Students' opinions about learning issues were categorized under the themes of retention and reasons for not learning the meaning of the words (see Table 4.43). In terms of retention, students found visual definitions supportive for long-term retention. Moreover they found the process interesting and entertaining; therefore promoted retention. Five students stated that if it is not practiced and used, it cannot be recalled in long-term. Moreover, one student pointed out that it cannot be recalled in long-term. If the

experimentation period lasts longer it can facilitate long-term retention and if the experiments go parallel with lectures in class it can facilitate retention. Two students stated that it can vary from person to person in terms of retention and two students stated that they remembered every word they learned.

When students asked for reasons for not learning the meanings of words, two of them stated that when two known words were combined, the words have a new meaning. In the experiment of *Pythagorean Theorem*, although students knew the meanings of "right" and "triangle", when these two words came together new meaning occurred, therefore they made mistakes. Moreover, they listed problems including inadequacy of the visuals and not knowing several words used in definitions and contextual sentences in mobile application. Two students focused on the problem of trying to guess the meaning of the words without looking mobile system (due to pre-knowledge). These students tried to guess the meaning of the words based on their pre-knowledge and in some points they made mistakes. One student claimed not reading the contextual sentences of visuals which was one of the essential problems confirmed during the retrospective reviews. Complexity of the experimental setup was also pointed out as one of the reasons not learning the meaning of the words. Interestingly, one student claimed that simplicity of several experiments resulted in looking up less the meaning of the words in mobile system and consequently learning inefficiently. He tried to complete the tasks by focusing on the experimental setup.

Table 4.44 Students' opinions concerning the mobile vocabulary learning system

Usability Issues		
Sub-themes	**f**	**Statements of Students**
A practical application	1	"There was no problem, very practical application."
Lack of experience in usage of Tablet PC	1	"I had problems while using Tablet PC. I am not good at using technological devices. For instance, although I use mobile phone, I am using it very slowly. I had problems at the beginning, and then I got used to and began writing without having problem in the last experiments."
Save problem	6	"Would it better if it saves automatically our answers?" "One or two times I logged out without saving, but it can be due to user error. The application was good."
Screen size is big	2	"Tablet PC is good, bigger than mobile phone and better in writing according to the paper."
So easy to write on touchscreen	4	"The usage of it is very easy, we use mobile devices already. We are familiar with writing on touch screen, it is very easy."
Fonts are boring	1	"Now it seems like you are writing on a straight word page which is boring, instead of straight font, *comic sans* can be used, it would be better."
Content Suggestions		
Sub-themes	**f**	**Statements of Students**
Simple definitions	5	"The words used in dictionary definitions can be simpler." "Some words have two meanings. If the first meaning of the word is used, it would be better."
Having opportunity of looking up the new meaning of two words when they were combined	1	"For instance, you are looking up the definitions word by word, however if I had the opportunity to combine two words and look up the new meanings after they were combined, it could be more meaningful. Definitions can be given both word by word and in group."
Suggestions about visuals	2	"Visuals can be more animated. For instance, there was a visual that someone was filling water. There can be an animation of pouring something, it would be better."
The content can be more gamified.	1	"If the content is more gamified it can be a preferable application."
Shorter sentences and more steps	1	"Shorter sentences, more steps can be used. Steps can be more with shorter sentences."

Table 4.44 (Continued)

Contextual sentences and visuals should be about the experiment.	3	"Visuals and their sentences were not related to the experiments. I could not associate them and also surprised. If they were related to the experiments, it could facilitate retention."
Visuals can be with alternatives.	1	I would prefer that the number of visuals can be not one,but maybe two, three or more; because you sometimes actually do not understand the visuals In this respect, alternatives can be used.
More exposure to words	4	"If we look up the definition of the word repeatedly, it can facilitate retention, so words can be used repeatedly."
More speaking language	1	"More speaking language can be used. The words that you expose every time, for instance while you are writing, reading can be used. For instance, *now try again;* you expose these kinds of words all the time. Learning with these kinds of words would be easier."
When do they use the system?		
Sub-themes	**f**	**Statements of Students**
Only for the instructions of the experiments	2	"It is efficient for looking at the instructions to complete the experiments, otherwise it is not."
To be sure for the meanings of the words	2	"I looked up the definitions of words that I cannot be sure. I thought whether or not I am thinking correctly and I got help with this point of view."
For looking up the meaning of specific discourse type of words	1	"When I could not guess the meaning of the word from the sentence, I used. Especially for specific words, for instance the name of the mechanism, square or circle."
Just for visual definition	3	"I just looked up the visuals and their related sentences. I did not use dictionary definitions. They were more beneficial for me."
Looking up most of the meanings of the words.	4	"I looked up the words all the time." "I always got help for the words. I got help all the time. It was beneficial. I could not do without it."

Students' opinions concerning the mobile system were categorized under the themes of usability, content suggestions and when they used the system (see Table 4.44). In terms of usability, one student found the system practical, and one student claimed about her lack of experience in usage of Tablet PC. She claimed that she had problems with technological devices, thus she uses them very slowly. Six students pointed out the save problem in mobile application, thus several of them tried to close the application without

saving. Interestingly, during the pilot tests with four students, students did not mention anything about saving issue. Moreover, two students found the screen size of Tablet PC big according to mobile phones and writing on touchscreen was found to be easy by four students. One student offered Comic Sans as font to be used instead of Time new roman, thus he found the texts boring in mobile application

Students gave suggestions about the content of the mobile system. Students mostly gave suggestions about the definitions in mobile system. They stated that the words that were used in the definitions of the vocabulary can be easier. First meanings of the words can be used or Turkish equivalences can be included. One student offered to have opportunity to looking up the new meaning of two words when they were combined. However, in the present study if two words formed a new term when they were combined, the meaning of these two words were given together. Suggestion concerning visuals was making them more animated instead of using static images. Visuals in mobile system included animations and static images. In several definitions, static images were used instead of animations; however the number of the animations can be increased in the future.

One student offered that the content can be more gamified. There were implications of combining mobile technologies that support situated learning environments with gaming characteristics in the previous studies. One student offered more steps with short sentences in the experiments and three students offered that related sentences and visuals should be about the experiment. However, it was not suggested by subject matter experts to make the visuals similar to experimental setup, even though it makes the process easy. In that case, the mobile system would not be a system that facilitate contextual learning, and would be more likely a prospectus which prescribe the process. Moreover, presentation of sentences and visuals with alternatives was offered, thus if anyone cannot understand the meaning of the words from the visuals or dictionary definition in mobile system, he/she will have chance to look up the alternatives. Three students offered more exposure to the target words during the process, which was also suggested

in previous incidental vocabulary learning studies. Making the target vocabulary more speaking language was another suggestion. In other words, they offered general discourse type of vocabulary to be used in mobile system; however scientific terms or specific discourse type words were also in the curriculum of Elementary level.

Lastly, when they used the system was asked and four students stated that they mostly looked up the words in mobile system. On the other hand, two students looked up the meanings to be sure and one student used when she cannot guess the meaning of the word from sentence. While three students used the system for only visual definitions, one student preferred for specific discourse type including name of the devices, mechanisms or words like "square", "triangle".

Table 4.45 Students' opinions concerning the future suggestions

Sub-themes	f	Statements of Students
Appropriate for younger age group	3	"I think this application should proceed, especially it can be applied to elementary school. We are learning English for ten years." "It would be a good opportunity for children. It is easier to promote children, these are interesting for them and they will be more interested."
Appropriate for applied courses	5	"It can be used in the future; however it can be beneficial in math or science classes, because to see and as a result to do experiments is easier and more understandable." "It can be good for math experiments. For instance, teaching Pythagorean Theorem actually would be good. They can use it in math class."
Should be continued with in groups	1	"If we came individually, it would not be efficient. In the future it should proceed with groups."
Experiments for everyone's interest	3	"I would prefer different types of experiments, not science but philosophy which is much more interesting for me. For instance, investigating a model about astronomy can be interesting for another person. For everyone's interest."
Long term implementation	3	"Long term implementation would contribute to our English. The number of the experiments can be increased."
Experiments can be in virtual environment	2	"Transferring the experiments to virtual environments would be better, thus everyone can access them. Maybe they can be desgined for digital platforms."

When students were asked for future suggestions, three of them found it appropriate for younger age group, thus learning English begins in early age and it would be good opportunity for them (see Table 4.45). Five of them suggested to be applied in lectures which are based on experiments (applied courses, e.g. Science). Three students suggested that it can be replicated with experiments for everyone's interest, thus one of them stated that she would preferred experiments about philosophy due to her interest. Three students offered the experimental process to be longer; therefore by increasing the number of the experiments it would facilitate gaining vocabulary knowledge efficiently. Finally, two students offered that experiments can be prepared in virtual platforms in order to be accessed by everyone.

CHAPTER 5

DISCUSSION AND CONCLUSION

This chapter includes discussion on the findings of the present study. First, discussion of the research questions will be presented; then, conclusion, practical implications and suggestions for future research will be presented respectively.

5.1 Discussion of How Mobile Supported Situated Learning Environment Facilitates Contextual Vocabulary Exploration

The first research question was "How does situated learning environment supported with mobile vocabulary learning system facilitate contextual vocabulary exploration processes?" Students' contextual vocabulary exploration processes were investigated based on various data sources including mobile system logs, observation notes, retrospective reviews, and semi-structured interviews. First of all, quantitative results will be discussed which give information about how the mobile system was used and which vocabulary type was mostly looked up during the process. Later, learners' contextual vocabulary exploration processes based on retrospective reviews and observation notes will be discussed elaborately.

Vocabulary learning is one of the essential problems in language learning. However, in the past, the main method in vocabulary textbooks was presenting word lists and giving the meaning of the words in native language. This method suggests learners that vocabulary learning is an issue of memorizing the target language equivalences of nature

language words (Shrum & Glisan, 2015). In this respect, students' general vocabulary learning strategies were determined in the present study. Students mostly pointed out writing the meanings of the words and memorization as a vocabulary learning strategy. Moreover, students mostly complained about forgetting the meaning of the words quickly, having difficulty in memorizing words, and not knowing how to study vocabulary. These issues were mostly mentioned in the previous studies, which indicates that students generally do not know how to learn vocabulary and as a result they use memorizing strategies (Huang & Eslami, 2013). However, learning words from definitions and separated from its contexts, it would be less successful and slow process (Brown et al., 1989).

In this respect, it was crucial to investigate when students used the mobile system during interactive experiments. They had the opportunity to look up the meaning of the words using the mobile system or infer the meaning from the sentence or authentic environment. System logs showed that students mostly looked up the meaning of the words in the mobile system. Even though several students knew the meaning of the words, they still looked up to be sure. Several researchers claimed that this type of explicit learning promotes in-depth understanding of the text (Hanson & Padua, 2011). On the other hand empirical findings indicated that in terms of long-term retention, it would be unsuccessful (Bora, 2013). Students had the opportunity to infer the meaning of the words from various contexts. While several of them managed those processes efficiently, several of them could not. Looking up the meaning of every word took a lot of time and distracted the learners from the authentic learning environment. On the other hand, definition support prevented learners from inferencing wrong meanings of the unknown words, which is one of the disadvantages of incidental vocabulary learning. In this respect, one of the difficult challenges for educational practitioners is to determine what should be made explicit in teaching and what should be left implicit. It is crucial especially for the novice learners. Students with higher vocabulary pre-knowledge might manage to make contextual inference better than novice learners, but providing

definition support for each word distract novice learners from the authentic learning environment.

