THE DESIGN AND IMPLEMENTATION OF A WEB-BASED ENGLISH VOCABULARY DRILL PROGRAM FOR VISUALLY IMPAIRED STUDENTS

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

BY

TUĞBA KAMALI ARSLANTAŞ

IN PARTIAL FULLFILMENT OF THE REQUIREMENTDS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
COMPUTER EDUCATION AND INSTRUCTIONAL TECHNOLOGY

SEPTEMBER, 2017

Approval of the thesis:

THE DESIGN AND IMPLEMENTATION OF A WEB-BASED ENGLISH VOCABULARY DRILL PROGRAM FOR VISUALLY IMPAIRED STUDENTS

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ABSTRACT

THE DESIGN AND IMPLEMENTATION OF A WEB-BASED ENGLISH VOCABULARY DRILL PROGRAM FOR VISUALLY IMPAIRED STUDENTS

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September 2017, 221 pages

The main aim of this study was to design, develop and test the instructional effectiveness of web-based English vocabulary drill program developed for 8th grade visually impaired students. In this respect, this study focused on the design principles of the program and the contribution of the study on student success on spelling and semantics. The instructional model guiding the development process of the program was Rosenshine's explicit teaching model.

Depending on the nature of the study, design-based research (DBR) framework with qualitative approach was used. Under the DBR framework, single-subject research design was applied with one pilot study and three cycles. Iterative cycles included face to face lectures and applied from October 2015 to February 2016. There were three groups of participants in the study as students, experts, and families. The data were collected through interviews, observations, and vocabulary and retention tests. Collected data were analyzed with both qualitative and quantitative data analysis techniques.

The results of this study revealed important findings for researchers, educators and teachers of students with visual impairments. Qualitative data analysis revealed that

the designed program was accurate, appropriate and accessible especially in underlining design considerations. Additionally, affordances of the study for VI students were identified as facilitating learning progress, effective presentation of the content and ensuring better educational performance. On the other hand, there were challenges as technical issues and low level knowledge of students. Quantitative findings revealed that students showed substantial progress on the vocabulary tests and maintained their achievements after the study.

Keywords: Visually Impaired, Spelling, Semantics, Assistive Technology

ÖZ

GÖRME ENGELLİ ÖĞRENCİLERE YÖNELİK WEB TABANLI İNGİLİZCE KELİME ALIŞTIRMA PROGRAMININ TASARIM VE UYGULAMASI

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Bu çalışmanın temel amacı, 8. Sınıf görme engelli öğrencilere yönelik web tabanlı İngilizce kelime alıştırma programının tasarlanması, geliştirilmesi ve eğitsel etkililiğinin test edilmesidir. Bu bağlamda çalışma, programın tasarım ilkeleri ve öğrencilerin İngilizce kelime yazım ve anlam başarıları üzerine yoğunlaşmıştır. Programın gelişim sürecini Rosenshine doğrudan anlatım modeli yönlendirmiştir.

Çalışmanın amacına ve niteliğine bağlı olarak nitel yaklaşımlı tasarım tabanlı araştırma (TTA) çerçevesi kullanılmıştır. TTA kapsamında 1 pilot ve 3 faz uygulanmış ve tek denekli deneysel desenler araştırma yöntemi kullanılmıştır. Döngüsel fazlar Ekim 2015 ve Şubat 2016 tarihleri arasında yürütülen yüz yüze dersleri içermektedir. Çalışmada öğrenci, uzman ve aile olmak üzere üç tür katılımcı vardır. Veriler görüşme, gözlem, kelime ve kalıcılık testleri ile toplanmıştır. Verilerin analizinde nitel ve nicel teknikler kullanılmıştır.

Çalışma sonuçları araştırmacılar, eğitimciler ve görme engelliler öğretmenlerine yönelik önemli bulgular içermektedir. Nitel araştırma sonuçlarına göre tasarlanan program tasarım ilkeleri açısından doğru, uygun ve erişilebilir olarak nitelendirilmiştir. Ek olarak, görme engellilere yönelik çalışmanın kolaylıkları

öğrenme sürecini kolaylaştırma, etkili içerik sunumu ve daha iyi eğitsel performans şeklinde tanımlanmıştır. Diğer taraftan, çalışmada teknik konular ve öğrencilerin bilgi eksikliği nedeniyle güçlükler ortaya çıkmıştır. Nicel araştırma sonuçlarına göre öğrenciler kelime başarı testlerinde önemli gelişmeler kaydetmiş ve çalışma sonrasında da bu başarılarını sürdürmüşlerdir.