Another important point was how students used the system. In this study, mobile system logs showed that visual+text definitions were preferred more than dictionary definition. Previous studies investigated the effects of these two types of glosses on vocabulary learning and findings showed that visual+text definitions resulted in more promising results compared to dictionary definitions in terms of vocabulary learning (Akbulut, 2007; Chun & Plass, 1996, Shahrokni, 2009). These findings was consistent with the idea that language cannot be learned isolated. As a result, vision, experience or other senses play a crucial role (Britsch, 2012). On the other hand, in this study several students just tried to understand the meaning of the words from the static images or animations, without reading the related sentence; therefore, they did not understand the meaning of the words correctly. Looking only at the visuals without reading their contextual sentences might not be meaningful. In other words, without contextual sentences visuals are not meaningful to help students acquire the word and retain.

Moreover, the students in this study were in the opinion that this kind of learning environment facilitates long-term retention of vocabulary due to visuals. One student gave an example of how she remembered the visual of the target vocabulary with its related context. The word of "hang" was presented with a woman hanging the clothes in mobile application and when she saw that word in the quiz in classroom activities she just remembered the visual. In contrast, several students did not prefer to use visual definition, instead used dictionary definition. Differences in the preferences between textual and visual annotations may have been due to individual differences. This finding was supported by the empirical evidence in the study of Taki and Khazai (2011), presenting learning materials with pictorial annotation to learners with high-visual ability as well as presenting the materials with written annotation to learners with high-verbal ability resulted in better learning. In this respect, while designing supportive materials, individual differences are needed to be taken into account. It is suggested that

supportive materials with more alternatives which have different presentation modes should be created.

On the other hand, according to retrospective reviews and interview results, in this study there were several problems concerning visuals in mobile system, such as being complex and not efficient. This was consistent with the findings of the previous study in which visuals in mobile systems were not found to be efficient by every user (Sandberg et al., 2011). Especially, instructional design for mobile devices is not an easy process due to their small screen size. However, in a previous mobile learning study, Mayer's multimedia learning theory principles were implemented in order to design presentation modality (text and picture) and consequently students' vocabulary test scores improved (Saran, Seferoglu & Cagiltay, 2012). In this respect, multimedia theories and developmental research can be beneficial in order to create more user-friendly interfaces by getting feedback from the users continually while creating those environments.

Students in this study mostly looked up the meaning of specific and intermediate discourse type words. It was an expected result that they knew or easily guessed the words to which they were frequently exposed in their daily lives before. Vocabulary was mostly learned in the context of ordinary communication (Brown et al., 1989). Specific and intermediate discourse types included words such as scientific terms; consequently, it was not possible for students to have been exposed to these kinds of words frequently in their daily lives. Specific and intermediate discourse types had the high academic utility. In the literature, academic language was suggested to be taught explicitly, but also there is an opinion that they are unlikely to be retained if they are taught in lists instead of being embedded in meaningful contexts (Snow, 2010). In the present study, concrete objects such as a triangle, lever or wheel and axle were easily comprehended with the support of mobile vocabulary learning system. In this respect, these kinds of specific words might be taught explicitly and word functions can be presented in different meaningful contexts. It should be noted that it is not an easy process for novice

learners to infer the meaning of such words from the context (Snow, 2010). In mobile supported situated learning environment, explicit teaching of specific terms can be combined with the strategy of contextual learning. Another issue for the concrete specific discourse type terms was that although students understood the meaning of the term and accomplished the task correctly, they could not name it in Turkish. For instance, for the word of "wheel and axle", although he understood that it was the simple machine that he already knew, he could not remember the equivalent in Turkish. This is a kind of natural learning and language learning is most effective when it is performed in a natural way (Oura, 2012).

In terms of time spent and frequency of words looked up in mobile system, students in the study spent most of their time looking the meanings of the words up in the first two experiments which were Free Fall and Wheel and Axle. There might be several explanations for this issue. The first one is the "novelty effect", which is characterized by the introduction of something new or novel that might result in significantly influencing the student's performance (Glass, 2010). Moreover, it might impact the respondent's willingness to participate (Gordon, 2003). This kind of learning environment was a new approach for each participant. As time went by, they got used to this kind of learning environment and managed the processes more easily. First they tended to look up the meaning of each word instead of making contextual guessing. In this respect, they spent time and this resulted in distracting learners from the authentic learning environment. According to the interview results, the second reason was that students found the first two experiments complex and complained about the excessive number of unknown words.

Learners in the study revealed that they experienced incidental vocabulary learning in this authentic learning environment. One of the main advantages of contextual vocabulary learning is incidental learning (Huckin & Coady, 1999). There are various factors, such as the usage of glosses, contextual clues, repetition of words, learners'

interest and focus, that affect incidental vocabulary learning and conflicting results have emerged in previous studies (Hu, 2013; Huckin & Coady, 1999; Webb, 2008).

As for the factor of interest, relationship between interest and experiments was asked. While some students stated that interest did not affect their experience because accomplishing the experiments did not require high level skills, several of them reported having fun because of their interest and continued participating in the experiments. Moreover, several students pointed out that interest really affected the outcomes. Because of having prior knowledge about the topic of the experiment, they were able to guess the meaning of the words easily from the context. This result was consistent with previous studies (Huang & Eslami, 2013; Huckin & Coady, 1999; Ramos & Dario, 2015). As a result, if the topic or main idea of the text is familiar, learners have a greater possibility of correctly guessing the meaning of unknown words. The difference between previous studies and the present study is that authentic learning environment was a real context, instead of a text. The comprehension strategy in language learning is to activate the student's prior knowledge; however, if learners lack prior knowledge, they cannot activate conscious comprehension strategies cannot be activated (Stahl, 2003). On the other hand, high pre-knowledge about the experimental environment might result in not exploring the meaning of the words. Several students in the present study did not find it necessary to look up the meaning of unknown words due to high pre-knowledge about the experiments. In this respect, authentic learning environment should be chosen very carefully by taking learners' interest and pre-knowledge into account.

Another factor which was crucial was *contextual clues* in incidental learning. If target words are supported with contexts that are uninformative or misleading, supplementary tasks or contexts involving those words are likely to be necessary for learners to gain knowledge of meaning (Webb, 2008). As most of the students in the study found the setup of the experiment Free Fall really complex, they did not have any idea about the experiment and they pointed out this issue as one of the reasons why they could not

learn the meaning of the words. This finding was consistent with the results of the previous study (Hulstjin et al., 1996) which found that when the text is authentic, students cannot infer the exact meaning of the unknown words from the context. In the study of Hulstjin et al. (1996), authenticity was again maintained with authentic texts. In the present study, due to the advantage of real environment, contextual clues were sufficient to promote learners' inferencing the meaning of the words. On the other hand, interestingly one student stated that simplicity of the experimental setup made him explore fewer words and resulted in not learning the meaning of the words, because he guessed the process and tasks from the experimental setup. A word surrounded by rich contextual cues is often easily comprehended, but this may result in less retention (DeBot et al., 1997). In this respect, an unclear context can be used in order to open up a learning need (Zahar et al., 2001). The setups of the experiments should be neither too easy to guess and nor so complex as to worry them and pre-knowledge about the experiment should be appropriate to make them interested and calm. In this respect, Flow Theory of Csikszentmihalyi (1997) claims that for completely focused motivation, the data presented to the learner should always be of sufficient complexity to maintain his interest and maintain a competitive situation, but not so complex as to discourage. It should be noted that incidental learning of vocabulary only can be effective when the context was well understood (Huckin & Coady, 1999).

Another component of incidental learning is multiple exposures to vocabulary. In the present study, several target words were frequently used. Based on observation notes, as a result of repetition of the words and tasks, students spent less time and retained the vocabulary better. For instance, the word "rotate" was used in the previous experiment of "Wheel and Axle", therefore students mostly remembered that word in the experiment of "Depth Skinner". The number of multiple exposures to the target vocabulary was not enough in the present dissertation study; therefore, students offered to extend the experimentation process (the entire of the semester) and also offered to increase the number of multiple exposures to the same vocabulary. The frequency of vocabulary

exposure seems to have a great impact on incidental vocabulary learning (Huckin & Coady, 1999). Repeated exposure to words in meaningful collocations is the key to form-meaning associations (Ramos & Dario, 2015). In this respect, determining the minimum number of repetitions of words to be learned was another issue that has been frequently investigated in incidental learning studies. Previous studies have demonstrated different results, ranging from 3 to 17 exposures (Hu, 2013; Rott, 1999; Huang & Lio, 2007). In order for repetition to be effective, it should be distributed across different meaningful contexts. Learning word functions in different contexts is much more crucial. In other words, multiple exposures should be in different meaningful contexts rather than focusing on the number of the exposures.

There are also several disadvantages of incidental learning. Learning takes a lot of time, there is a possibility of guessing the meaning of words incorrectly and it can only be effective when the context is well understood. Those disadvantages have also been mentioned in the previous study (Huckin & Coady, 1999). While creating those learning environments, educators should try to minimize these disadvantages. In the present study, in order to minimize the possibility of guessing the meaning of words incorrectly, supportive multimedia technologies and contextual clues were used. The advantage of the present study was using a real context instead of an authentic text that provides various contextual clues. Another advantage of this study was providing students with an opportunity to learn and practice the target vocabulary later in their in-class activities. Out-off-class activities should be connected with in-class activities in order to minimize misunderstandings. This result was consistent with the result of Chen and Li (2014)'s study in which he designed a mobile vocabulary learning system just for informal learning and suggested integration of in-class and out-class activities.

Allowing students to practice the knowledge in different situations or contexts encourages them better to apply the knowledge to real-life situations (Catalano, 2015). In the present study, even though several students did not understand the meanings of the words from the mobile system, they tried to guess their meanings from the

experimental environment. The opposite of this situation also happened. Some students tried to guess the meaning of a word from the experimental environment and then looked the meaning of the word up in the mobile vocabulary learning system. For instance, for the word group of "magnetic sharp tip", when they saw the word group of "at the top of the device", they searched somewhere to hang the ball at the top of the device and finally, they found the magnetic sharp tip. The most effective way to learn vocabulary is using context efficiently to infer the meaning of the word. Especially for novice learners who have problems with this process, alternatives contexts or different perspectives promote contextual vocabulary exploration processes.

One of the main characteristics of situated learning environments is to be able to apply what is newly learned to different contexts (Chen et al., 2009; Egbert & Petrie, 2005; Lee et al., 2005). This process is referred to as transfer ability (Huang et al., 2011). Transferring is not an easy process especially for novice learners since it requires higher cognitive skills. In the present study, several students experienced problems in applying newly learned words to different contexts. Participants of the study were elementary level students who can be considered as novice learners. Especially, in the first experiments, students had such problems; however, after a while, their transfer ability improved. Present study shows that transfer ability might improve gradually in contextual learning environments; therefore, it is crucial to design authentic learning environments in order to promote learners' transfer ability. In this respect, it is suggested that vocabulary should be presented within various contexts repeatedly to improve learners' transfer ability.

Lastly, students in the study did not tend to look up words, when the instruction given by the mobile system did not include any task that needed to be accomplished in the real environment. Several steps of the experiments did not include tasks that needed to be accomplished in real environment. However, authentic activities should require seeing the consequences of actions in real world (Herrington & Oliver, 2000). In this respect, learners should see the consequences of their actions to enhance participatory learning

(Kearney et al., 2011). Authenticity of the task depends on whether or not a student is engaged in the task. In this respect, any task that only give general information or do not include any activity with real-word relevance might keep the learner away from authentic learning environment.

5.2 Discussion of How Mobile Supported Situated Learning Environment Facilitates Task Completion

Second research question was "How does situated learning environment supported with a mobile vocabulary learning system facilitate task completion?" Data from retrospective reviews, observation notes and semi-structured interviews were presented in order to discuss how situated learning environment supported with a mobile vocabulary learning system facilitated task completion.

Essential components of situated learning environments are authentic tasks and sub-tasks which have real-world relevance, thus students have opportunity to observe real life episodes (Chu et al., 2010; Herrington & Oliver, 2000; Young, 1995). In the present study, a mobile system presented instructions of tasks to be accomplished in real environment. The authentic tasks were completed by learners as a result of understanding instructions in the target language. Another important component of situated learning environments is authentic assessments. In this respect, at the end of the experiments, students were given open ended questions that needed to be replied after completing all the tasks. In the literature, there are two kinds of authentic tasks including simulation and participation (Radinsky et al., 2001). In the present study, instead of simulation, participation approach was used in order to create opportunities for students to participate in the actual work, engaging them directly in the real environment. Participation in actual work outside the classroom was used as an instructional strategy in previous studies and resulted in promising results in terms of vocabulary learning (Catalano, 2015, Sandberg et al., 2011). Learning in real situations rather than simulated

situations enables students to develop a stronger sense of immediacy and, consequently, enhances learning motivation and outcomes (Huang, Yang, Chiang & Su, 2016).

One of the important factors while performing the authentic tasks was focus of students. According to the interview results and retrospective reviews, while some students in the study focused on completing the tasks, others focused on the words and tried to learn their meanings. Students who focused on completing the tasks pointed out that it was possible for them to complete the tasks without looking up the meaning of the words and one of them stated being in flow while performing the tasks. Flow Theory of Csikszentmihalyi (1997) supported the idea that when people are engaged in an activity that is appropriately challenging to their skill level, they often experience immersion and concentrated focus on a task). In that point, ability and pre-knowledge were important factors that needed to be taken into consideration while designing authentic tasks. Lower level students in the study felt frustrated, confused and demotivated with complex authentic tasks, especially at the first experiments. This finding was consistent with the previous study of Guariento and Morley (2001) who suggested not using authentic texts in the first place for novice learners. On the other hand, high pre-knowledge about the experimental setup lead to unintended consequences. Students with high pre-knowledge did not find it necessary to learn the meaning of the unknown words and also did not follow the steps of the experiments properly. This result was consistent with the previous empirical findings of Ruso (2007) who indicated that if the tasks are almost the same and if they are uninteresting, students do not feel satisfied. In this respect, it is crucial to design authentic tasks appropriate for their ability and pre-knowledge.

On the other hand, several students in the study focused on the words while performing authentic tasks and they claimed that it was not possible to complete the tasks without looking up the meaning of the words. Researchers have different opinions about this issue. Several of them point out that without attention, vocabulary learning is impossible; some of them state that at least some degree of conscious attention is necessary (Webb, 2008). In the present study, it was found that if students did not pay

attention to the words and just focused on completing the tasks, they missed several target vocabulary and did not learn their meanings. This result is consistent with the previous empirical findings (Ellis, 1994; Ramos & Dario, 2015). In this respect, a certain degree of attention must be raised towards vocabulary in order to make learners notice the vocabulary to which they are being exposed.

Elements comprising task difficulty in language learning can be identified as complexity of the language, cognitive load or performance conditions. In terms of language, several students did not understand the sentences that explain tasks in mobile system. Students had problems with excessive number of unknown words and sentence structures in the mobile system. In terms of cognitive load, some students had problems with the first two experiments. Because experimental setups of Free Fall and Wheel and Axle were too complex for several students, they became worried before beginning to do the tasks. Those were the experiments on which students spent most time during the five-week period. In terms of performance conditions, although two students understood the tasks correctly, one of them experienced direction problems. She confused her right side with her left side during the process and could not accomplish the tasks correctly. Another student had anxiety problems with language learning. As a result, especially during the first three weeks she was worried and experienced a constant feeling of anxiety. However, she got used to the process and did the tasks correctly in the last weeks. In the present study, most of the students were novice learners; therefore, it was crucial to design environments appropriate for their ability and pre-knowledge. In a previous study, early exposure of novice learners to authentic activities and tasks that they will encounter in the future led them to feel uncomfortable, lost and frustrated (Huang et al., 2011). Huang et al. (2011) recommended educators to pay attention to managing students' feelings and fostering their positive attitudes of situated learning. In this respect, enabling teachers to track the progress is crucial to foster learners' positive attitudes.

When learning takes place in real life tasks, assessments also should be in real contexts (Herrington & Oliver, 2000; McLellan, 1993; Young, 1995). In the present study, open-ended questions were kind of *authentic assessments* that students have to accomplish as a result of understanding the instructions in target language. It is crucial to make learners actively immerse in those authentic contexts, and separate assessment from authentic context might result in unauthenticity. In the present study, all tasks and assessments were complementary to each other. If learners did not accomplish the previous tasks or missed one of them, at the end they could not reply the open-ended questions correctly. Moreover, another issue was that although several students followed the steps properly and understood the tasks, they could not answer the open-ended questions correctly. However, the aim of the study was not to evaluate students' scientific knowledge but to determine whether or not they understood the tasks in the target language. In this respect, it is suggested that teachers should follow the progress for accurate assessments; otherwise, the outcomes might be misleading.

Students in the study followed different strategies to accomplish the tasks. As several of them preferred to see all the steps of the experiments at the beginning, they were able to complete the tasks only after they understood the entire experiment. They thought that they understood it better after they saw the whole process. In this respect, flexibility is essential because while educators might expect that students will use certain strategies while doing the tasks, students might follow different strategies.

In the literature, authentic tasks had promising effects on learners' motivation, satisfaction, engagement and learning (Melvin & Stout, 1987; Lee et al., 2005; Yang, 2011). However, creating authentic tasks is not an easy process and various factors should be taken into account. Those factors including learners' ability, pre-knowledge, domain knowledge, focus might be crucial while designing authentic environments as they influence the outcomes including engagement, learning and satisfaction.

5.3 Discussion of Difference Between Pretest, Posttest, and Retention Test Scores

The third research question was "Is there a significant difference between pretest, posttest, and retention test scores?" Quantitative findings were used in order to discuss this research question.

Vocabulary learning or vocabulary acquisition was widely investigated in previous mobile supported language learning studies in Turkey (Akkuzu, 2015; Saran, 2009; Orhan Ozen, 2013) and promising results were obtained in terms of academic achievement. In these studies, various strategies including supporting textbooks with QR codes or Bluetooth technologies (Celik, 2012; Orhan Ozen, 2013) and multimedia messages via mobile phones (Saran, 2009) were implemented in order to facilitate vocabulary learning with mobile technologies.

The present study, different from previous studies; included out-class authentic activities which were parallel to in-class activities. Overall results showed that there was an improvement from pretest scores to posttest scores and from posttest scores to retention test scores. When the vocabulary that was taught in classroom activities were excluded, similar results were obtained. Interestingly, although no significant difference between posttest and retention test scores was expected, overall results indicated an increase from posttest to retention test scores. Therefore, repeated measures were conducted for each experiment in order to understand this issue elaborately. Interestingly, results indicated that the first two experiments, which were Free Fall and Wheel and Axle, had similar results; however the last three experiment results indicated that there was no improvement between posttest and retention test scores. This finding can be due to different reasons.

One of the possible reasons is "novelty effect". First experiments were the experiments that students spent most time and looked up most words throughout the whole process. They were not used to this new learning environment at the beginning; therefore, "novelty effect" could have been one of the factors. Novelty effect is characterized by

the introduction of something new or novel which might significantly influence students' performance (Glass, 2010). In this respect, students might not perform authentic tasks efficiently at the beginning; however, by getting used to the learning environment, their posttest scores improved gradually, and hence the difference between retention test and posttest scores decreased.

Other reasons may be complexity of the first two experiments and excessive number of unknown words which were mentioned in the interview sessions. Although target vocabulary was excluded while investigating the difference between scores, the elementary level students were exposed to the target language in-class activities. In this respect, as time went by, they got used to the target language. Moreover in terms of exposure, several words were used in multiple contexts in five-week experimentation period. They were exposed to the vocabulary they encountered in the first experiments multiple times throughout the process; therefore, those multiple exposures might have influenced their retention scores. Multiple exposures to the target vocabulary in various contexts resulted in promising results in terms of retention in previous studies (Hirsch, 2013; Stahl, 2003; Web, 2007). In this respect, the retention test scores of the first experiments might have improved after a while. As a result, duration of the study could be extended by embedding different contexts of the same vocabulary to cause learners to be exposed to the target vocabulary frequently. Although, based on meta-analysis of Sung et al. (2015) that explore how effective mobile devices are for language learning, mid-term intervention (1-6 months) resulted in better learning performance than very short-term (<1 week) and long-term interventions (>6 weeks); the present study shows that multiple exposures in different contexts facilitate long-term retention.

Although students' vocabulary test scores improved gradually, students indicated several reasons about themselves that may have blocked their learning. Those were not reading the related sentences of visuals in mobile system and trying to guess from only visuals by not using the alternative definitions. Moreover, they had problems due to just focusing on different meanings of the words that they knew before which resulted in not

learning the correct meanings of the words. For instance, for the words of "right triangle", they mostly did not look up the meaning in mobile system and thought the word group as the triangle which is at the right side of their bodies. In that point, vocabulary learning is a process of explicit-implicit continuum (McDonough & Shaw, 2012). Especially, for the novice learners, several of them did not have the ability of inferencing the meaning of the words from the context. Since specific discourse type words which have high academic utility should be taught explicitly, skills of several students are not enough to support inferences about meaning of these kinds of words (Snow, 2010). In this respect, mobile support systems might be beneficial for providing definition support as an explicit part of vocabulary learning; however, students needed to be guided about when to use this system.