Anahtar kelimeler: Görme Engelli, Yazım, Anlamsal, Yardımcı Teknoloji

To my dearest Tevfik Burak Arslantaş

&

Upcoming baby Umay

ACKNOWLEDGEMENTS

First and foremost I would like to express my sincere gratitude to my supervisor Prof. Dr. Soner Yıldırım and co-supervisor Assist. Prof. Dr. Banu Altunay Arslantekin for their guidance, support, valuable feedback and encouraging conversations. Without their guidance and support, this study would never have been accomplished.

Furthermore, I would like to thank and express my deepest gratitude to my thesis committee members: Prof. Dr. Zahide Yıldırım, Assoc. Prof. Dr. Yeşim Çapa Aydın, Assoc. Prof. Dr. Ayfer Alper and Assist. Prof. Dr. Evren Şumuer for their critical suggestions, encouraging conversations and guidance.

I would like to thank İbrahim Elibal for his contributions to the study, sincere support and beliefs in this research. He was always available from beginning to the end of the study for providing feedback, helping with the technical details. I feel very lucky and glad since I met with him. Besides I would like to thank to English teachers of Göreneller Visually Impaired School who participated in this study. I was able to conduct the study since they spent their time. I really appreciate their valuable insights, support and feedback. Besides, many thanks to my lovely student participants whom I cannot mention by name. I would like to thank all of them for the time they dedicated to this study after their school hours and even weekends. You will always be in my memory. Furthermore, I owe a debt of gratitude to the families for their support by approving the participation of their children in the study.

I wish to express my special thanks to my colleagues from METU who supported me throughout the study, Selin Deniz Uzunosmanoğlu, Okan Arslan, AbdülMenaf Gül, Zafer Kadirhan, and Ömer Faruk İslim. Especially, I would like to thank for joining face to face sessions with me, providing feedbacks and encouraging me throughout the study.

I owe a debt of gratitude to my cousin Samet Can who supported me in the technical parts of the study. I am grateful for the sleepless nights and effort he provided.

I would like to mention that this study was supported by Scientific and Research Council of Turkey (TUBİTAK) with 2214A program. With this support, I was able to conduct research in University of Florida, USA which contributed to my thesis and personal career a lot.

Last but not least, I would like to express my deepest gratitude; to my dearest Tevfik Burak Arslantaş and upcoming baby Umay Arslantaş, to my parents Şadıman and Zamit Kamali; to my parents in love Semiha and Mehmet Arslantaş; and to my sisters Kübra Kamalı and Fethiye Arslantaş for their unconditional love, restless support, caring and guidance. Your support have made me who I am today. I am proud to be a part of this family.

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CHAPTER 1

INTRODUCTION

This chapter begins with the background of the study, and includes both issues and problems. It then continues with the purpose of the study, research questions, the significance of the study, and finally with a definitions of terms.

1.1 Background of the Problem

Foreign language learning has always had a place in educational, social, cultural and intellectual sophistication. Due to a high interest for foreign languages, educators have started applying appropriate methodologies and various techniques to encourage language learners to speak and use the language. For that purpose many research studies have been conducted in order to find the most effective teaching methodologies and techniques, especially for learning English as a Foreign Language (EFL), one of the predominant worldwide languages. As technological developments have accelerated, so an increase has been seen in the number of research studies.

Visually impaired (VI) or blind people also have an increasing demand to learn foreign languages. Despite the high number of studies conducted in EFL for sighted people, there is a paucity of research studies and materials in vision education and foreign language education for VI or blind people (Conroy, 2005; Guinan, 1997; Milian & Ferrell, 1998; Grundtvig Learning Partnership, 2008-2010; Warren, 1994). This situation indicates a tendency to ignore the foreign language needs of VI or blind people (Araluc, 2002; Grundtvig Learning Partnership, 2008-2010; Guinan, 1997; Jayakody et al., 2016) by overpassing their language abilities (Couper, 1996; Donley, 2002; Nicolic 1986).