In the present study, the target vocabulary was chosen from the curriculum and students were motivated to encounter the target vocabulary later in-class activities. They were in the opinion that the experiments which were parallel to their lessons resulted in long-term retention. Learning that takes place in multiple settings produces a maximal learning effect by connecting formal (e.g. classroom) and informal learning (e.g. real-life situations) (Sung et al., 2015). This result was consistent with the study of Sandberg et al. (2011) in which the group who had combined formal learning at school with informal learning at different contexts achieved better vocabulary test scores. .

5.4 Discussion of Experiences of Learners Concerning Mobile Supported Situated Learning Environment

The last research question was "What are the experiences of the learners concerning mobile supported situated learning environment?" Information about the students' experiences about the entire five-week period and their suggestions was gathered in semi-structured interviews. When students' opinions about positive aspects of this mobile supported situated learning environment were asked, they pointed out that they found it interesting, entertaining and different. This finding was consistent with the

study of Shih and Young (2008) who gathered opinions of learners about situated language learning environments that promote learners' English communicative competence. Moreover, students mostly emphasized contextualized learning, learning by doing and incidental learning as positive aspects of situated learning environment which are highly recommended strategies for vocabulary learning.

On the other hand, students' negative opinions were also gathered for the mobile system which included difficult sentence structures and vocabulary and inadequate visuals which were discussed in the previous sections. Moreover, several students pointed out that situated learning environments were not appropriate for everyone. The learners who were not interested in science and also the novice learners experienced problems during the process. In this respect, it is crucial to design those environments according to their interests. Situated learning environments could be more effective for expert learners instead of novice learners. In the study of Guariento and Morley (2001), lower level students became frustrated, confused and demotivated with complex authentic tasks.

Three of the students focused on the difficulty of creating these kinds of environments, and they stated that it is not possible for everyone to go to museums with tablets. The researcher agreed with the idea that creating those environments is not an easy process. Moreover, this mobile system was appropriate for only METU Science and Technology Museum, therefore only students from METU were able to benefit from it. As a motivating strategy, the target vocabulary was chosen based on the curriculum of Elementary level; thus, the students wanted to proceed as their knowledge of the target vocabulary would be tested in the vocabulary quizzes and in the midterm exams in their departments. The best way to provide authenticity is actual work in real environment (Herrington & Oliver, 2010), although it is not an easy process to create and make the learners access those kinds of learning environments.

Students' opinions about the mobile vocabulary learning system were categorized into two groups: usability issues and content suggestions. Students mostly expressed positive

opinions about usability; however, almost half of the interviewed students pointed out the save problem. In this mobile system, students needed to save before closing the application; instead, they suggested an automatic save function before closing the mobile system. Interestingly, in the pilot study students did not have any problems with this issue; thus, the researcher did not make any changes before the actual experiment. Students also expressed positive opinions about practical applications, appropriateness of screen size and easiness of writing on touchscreen. In previous mobile language studies, although the use of smaller hand-held devices have increased substantially in recent years (e.g. cell phones), the use of larger devices remained the same due to their larger screen sizes and higher processing power (Sung et al., 2015).

As for content suggestions, they suggested that words used in the definitions and related sentences could have been easier and they also advised the researcher to use only the first meanings of the words and give Turkish equivalences. However, since presenting list of words and giving the meaning of the words in native language promote memorization, it is not a suggested strategy to learn vocabulary (Shrum & Glisan, 2015). Another suggestion was to make the content more gamified. There were several studies which integrated game based learning in mobile systems and resulted in promising results in terms of motivation and vocabulary learning (Akkuzu, 2015; Chen et al., 2009). According to these students feedback, in the future this study can be replicated by combining principles of situated learning theory and game based learning.

Finally, future suggestions were gathered and the students suggested replicating the present study with a younger age group. Moreover, they offered that this kind of learning is more appropriate for applied courses (Science and so forth.). Because one student did not like to go to the museum every week, she offered in class activities instead of going to the museum. For this issue, two students suggested creating digital platforms that everyone could reach. Digital authentic environments including 3D virtual platforms and mobile blogs were mostly used in the previous studies (Shih & Young, 2008; Huang et al., 2011; Yang, 2011). Although common idea for authenticity is

providing real-world tasks (Huang et al., 2016), authenticity depends on how the learner immerse and engage in the authentic activity. Authenticity of the task depends on whether or not a student is engaged in the task (Guariento, 2011). In this respect, digital platform can be used by taking into account how learner is engaged in the task.

5.5 Conclusion

EFL learners do not have the opportunity to learn vocabulary in the context of ordinary communication; by contrast, they use memorizing strategies, which is a slow and less successful process. In this respect, situated learning environments which provide authentic learning environments might promote contextual vocabulary learning. There are three main components of contextual vocabulary learning: the context, the learner and the vocabulary. This study has contributed to a better understanding of the relationships and dynamics between these components and deciding what should be made explicit in teaching and what should be left implicit in situated learning environments that promote contextual vocabulary learning.

In the present study, *context* was a real environment that learners could manipulate science experiments as a consequence of understanding the instructions in the target language. In previous contextual vocabulary learning studies, authentic texts were widely used as authentic context. The difference of the present study is using a real environment as authentic context. Real-world relevance led the learners to be engaged in the activities and sometimes made them to be in state of flow. Authenticity of the context depends on whether or not a student is engaged in the context. Engagement can be maintained by providing learners with the opportunity to see and explore consequences of their every action and embedding assessments in situated learning environment. Otherwise, they do not attempt to learn the meaning of the words or try to inference from the context. Another advantage of real-environment is providing rich contextual clues. In a real environment, students have the opportunity to infer the meaning of the words from the experimental setup with rich contextual clues.

Problems related to context arise due to novelty effect and the complexity or simplicity of the authentic environment. This kind of learning environment was a new approach for learners. As a result of novelty effect, learners did not behave naturally and could not manage contextual vocabulary exploration processes properly at the beginning. On the other hand, while complexity of the experimental setups discouraged some of the learners, simplicity of the setups caused some of the learners not to infer the meaning of the words from the context. In this respect, the first step of creating situated learning environments is to choose appropriate context which will not make the learner exhausted or bored.

The process of inferencing the meaning of the words from the context is not an easy process and not appropriate for each learner. In this respect; it is crucial to investigate the second component, the learner and his/her interaction with the context. As for learner component, learners' prior knowledge about the context and their focus while interacting with the real environment were crucial dynamics. In the present study, learner's prior knowledge about the context affected the results in two ways. While high pre-knowledge resulted in not exploring the contextual vocabulary, low pre-knowledge resulted in incorrectly guessing the meaning of the words from the context. In this respect, it is crucial to design an authentic environment appropriate for the pre-knowledge of learners. Another important factor was the focus of learners. Learners who focused on just completing the authentic tasks were not able to learn any vocabulary from the context. At least some degree of conscious attention was necessary to learn the target vocabulary. In the present study, students were exposed to the target vocabulary in classroom activities after their authentic learning experience. This approach promoted learners to pay attention to the target vocabulary while performing authentic activities and also they had the opportunity to practice newly learned target vocabulary later in classroom activities.

In situated learning environment, the novice learners and the learners who do not have any experience of contextual vocabulary exploration have problems while inferencing

the meaning of the words from the context. In this respect, supporting technologies might play crucial role. In the present study, mobile vocabulary learning system provided the definition of the vocabulary in multiple modes including visual and dictionary definition. Although visual definition support was highly preferred, providing support with alternatives gave learners the opportunity to choose the most appropriate one. This guidance which can be referred to as the explicit teaching part of contextual vocabulary learning played a crucial role in minimizing limitations of incidental learning. Especially, novice learners and learners with high anxiety of language learning benefitted from this support. However, there is always a risk of shifting from an authentic learning environment to an unauthentic learning environment. In this respect, it is highly recommended that the definition support for each word should not be provided; instead, hidden contextual clues could be more beneficial. While deciding what to teach explicitly, the third component of contextual learning played a crucial role: the *vocabulary*.

The present study included three types of vocabulary which were general discourse type, intermediate discourse type, and specific discourse type. General discourse type was not looked up in the mobile learning system. On the other hand, intermediate and specific discourse types of words which have a high academic utility were mostly looked up in the mobile learning system. They were the words that the learners had not been exposed to before. The findings of the present study showed that words with high academic utility can be taught explicitly; however, they are unlikely to be retained if they are taught in lists rather than being embedded in meaningful contexts. Another important dynamic for vocabulary is the multiple exposures. The findings of the present study indicated that multiple exposures to the target vocabulary resulted in long-term retention. Especially, multiple exposures in different contexts enabled the learners to learn different functionalities of the target vocabulary. It can be recommended that instead of presenting an excessive number of unknown words to the learner, multiple

exposures of the same vocabulary in different meaningful contexts could be much more beneficial for long-term retention.

Authentic task completion is a consequence of understanding the task in target language. Previous studies did not recommend early exposure of novice learners to the kinds of authentic tasks they will encounter in the future. Indeed, it is not an easy process for elementary level students to accomplish authentic tasks based on instructions in target language. However, this study showed that they can get used to the process and accomplish the tasks after a while, especially with the support of a mobile system. Appropriate guidance can prevent learners to feel frustrated, lost and uncomfortable in a situated learning environment.

The assessments which were embedded in situated learning environment also made the assessment process authentic. The present study used the strategy of accomplishing the tasks as a consequence of understanding the instruction in the target language. However, in some situations this type of assessment might mislead the teacher, because several students in the study could not accomplish the tasks not due to language issues, instead, due to complexity of experimental setup, sense of direction problems and so forth. It is recommended for teachers to follow the progress of learners in situated learning environments to minimize these misleading issues.

According to the results of the pretest, posttest, and retention test, the learners' vocabulary test scores improved as a result of experiencing mobile supported situated learning environment. In terms of long-term retention, the learners' vocabulary scores were still high after six weeks from the experimentation process. Moreover, opinions of the learners were promising in terms of its contributions to their long-term retention, incidental and contextual vocabulary learning. However, it is not an easy process for educational practitioners to create those situated learning environments. Moreover, there are issues of generalizability of this kind of learning environments. The context of this study was METU Science and technology museum that only METU learners had the

opportunity to access. In this respect, virtual representations of such environments might be recommended in order to maintain engagement. 3D virtual worlds such as Second Life, Active Worlds provide opportunities of highly real-world relevance. Situated learning environments can be created in those platforms by taking attributes of learner, context and vocabulary into account.

5.6 Practical Implications

Designing and developing situated learning environments to promote contextual vocabulary learning is a process in which various dynamics, such as target vocabulary, attributes of learners and context, need to be taken into account: Following suggestions for educational practitioners were revealed based on the findings of the present study.

- Authenticity of the context depends on how learner engages in the context. Engagement can be maintained by providing high real-world relevance and an opportunity for learners to see the consequences of their every action in the context.
- Learners' interest and pre-knowledge about the context should be taken into account in order not to make them bored or exhausted.
- Having learners accomplish the authentic tasks as a consequence of understanding the instructions in the target language can be chosen as a strategy of situated assessment; however, teachers need to follow the progress of learners to minimize misunderstandings.
- It is recommended not to provide definition support for each word; instead, hidden contextual clues might be much more beneficial especially for high frequency words. Specific discourse type words, such as scientific terms, can be taught explicitly by presenting them in various meaningful contexts. High frequency words, in contrast, can be learned incidentally with multiple exposures.

- Providing multiple exposures to the target vocabulary is crucial. Consequently, instead of presenting an excessive number of unknown words to the learner, multiple exposures of the same vocabulary in different meaningful contexts might be much more beneficial for long-term retention.
- Support or guidance in contextual vocabulary learning is crucial and mobile technologies can be used by taking advantage of portability of the device and mobility of the learner.
- Although visual definition support is highly preferred, providing support with alternatives might allow learners to choose the most appropriate one for them. Providing alternative supports also minimizes the problems that may result from content design issues.
- Contextual vocabulary exploration is not an easy process especially for novice learners. Those learners might need extra support or guidance at the beginning. After a while, they get used to this type of learning.
- Exposing learners to the target vocabulary in classroom activities after authentic learning experiences contributes to long-term retention and make them pay attention to the target vocabulary while performing authentic tasks. At least some degree of conscious attention to the target vocabulary is necessary in incidental vocabulary learning.
- Tablets can be used as supportive technologies in situated learning environments as they have a large screen size and it is easy to write on their touch screens.

5.7 Recommendations for Further Research Studies

Although the number of mobile learning studies increases gradually, previous studies have mostly focused on the effectiveness of mobile learning or development of mobile learning systems. In the present study, learners' processes were explored elaborately. In this respect, learners' processes in mobile supported learning environments can be studied more in different domains.

Moreover, as suggested by the participants of the present study, vocabulary learning is a process that begins in the early childhood; therefore, this study can be replicated with younger age groups, such as primary school or pre-school students. On the other hand, since enabling the learners to access the situated learning environments is not an easy process, virtual situated learning environments for vocabulary learning can be developed by taking into account how the learner is engaged in the activities. Moreover, factors such as learner's interest, pre-knowledge, learning strategies, and anxiety levels can be explored by supporting with empirical findings in the future.

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APPENDIX A

DEMOGRAPHIC INFORMATION FORM

Bilgi Alma Formu

Bu anket, ODTÜ Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü'nde yapılmakta olan "Exploring the effects of situated mobile learning system on learners' vocabulary acquisition, task completion and contextual vocabulary exploration processes" başlıklı doktora tezi kapsamında gerçekleştirilecek mobil destekli deneyler öncesinde genel bilgi almak amacıyla hazırlanmıştır.

Bu anket için vereceğiniz cevaplar yalnızca bu araştırma için kullanılacaktır.Bu nedenle lütfen her soruyu dikkatle okuyarak, kendinize en uygun seçeneği işaretleyiniz veya cevaplayınız.Lütfen cevapsız soru bırakmayınız.Katkılarınız için teşekkür ederiz.

Çiğdem Uz Bilgin

Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü

1) Adınız Soyadınız:

2) Okul Numaranız:

3) Yaşınız:

4) Cinsiyetiniz: ○Kadın ○Erkek

5) Mezun olduğunuz lisenin adı:

_____

6) Mezun olduğunuz lisede eğitim gördüğünüz alan türünü işaretleyiniz.

○ Sayısal ○Sözel ○Eşit ağırlık ○Yabancı Dil ○Diğer varsa belirtiniz

7) Aşağıdaki alanlardan hangisi/hangileri ilginizi çekiyor?

○ Sosyal Bilimler ○ Fen Bilimleri ○ Güzel Sanatlar ○Spor Bilimleri

○ Diğer varsa belirtiniz:

_____

8) Fen Bilimleri (Matematik, Fizik vb.) alanıyla ilgili bilimsel deneyler ilginizi çekiyor mu?

○ Evet ○ Hayır

9) ODTÜ'de kazandığınız bölüm:

10) ODTÜ İngilizce Hazırlık sınıfında alacağınız eğitim dışında, ortaöğreniminiz sırasında İngilizce Hazırlık eğitimi aldınız mı? ○ Evet ○ Hayır

11) İngilizce Hazırlık eğitimi dışında, daha önce herhangi bir İngilizce dersi, İngilizce kursu vb. eğitime katıldınız mı? ○ Evet ○ Hayır

12) İngilizce eğitiminiz sırasında karşılaştığınız aşağıdaki beceri alanlarını, kendinize güvenme derecenize göre, dairelere 1'den 6'ya doğru sıralayarak yazınız (Kendinize <u>en çok güvendiğiniz</u>alana 1, <u>en az güvendiğiniz</u> alana 6 yazarak 1'den 6'ya doğru sıralayınız).

◯ Kelime bilgisi ◯ Okuma

◯ Gramer bilgisi ◯ Konuşma

◯ Yazma ◯ Dinleme

13) Dokunmatik ekranı olan cep telefonu, tablet bilgisayar vb. bir mobil cihaza sahip misiniz?

○ Evet ○ Hayır

13. soruya cevabınız Evet ise aşağıdaki a ve b şıklarını cevaplayınız.

a) Sahip olduğunuz dokunmatik ekranı olan mobil cihaz, aşağıdakilerden hangisi/hangileridir?

○ Tablet bilgisayar ○ Dizüstü bilgisayar ○ Cep telefonu

○ Diğer varsa belirtiniz:

_____

b) Dokunmatik ekranı olan mobil cihazı ne kadar süredir kullanıyorsunuz?

○ 1 yıldan az ○ 1 - 3 yıl ○ 3- 5 yıl ○ 5 - 7 yıl ○ 7 yıldan fazla

14) Daha önce herhangi bir ders kapsamında, öğretmeninizin rehberliğinde bir mobil cihaz(tablet bilgisayar, cep telefonu vb.) kullandınız mı? ○ Evet ○ Hayır

14. soruya cevabınız Evet ise aşağıdaki a ve b şıklarını cevaplayınız.

a) Ders kapsamında hangi mobil cihaz/cihazları kullandınız?

○ Tablet bilgisayar ○ Dizüstü bilgisayar ○ Cep telefonu

○ Diğer varsa belirtiniz:

_____

b) Mobil cihazı hangi ders/dersler kapsamında, hangi amaçla kullandınız?

Ders/derslerin ismi: _____

Kullanım amacı: _____

15) Daha önce herhangi bir ders kapsamında, öğretmeninizin rehberliğinde eğitim amaçlı bir mobil uygulama (app) kullandınız mı? ○Evet ○ Hayır

15. soruya cevabınız Evet ise, ders kapsamında öğretmeninizin rehberliğinde hangi mobil uygulamayı (app)/ uygulamaları , hangi ders kapsamında ve hangi amaçla kullandınız?

Mobil uygulamanın ismi:

_____

Dersin ismi: _____

Kullanım amacı: _____

16) İngilizce dersi kapsamında, öğretmeninizin rehberliğinde İngilizce öğrenmeye yönelik mobil bir uygulama (app) kullandınız mı? Evet ○ Hayır ○

_____

16. soruya cevabınız Evet ise, İngilizce dersi kapsamında öğretmeninizin rehberliğinde hangi mobil uygulamayı (app) , hangi amaçla kullandınız?

Mobil uygulamanın ismi:_____

Kullanım amacı: _____

17. Herhangi bir ders kapsamı dışında, İngilizce öğrenmeye yönelik mobil bir uygulama (app) kullandınız mı? ○ Evet ○ Hayır

17. soruya cevabınız Evet ise, ders kapsamı dışında İngilizce öğrenmeye yönelik hangi mobil uygulamayı (app), hangi amaçla kullandınız?

Mobil uygulamanın ismi:

_____

Kullanım amacı:

---

18. Bu çalışmaya katılmak için hafta içinde size en uygun olan 3 günü, uygunluk derecesine göre 1'den 3'e kadar sıralayınız (Dairelerin içine size en uygun güne 1, daha az uygun olan güne 2, en az uygun olan güne 3 yazınız).

◯ Pazartesi ◯ Salı ◯ Çarşamba ◯ Perşembe ◯ Cuma

19. Bu çalışma kapsamında, sizinle gerekli durumlarda iletişime geçebilmemiz için cep telefonu numaranızı yazınız

APPENDIX B

ACADEMIC ACHIEVEMENT TEST

Vocabulary Test-Part 1

A. Complete these sentences using the words on this list. Use each word only once

opposite	disc	swelling up	look	stared	pattern
palm	seconds	stepped back	times	also	still
shrink	direction	again	stands	spinning	appears

1. When I saw him, he was going in the _____ of the library.
2. _____ at the sky! Enjoy beautiful blue sky and fluffy clouds
3. The _____ shape with a hole in the middle is typical of ancient Chinese coin.
4. Everyone _____ at the boy with the ripped shirt.
5. My housecleaner comes to clean my house two _____ a month.
6. As a salesclerk, he _____ behind the counter all day. It is so tiring.
7. Hold your breath for six _____ and then breathe out.
8. Tom moved forward to kiss Mary, but she _____.
9. The horse ate the apple pieces from the _____ of my hand.
10. When I woke up, it was _____ raining.
11. He is older than he _____.
12. She works as an artist and _____ as a musician.
13. On Venus, the sun rises in the west, and sets in the east - the _____ of Earth.

14. I couldn’t hear you, please say that _____.
15. Her bruised knee was already _____.
16. Wool sweaters always _____in that dryer.
17. Don't put your arm in the washing machine while it is _____; you could hurt yourself.
18. The _____on the wallpaper in the kids’ room is of a tropical jungle with exotic plants, birds and animals.

B. Complete these sentences using the words on this list. Use each word only once.

top	digital	sharp	compared	tip	other	read	velocity
hangs	green	process	press	button	display	time	
balls	device	magnetic	mass	each	showed	fall	

19. Her _____of writing a book begins with getting an idea and sketching it out.
20. I chose this coat because the _____ones were too expensive.
21. I _____the two brands of soup and decided this one tastes better.
22. The _____of the wind is twenty kilometers per hour.
23. I'll need a _____knife to cut this pumpkin.
24. I cut the _____of my finger off with a very sharp knife.
25. You need to _____this button to turn off the alarm.
26. She _____her coat on a hook behind the door.
27. There are four bedrooms, _____with its own shower and WC.
28. Tennis _____are generally yellow, and usually have a number on them.
29. He pushed the power _____on his computer.
30. They climbed to the _____of the mountain.
31. Please follow the instructions you see on the _____of your computer.
32. Do not _____from the top of the tree! You can break your legs.
33. _____traffic light allows traffic to proceed in the direction.
34. I _____that book last year and loved it.

35. I can attach my new _____camera to my computer and download my photos onto my hard drive.

36. He _____ me his new cat, it was so cute!

37. A telephone is a type of communication _____.

38. The _____of an object is the amount of matter it contains and never changes.

39. My children used to enjoy spelling words on our fridge with _____letters.

40. Temperature and cooking _____depends on the food.

Vocabulary Test Part 2

A. Complete these sentences using the words on this list. Use each word only once.

kept his balance	kilogram	put	left	use	center
units	levers	right	weight	now	try

1. The cashier _____ my groceries in the bag.
2. One _____ equals to a thousand grams in metric system.
3. If you want to lose more than five kilograms of _____, you'll need to eat less and exercise more.
4. A ruler is a measuring stick marked with _____ for measuring along its edge.
5. The dancer _____ while standing on one toe.
6. A married woman typically wears a ring on her _____ hand.
7. Most people use their _____ hand to eat with and write with.
8. _____ are generally used to lift heavy objects easily.
9. Please _____ a black pen to fill out the form.
10. If we leave _____, we can be home by ten o'clock.
11. You need a pencil and ruler to find the _____ of the circle.
12. I_____ answer all the questions on the test, but I do not have enough time.

B. Complete these sentences using the words on this list. Use each word only once.

tie	diameter	cylinder	force	same	different	then
number of times	which	wheel and axle	amount	apply	rotating	lifted

13. They use _____ disco balls to give light show in the disco.
14. He _____ the heavy suitcase on the floor with difficulty.
15. _____ this label to your suitcase, so you don't lose it.
16. To move heavy things around, you'll need to _____ force.
17. Parents should not use _____ against their children as a method of discipline.
18. The radios were the _____ price, but this one sounded better.
19. I do not remember the _____ I have crashed my car; I am so careless.
20. For this project, you'll need a tall _____ like a large juice can.
21. To calculate the area of a circle, you need to know the _____.
22. The _____ is one of six simple machines which is used for lifting weights.
23. The books, _____ have red covers, are new.
24. This _____ of snow isn't enough for skiing.
25. The twins wear _____ shirts so the teacher can tell them apart.
26. He won the first game in 1994. _____ ,he won the second game in 2004.

C. Complete these sentences using the words on this list. Use each word only once.

water	objects	biggest	noticed	so that	triangle	when
filled	turn	square	right triangle	between	again	

27. _____ the key in the lock to open the door.
28. The prisoners are allowed to keep only a few personal _____ in their cells.
29. 13.8 million people live in Istanbul, making it the _____ city in Turkey.
30. All sides of a _____ are equal in length.

31. The border _____ Mexico and the United States is too dangerous.
32. The sum of all the angles of a _____ is 180 degrees.
33. He _____ the box with candy.
34. _____ is the most common liquid on Earth.
35. I _____ that you were not in school today.
36. _____ is one of the closed geometric figures which has a right angle.
37. Close the door _____ the cold air doesn't come in.
38. I couldn’t hear you, please say that _____.
39. The dog stopped barking _____ he saw his owner

APPENDIX C

OBSERVATION FORM

Deney: Wheel and Axle

Öğrencinin adı soyadı:

Tarih:

Deney Basamakları	+/-	Notlar
1. Rotate the wheel and axle and lift the weight.		
2. Tie the weight to the second cylinder which has a different diameter. Then lift the weight.		
3. Now tie the weight to the third cylinder which has a different diameter. Then lift the weight.		
4. When you used different cylinders: a) Did you apply the same amount of force? Explain.		
b) Did you rotate the wheel and axle the same number of times? Explain.		

Yapabiliyor:+ Yapamıyor:-

APPENDIX D

INTERVIEW PROTOCOL

Görüşme Soruları

Merhaba …… (öğrencinin ismi), geçtiğimiz beş haftalık süreçte yapmış olduğunuz mobil destekli deneyler hakkındaki görüşlerinizi almak üzere size bir takım sorular yönelteceğim. Yapacağımız görüşmeler sadece araştırma amaçlı kullanılacaktır.Bu çalışma sonunda isminiz hiçbir yerde kullanılmayacaktır. Görüşmelerimiz ses kayıt cihazı ile kaydedilecektir. Bu mülakata katılmayı onaylıyor musunuz?

Öğrencinin genel özellikleriyle ilgili sorular

1) Daha önce İngilizce eğitimi aldın mı? Nasıl bir eğitim aldın?
2) Fen ve matematik deneylerine ilgili duyuyor musun?
3) Sözel mi yoksa sayısal alana mı yatkın olduğunu düşünüyorsun?
4) Bu deneylerde ilgi alanının deneyi etkileme/etkilememe durumu hakkında ne düşünüyorsun?
5) İngilizce kelime öğrenimi ile aran nasıl? Nedenleriyle açıklar mısın?
6) Kelime öğrenmek için neler yaparsın?
7) Herhangi bir İngilizce metin okurken anlamadığın/bilmediğin bir kelime ile karşılaştığında ne yaparsın?

Deney süreci ile ilgili genel sorular

8) Bu beş haftalık süreçte gerçekleştirdiğin tablet bilgisayar destekli deney süreci hakkındaki olumlu ve olumsuz görüşlerin nelerdir?
9) Deneyleri yaparken zorlandın mı? Eğer zorlandıysan en çok nerelerde zorlandın? Neden?
10) Deneylerde kullanılan İngilizce kelimeleri anlamlarına bakmadan deney ortamından tahmin edebilir miydin? Eğer edebiliyorsan nasıl?
11) Deneylerde kelimeyi, cümleyi anlamadığında ne yaptın? Nasıl bir yol izledin?
12) Kelime anlamlarına bakıp da anlamadığın kelimeler oldu mu? Eğer anlamadığın olduysa neden kaynaklandığını düşünüyorsun?
13) Kelime anlamını bilmemene ve anlamına bakmamana rağmen deney ortamından anlamını çıkardığın kelimeler oldu mu? Nasıl oldu?
14) Senin için önemli olan kelimeler mi yoksa deneyi yapmak mı?

Öğrenmeye katkısı

15) Bu sistemin senin kelime öğrenimine katkısı olduğunu/olmadığını düşünüyor musun? Açıklar mısın?
16) Bu şekilde kelime öğrenmenin kalıcılığı konusundaki düşüncelerin nelerdir?
17) Deney sürecinde kelimenin anlamını anlayamama/öğrenememe durumları ile karşılaştın mı? Karşılaştıysan sebepleriyle açıklar mısın?

Mobil Sistem

18) Tablet bilgisayardaki yazılımın kullanışlılığı hakkında ne düşünüyorsun? Olumlu ve olumsuz yönlerini söyler misin?
    -Yönergeler açık ve net miydi?
    - Deney basamakları açık ve net miydi?
    -Resim ve animasyonlar/sözlük anlamları yeterli miydi?
    -Deney basamakları arası geçişler uygun muydu?

19) Yazılımı kullanmayı öğrenmen kolay mıydı yoksa zor muydu? Nedenleriyle açıklar mısın?
20) Deney süresince tabletteki mobil sistemden yardım aldın mı? Hangi sıklıkla yardım aldın? Ne zaman ihtiyaç duydun?
21) Tablet bilgisayardaki mobil sistem olmadan bu deneyleri gerçekleştirebilir miydin? Bu sistem, deneyi anlamanda yardımcı oldu mu? Nasıl?
22) Bu mobil yazılımın daha kullanışlı olabilmesi için önerilerin neler olabilir?
23) Tablet bilgisayarı kullanırken ne gibi olumlu/olumsuz şeylerle karşılaştın?

İleriye yönelik sorular

24) İleriki dönemlerde kelime öğretiminde bu tür uygulamaların kullanılmasını tercih eder misin? Nedenleriyle açıklar mısın?
25) Bu tür bir sistemin diğer derslerinde de kullanılması konusundaki düşüncelerin neler?
26) Bu çalışmayı göz önünde bulundurarak ileriye yönelik önerilerin neler olabilir?

APPENDIX E

INFORMED CONSENT FORM

ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU

Bu araştırma, ODTÜ Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü doktora öğrencisi Çiğdem Uz Bilgin tarafından ve Yrd. Doç. Dr. S. Tuğba Tokel danışmanlığında yürütülen doktora tez çalışmasıdır. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Çalışmanın Amacı Nedir?

Araştırmanın amacı, yabancı dil eğitimi kapsamında geliştirilen mobil kelime öğretim sistemi ile öğrenciyi gerçek öğrenme ortamında desteklemek ve öğrencilerin bağlamsal kelime öğrenme süreçlerini incelemektir.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?

Araştırmaya katılmayı kabul ederseniz, sizden beklenen, size verilecek olan kelime bilgisini ölçen akademik testi doldurmak, Uygulamalı Bilim Merkezi'nde gerçekleşecek olan deneylere bizzat katılmak, deney sürecinde gözlemlenmeyi kabul etmek ve sürecin sonunda yapılacak olan yüz yüze görüşmelere katılmaktır.

Sizden Topladığımız Bilgileri Nasıl Kullanacağız?

Araştırmaya katılımınız tamamen gönüllülük temelinde olmalıdır. Cevaplarınız tamamıyla gizli tutulacak, sadece araştırmacılar tarafından değerlendirilecektir.

Katılımcılardan elde edilecek bilgiler toplu halde değerlendirilecek ve bilimsel yayımlarda kullanılacaktır.

Katılımınızla ilgili bilmeniz gerekenler:

Size yazılı olarak uygulanacak olan Akademik Test hiçbir şekilde dersinize etkisi olmayacaktır, sadece bilimsel amaçlı kullanılacak ve kimliğiniz gizli tutularak değerlendirilecektir. Uygulamalı Bilim Merkezi'nde gerçekleşecek deneylerde herhangi bir rahatsızlık verecek unsur bulunmamaktadır. Yapılacak deneylerde, deney sürecindeki gözlemlerde ve sonunda gerçekleştirilecek olan yüz yüze görüşmelerde kendinizi rahatsız ederseniz uygulamayı yapan kişiye durumu bildirmeniz ve çalışmaya katılmayacağınızı iletmeniz yeterli olacaktır.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü doktora öğrencisi Çiğdem Uz Bilgin (uz.cigdem@metu.edu.tr) 'den detaylı bilgi alabilirsiniz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.

(Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim Soyad Tarih İmza

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APPENDIX F

EXPERIENCES OF STUDENTS CONCERNING MOBILE SUPPORTED SITUATED LEARNING ENVIRONMENT (TURKISH)

Deney Süreci

Olumlu Görüşler		
Alt-tema	**f**	**Öğrenci İfadeleri**
Eğlenceli, ilgi çekici, farklı	6	"Çok eğlenceliydi. Bir şeyler öğrendim kelimeler açısından, aynı zamanda eğlenceli geçti." "Deneyler bizim ilgimizi çeken şeylerdi ve çok farklıydı".
Uzun süreli kalıcı	6	"Görsel bir şey akılda daha çabuk kalıyor. Ama kitaptan okuduğumuzda kalıcı olmuyor hiçbir şekilde." "Derste okuduğumuz metinlerde *hang* falan gördüğümde aklıma hemen sizin şu uygulamadaki o kadının çamaşır astığı resim geliyor. Bende görsel hafıza var ilk aklıma o geliyor."
Bağlamsal öğrenme	5	"Kelimenin anlamını bulamayınca deneyden bulmaya çalışıyorsun. İşe yarayan bir metod." "Sadece bir iki tane sözlük anlamına baktığım zaman anlamını çıkaramadım. Onlar da görselden çıkıyordu zaten. O bakımdan yararlı." "Normalde ben kelime kelime çevirirdim cümleyi, normalde belki kelimenin anlamını bile bulamazdım ama artık cümleye bakıyorum daha rahat oldu. Arkasına ne geleceğini düşünüyorum artık kelimelerin."
Rastlantısal öğrenme	3	"Bence etkili bayağı kelime öğrenme konusunda, çünkü ben öğrenemeyen bir insandım, kelimeyi ezberleyemiyordum böyle istemeden öğreniyor, ezberliyor insan daha güzel oluyor."
Yaparak öğrenme	6	"Bir şeyi kullanarak öğrenmek yararlı bir şey sonuçta biz Türkçeyi de öyle öğreniyoruz." "Deney yaparak öğrenildiği zaman daha çok kalıcı oluyor aklımda".
Derslerle paralel olması	2	"Bu normal derslerimizle alakalı olan kelimeler olduğu için de yararlı oldu." "Zaten kelime seviyem iyi olmadığı için birçok kelimeyi öğrendim, orada quizlerde filan da çıktı o kelimeler."

Olumsuz Görüşler		
Kelime ve cümle yapısı problemleri	4	"İlgili cümlede de kelimelerin anlamını bilmeyince biraz zor oluyordu." "Deney basamaklarındaki cümle yapıları biraz zor geldi benim seviyeme. Emir cümleleri vardı. Cümleler daha basit olsa daha iyi olurdu". "Bazı deneylerde zorlandım çünkü çok fazla kelime vardı, karışık geldi. Kelimeler daha aza indirilebilirdi. Bilmediğim kelime çoktu, , özellikle başta zor geldi."
Deney sürecinin kısalığı	2	"Sadece beş tane deneyle İngilizceye ne kadar katkısı olur onu bilmiyorum ama bu her hafta veya haftanın 3 günü biz bunu yapıyor olsak daha yararlı olurdu." "Deneyler daha uzun olursa belki daha kalıcı olabilir diye düşünüyorum çünkü çok kısa. Beş deney biraz az geliyor daha fazla olursa daha kolay öğrenebileceğimi düşünüyorum."
Bu tür otamların oluşturulmasının zor olması	3	"Mesela bunlar derste nasıl kullanılabilir ki? Deney ortamı yok sonuçta. O zaman da sınıfa mı uyarlanacak şekilde olacak? Deney ortamını oluşturmak bence zor." "Buna ulaşım sağlayabilecek kaç kişi var bu ülkede? Deneyleri nasıl yapabilecekler?"
Herkes için uygun değil	1	"Verimliliği kişiden kişiye değişir. Benim görsel hafızam olduğu için yararlı. Herkeste aynı olmayabilir"
Görseller yetersiz	1	"Bir de görseller biraz yetersiz kalıyordu benim için, tam olarak anlamını çıkartamıyordum bazı görsellerden."
Deney sürecinde karşılaşılan problemler		
Kaygı yüksekliği ve yön duygusu hataları	1	"Burada hazırlıkta yaşadığım İngilizce ile ilgili sıkıntılardan. Ben bunu öğrenemeyeceğim ki algısı oluştu. Deneylerde de bunun etkisini gördüm. Zaten öğrenemeyeceğim bakış açısıyla geldiğim için zorlandım." "Zaten baktığın zaman belli oluyor ama ben burada biraz yön algımdan kaynaklanan hataları yaptım."
Bilinmeyen kelimenin fazla olduğu deneylerde zorlanma	5	"ilk deneylerde zorlandım. Kelime bilgim arttı sanırım zamanla, sonra biraz daha anladım yavaş yavaş." "Bazılarında zorlandım. İlk deneylerde bilmediğim çok kelime vardı. Sonlarda o kadar yoktu ama."
Deney düzeneğinin karmaşık olması	5	"Zorlandım çünkü en çok da ilk deneyimizde zorlanmıştım o da deney düzeneğinden kaynaklıydı (serbest düşme deneyi), ama yavaş yavaş daha iyiye gittiğimi düşünüyorum. Çünkü deney düzeneğinden kaynaklı olduğunu düşünüyorum"
Görsellerin yanındaki ilgili cümleleri okumamak	1	"Mesela görselin yanında cümle var. O cümleyi okumadan direk görselden anlamaya çalışıyordum. Daha sonra resmin yanındaki cümlelere de bakmaya başladım anladım."
Deneyi bitirmeye odaklanmak	2	"İlk başta biraz aceleci oldum çok dikkat etmedim, bitirmeye odaklandım."

Anlamlarda alternatifleri kullanmamak	1	"Sonradan alışınca hani ilk başta resimlerin anlamlarına bakıyordum, resimde daha kolay gibi geliyordu sonra sözlüğe geçince aslında daha mantıklı gelmeye başladı ve anladım. Alternatifleri kullanmaya başladım."
Kelimelerin anlamını yanlış öğrenmek	2	"Bir de bazı kelimeleri yanlış anladığım oldu. O yüzden deneyleri tam yapamadım."
Deney ve ilgi alanının ilişkisi		
İlgi etkilemez	2	"İlgi alanımın sonuçları çok fazla etkilediğini düşünmüyorum." "Çok fazla formül, teknik bilgi içermiyor. O yüzden etkilemez bence."
İlgiden dolayı eğlenme	2	"Deneyler süresince fene ilgi duyduğumdan dolayı eğlendim, sıkılmadım, bu da sonucu etkiledi bence." "İlgim olmasaydı sıkılırdım. İngilizceyi zaten sevmiyorum bir de öyle olsa hiç yapamazdım."
Neden ve sonuç ilişkisi daha kolay kurulabilir	1	"Nedenlerini ve sonuçlarını anlardım. O bakımdan etkisi olabilirdi."
İlgiden dolayı fikir yürütebilme	2	"Çoğunu zaten deneyden çıkarttım bilmediğim bir şey olsaydı zorlanırdım." "Deneye daha çok ilgi duyduğum için okuyup uğraşmaktansa deneyi düşünüp fikir yürütmeye çalışmış olabilirim. O yönden ilgimin bir yararı olmuş olabilir."
Öğrencilerin odak noktaları		
Deneyleri bitirebilmek için kelime bilgisi	3	"Kelimeler daha önemli. Çünkü kelimeyi bilirsek zaten deneyi yapabiliriz." "Kelimeler tabi ki yoksa deneyi yapamazsın".
Deneyler (kendini kaptırma)	6	"Aslında kelime olması lazım ama deneyler. Buraya gelirken amacım kelime öğrenmekti ama sonra geldim ve deneyleri görünce kendimden geçtim diyebilirim."
Kelimelerin anlamına bakmak merak uyandırıcı	2	"Kelimeler de merak uyandırıcıydı bu ne demek falan diye. Kelimelere bakmak odak noktamdı" "Kelimeyi öğrenmek deneyin amacı bu zaten hazır deneyi yaparken bende öğrenmek istedim ve eğlenceli de geldi"
Kelimelerin anlamını bilmeden de deney yapılabilir, deney	1	"Bana göre benim odak noktam deneylerdi, çünkü deneyleri kelimelerin anlamlarına bakmadan bitirebilirdin, deney ortamından anlayabilirdin."

Öğrenme Durumları

Kalıcılık		
Alt-tema	**f**	**Öğrenci İfadeleri**
Görseller kalıcılığı etkiler	2	"Görsel bir şekilde çok kalıcı oluyor. Çok güzeldi bu deneyler." "Direkt kitap veya bilgisayar ortamında görsel olmadan direkt okumayla olduğu zaman o bilginin silinme şansı daha yüksek."
Farklı ve eğlenceli olması kalıcılığı etkiler	2	"Mesela hocalarımız hikaye falan anlattığı zaman, eğlenceli bir şeyler olduğu zaman, ilgimizi çektiği zaman daha çabuk öğreniyoruz, uzun süreli kalıcı oluyor, aynı şey oldu"
Tekrar edilmezse kalıcı olmaz	5	"Bence güzel öğretiyor ama onu tekrar etmedikten sonra anlamlı değil. Aynı kelimeyi birkaç kere daha biz tekrar edersek bence kalıcı olur."
Uzun vadede kalıcı olmaz	1	"Bir ay iki ay süreliğine işe yarar. Çok uzun sürede işe yarayamayabilir."
Uygulama süresi daha uzun olursa kalıcı olur	2	"Uzun olsa bunu hep yapıyor olsak kalıclığa baya katkı sağlar."
Derslerle parallel olursa kalıcı olur	1	"Derslerimizde daha sonra görüyoruz paralel diyebiliriz direk ben biliyorum diye aklıma geliyor. Derste de görmek kalıcılığı etkiliyor."
Kişiden kişiye göre değişir	2	"Bana göre görsel öğrenim daha iyi olacağı için unutmayacağını düşünüyorum ama kişiden kişiye göre değişebilir."
Öğrendiği her kelimeyi hatırlıyor	1	"Kalıcı. Orada öğrendiğim bütün kelimeleri hatırlıyorum."
Kelimelerin anlamını öğrenememe nedenleri		
Alt-tema	**f**	**Öğrenci İfadeleri**
İki kelime birleştiğinde farklı bir anlam çıkması	2	"Iki kelimeyi birleştirdiğimizde farklı bir anlam çıkıyor. Ama kendi düşünceme göre biz kendi bildiğimiz anlama göre bir kelime türetiyoruz kafamızdan ama doğru olmuyor anlayamıyoruz bazen."
Mobil sistemdeki görsellerin yetersizliği	3	"Son haftaki deneyimizde "steps back" i görselden gitmeye çalıştım ama görseli anlayamadım."
Anlamlarda ve ilgili cümlelerde kullanılan kelimelerin bazılarının bilinmemesi	5	"İngilizce anlamlarını da anlayamayabiliyorum bazen orada da çünkü anlamadığım kelimeler oluyor bilmediğim kelimeler oluyor."
Uygulamayı kullanmadan tahmin etmeye çalışman (ön-bilgi)	2	"Kendi bilgimden. Mesela orda left vardı. Ben onu *bırakmak, terk etmek* olarak anladım. Ama sol demekmiş. Appe bakmadım, kendi bilgimden dolayı anlamadım."

Görsellerin ilgili cümlelerinin okunmaması	1	"Cümleyi okumayınca resimde alakasız bir resimse hani çünkü bir sürü şey düşünüyorum o resme bakınca, aklıma bambaşka şeyler geliyor."
Deney düzeneğinin zorluğu	1	"Deney düzeneği karışık olduğu için kafam karıştı."
Deney düzeneğinin basitliği	1	"Deney kolay olunca kelimelere daha az bakılıyor, kafadan çıkartmaya çalışıyoruz yanlış olabiliyor."

Mobil Sistem

Kullanışlılık		
Alt-tema	**f**	**Öğrenci İfadeleri**
Pratik bir uygulama	1	"Hiçbir sıkıntı yoktu gayet pratik bir uygulama."
Tablet kullanımı konusunda tecrübesizlik	1	"Tableti kullanmaya başladığımda sıkıntı yaşadım. Çünkü teknolojik aletleri kullanmaya pek meyilli değilim. Telefonu kullansam da onu da yavaş kullanıyorum mesela. Başta biraz zorlandım. Sonra alışınca son deneyde hiç karıştırmadan yazmaya başladım."
Kaydetme problemi	6	"Verdiğimiz cevapları direkt yazınca kaydetse olmaz mı? Kaydetmeden çıkma problemi olabiliyor." "Bir iki kere kaydetmeden geri çıkmıştım o biraz kullanıcını hatası olabilir ama yazılım güzeldi."
Ekran büyüklüğü çok iyi	2	Tablet bilgisayar güzel. Telefondan daha iyi büyüklük açısından. Kağıtla yazmaktan da çok çok daha iyi.
Dokunmatik ekrana yazmak kolay	4	"Gayet basit kullanımı ki mobil aygıtları kullanıyoruz zaten. Dokunmatik ekran alışkanlığı var, kolay yazılıyor."
Düz yazı fontları yerine eğlenceli fontlar kullanılabilir	1	"Şu an düz bir Word penceresine yazı yazılmış gibi duruyor, sıkıcı. Duz değil de Comic sans falan olsa daha iyi olacak."
İçerik Önerileri		
Alt-tema	**f**	**Öğrenci İfadeleri**
Anlatımlarda ve cümlelerde kullanılan kelimeler daha kolay seçilebilir	5	"Sözlük anlamında kullanılan kelimeler biraz daha basit olsaydı." "Kelimenin iki anlamı var herkesin bildiği değil de öbür anlamı vardı. İlk anlamları kullanılsa daha iyi olur"

İki kelimeyi birleştirip ikisinin anlamına bakma şansı olmalı. Hem kelime kelime hem de grup anlamları verilsin	1	"Mesela kelime kelime bakıyorsun ya o iki kelimeyi ben bağdaştırmış olsam o iki kelimeyi birbirine şöyle çekip birleştirip ikisinin birlikte anlamlarına baksam mesela daha anlamlı olabilirdi belki. Hem kelime kelime hem de grup gurup olsun."
Mobil sistemdeki görsellerle ilgil öneriler	2	"Mesela görseller daha animasyonlu olabilir. Mesela dökme vardı. O kelimeyi orada öğrendim. Mesela bir şey dökülürken olsa daha güzel olabilirdi."
İçerik oyunlaştırılabilir	1	"İçerik daha oyunlaştırılırsa tercih edilebilecek bir app olabilir."
Basamak sayıları arttırılabilir.	1	"Daha kısa cümleler daha fazla aşamalar olabilirdi. Aşama daha da arttırılabilir belki daha kısa cümlelerle."
cümleler ve görseller deneylerle ilgili olabilir	3	"Görselleı ve yanındaki cümleleri deney ile bağdaştıramadım ne alaka dedim. Deneyle ilgili olsa daha akılda kalabilirdi".
Cümleler ve görsellerin alternatifleri olabilir	1	"Resim bir değil de iki tane üç tane resmin olmasını isterdim. Çünkü bazen gerçekten anlayamadığım resimler oldu. Alternatifler kullanıbilirdi."
Kelimelerin tekrarlı kullanılması	4	"her kelimeye birkaç kere baktığımızda daha çabuk aklımızda kalabilir, kelimeler tekrarlı kullanılabilirdi." "Mesela kelimeler bittikçe yeni kelimeler gelip dönüşüm olarak devam etse daha başarılı olur"
Konuşma diline yakın kelimelerin kullanılması	1	"Daha konuşma diline yakın. İnsanın konuşma dili olmasa bile sürekli bir şey yazarken bir şey okurken sürekli karşılaşabileceği şeyler. Mesela now try again onlarla da çok sık karşılaştık. Onlarla da o tarz kelimeler öğrenmek daha kolay olabilir."
Sistem ne zaman kullanıldı?		
Alt-tema	**f**	**Öğrenci İfadeleri**
Sadece deneylerin yönergeleri için	2	"Yönergelerin gelmesi konusunda etkili ama onun dışında pek şey olmadı benim için."
Kelime anlamlarından emin olmak için	2	"Emin olamadığım şeylere baktım. Tamam, bunun anlamı bu dedim ama acaba yanlış mı düşünüyorum bakış açısıyla da yardım aldım."
Spesifik kelimelerin (terim vb.) anlamlarına bakmak için	1	"Cümlenin içinden çıkaramadığımda başvurdum. Spesifik kelimelerde özellikle mesela düzeneğin adı, kare daire falan onlarda çok başvurdum."
Sadece görsel anlatım için	3	"Kelimelerin görsellerine baktım ve yanındaki cümleye baktım. Sözlük anlamını çok çıkartamadım. O ikisi daha yararlı oldu benim için."

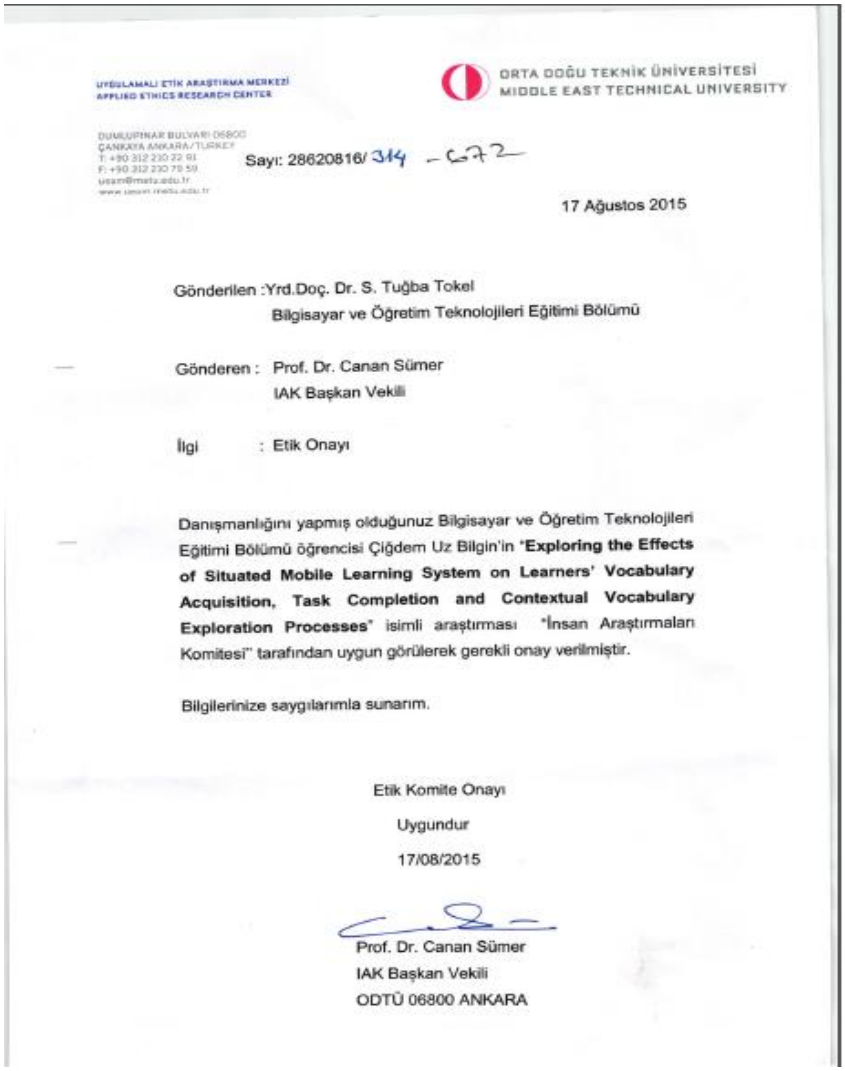
Her kelimenin anlamına baktım	4	"Kelime için hep baktım." "Her zaman yardım aldım yani kelime için. Çok aldım hatta. Bayağı yararlıydı. O olmasa yapamazdım herhalde."

Geleceğe yönelik öneriler

Alt-tema	**f**	**Öğrenci İfadeleri**
Küçük yaş grubuna uygulanabilir	3	"Bence yapılsın özellike ilkokula da böyle bir uygulama yapılabilir. 10 senedir İngilizce görüyoruz." "Özellikle çocuklar için çok güzel bir fırsat olur. Çocukken eğilim daha fazla olduğu, çocukları teşvik etmek için daha ilgi çekici."
Deney bazlı derslerde kullanılabilir	5	"Yani olabilir ama matematik ve fende daha yararlı olur diye düşünüyorum çünkü bir şeyleri görüp deney yapmak daha kolay daha anlaşılır bence." "matematik deneylerinde gayet hoş olabilir. Mesela o Pisagor Deneyi onun öğretilmesi açısından o kadar hoş bir şey olabilir ki aslında. Onu mesela matematikte kullansınlar."
Öğernci gruplarıyla devam edilmeli	1	Belki de tek tek olsak etkili olmazdı, gruplar halinde gelinmesi etkili olabilir ileride.
Herkesin ilgi alanina göre deney	3	"Bir de farklı türlü atıyorum fizik şeyi değil de bir felsefi deneyi olabilir. İlgi çekici başka bir şey.Mesela astronomi ile ilgili maketin incelenmesinde bu tür şeye başvurulabilir. Herkesin ilgisine gore"
Deney süreci uzayabilir	3	"Uzun süreli bir şey bizim İngilizcemiz açısından katkı sağlar. Deneylerin sayısı arttırılabilir"
Deneyler sanal ortama aktarılabilir	2	Deneyleri sanal ortama aktarılması daha iyi olur herkes daha kolay ulaşır. Belki dijital ortamda yapılsa daha iyi olabilir.

APPENDIX G

PERMISSION OF ETHICAL COMMITTEE



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17 Ağustos 2015

Gönderilen :Yrd.Doç. Dr. S. Tuğba Tokel
Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü

Gönderen : Prof. Dr. Canan Sümer
IAK Başkan Vekili

İlgi : Etik Onayı

Danışmanlığını yapmış olduğunuz Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü öğrencisi Çiğdem Uz Bilgin'in **'Exploring the Effects of Situated Mobile Learning System on Learners' Vocabulary Acquisition, Task Completion and Contextual Vocabulary Exploration Processes'** isimli araştırması "İnsan Araştırmaları Komitesi" tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı
Uygundur
17/08/2015

Prof. Dr. Canan Sümer
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EDUCATION

Degree	Institution	Year of Graduation
PhD	METU, CEIT	2016
MS	Hacettepe University, CEIT	2011
BS	Yıldız Technical University, CEIT	2008
High School	Antalya Anatolian High School	2004

WORK EXPERIENCE

Year	Place	Enrollment
2009-Present	Yıldız Technical University, CEIT	Research Assistant

2013, 7 months	Boise State University, USA	Visiting Research Scholar

AWARDS /SCHOLARSHIPS

2014	PhD Support Scholarship The Higher Education Council of Turkey
2013	ERASMUS Staff mobility The Faculty of Education of the University of Córdoba, SPAIN
2008	Yildiz Technical University, CEIT Runner Up Graduation Award

PROJECTS

2011-2013 TUBITAK Project, scholar

Computer Ethics Education and Developing Electronic Performance Support System for Ethical Decision Making Process: BILEP

PUBLICATIONS

Journals in the Scope of SCI / SCI-Expanded / SSCI / AHCI

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