Paucity of research studies and materials have shown that many educators have failed to perceive that VI and blind people have unique foreign language educational needs (Conroy, 2005; Grundtvig Learning Partnership, 2008-2010; Guinan, 1997; Warren, 1994). Incapability of understanding specialized needs of those people create a challenge for the classroom teacher and also for the student. For example, when the classroom teacher writes content on the board VI and blind students encounter another challenge since they cannot see the written content (Milian, 1996). A similar issue was pointed out by Donley (2002) as students with vision problems feel themselves isolated in the classroom and as a result they cannot interact properly with the teacher since the activities are not designed based on their individual characteristics. In order to bridge the gap that stems from VI or blind people's inability to conceptualize material in a visual manner (Warren, 1994), foreign language teachers should modify the methods they apply for classroom presentations when a VI or blind student is a member of their class (Guinan, 1997). Thus, the teachers' role in this process is of the utmost importance since their preparedness directly relates to the success of their VI and blind students. In their study, Milian and Ferrell (1998) studied 361 teachers of VI as part of a project and found that 45% of the teachers had little knowledge about the educational needs of VI English language learners. The teachers indicated that prior to participating in this study, they did not understand that they needed special training. Similarly, Conroy (2005) pointed out that English teachers do not understand that VI students have particular needs unless VI students were their caseloads. Understanding VI students' needs and involving relative strategies in the classroom is essential for language teachers. Especially, the usage of customized materials can enable VI and blind students to understand what they read or listen to.

Another consequence of the paucity of research studies and materials, is the thinking of VI or blind people as being disadvantaged in foreign language learning due to their lack of vision (Brown, 1994; Turnbull, Turnbull, & Wehmeyer, 2007; Warren, 1994). This understanding was more widespread before the 1980s (Araluc, 2002), but which has started to change dramatically in recent years and thus many pedagogical and technological solutions have been applied for blind or VI people in EFL. This changing

understanding can be related with the studies in neuroscience field which has led up to better understand how VI people brain functions during learning (Alferink & Farmer-Dougan, 2010). According to the studies in the literature, congenitally blind individuals possess knowledge about the visual items and they are able to produce and control mental images in an analogical form (Cattaneo & Vecchi, 2011; Kaski, 2002). According to a study conducted by Amedi, Raz, Pianka, Malach and Zohary (2003), unlike sighted individuals; the occipital lobe, the visual processing center of the brain, of VI individuals is activated by verbal tasks despite the absence of visual cues. Similarly, Sadato et al. (1996) pointed out that visual cortex of blind people is able to reorganize itself to accept non-visual information. As a result of this activation in occipital cortex, VI people have superior verbal memory when compared to their sighted counterparts (Amedi et. al., 2003; Cattaneo, & Vecchi, 2011; Hull & Mason, 1995; Pring, 2008; Raz, Amedi, & Zohary, 2005; Raz, Striem, Pundak, & Orlov, 2007; Röder, Rösler, & Neville, 2001). In the current situation, some researchers now even consider that VI or blind people have advantages in EFL because of their aural sensitivity (Araluc, 2002) and intense memory training (Araluc, 2002; Couper, 1996; Pring, 2008; Raz et al. 2007).

With changes to understanding and the improvements seen in technology, it has become more possible to create the required methodological and pedagogical conditions in EFL for students with vision loss. Assistive technology has a huge impact in this manner and has contributed to the foreign language needs of VI or blind people in terms of instantaneous access to information (Hersh & Johnson, 2008; Tobin, Bozick, Douglas, Greaney, & Ross, 1997), individualized instruction (Tobin et al., 1997), and better educational performance (Koenig & Ashcroft, 1983; LaGrow, 1981). In addition to other areas, VI or blind students are now also finding the chance to obtain equity in education. Assistive technologies developed for VI and blind people to access printed information are low vision aids, audio transcriptions, and tactile methods; whilst electronic information is accessible from computers and accessible Web and spoken information is accessible through telecommunication (Hersh & Johnson, 2008). Specifically, computers and web technologies have become supporters for

solving the problems people face because of their vision loss. The most widespread techniques for showing textual information to the blind are "speech synthesizers and Braille cell displays or Braille embossing printers" (Shimomura, Hvannberg, & Hafsteinsson, 2010, p.297). Mainly, blind people use screen-reading software (text-to-speech technology) in order to access information on computer screens. Such software can be attributed as a breakthrough for the blind and VI in the accessing of information which opens up new opportunities.

Despite the existing technologies, VI or blind people face with problems in EFL since text-to-speech technologies lessen their exposure to the written form of words (Gompel, Janssen, Van Bon, & Schreuder, 2003; McCall, 1999; Stein, Neßelrath, & Alexandersson; 2010). In English, it is not possible to understand the orthographic form of the words based on their pronunciation. Listening the text read by text-to-speech technology prevents VI or blind people from learning the orthographic forms. For example, homophones mainly create problems like faze/phase; feat/feet; find/fined etc. Thomas and Dieter (1987) conducted a study and indicated that the writing of words correctly is necessary in order to gain good orthographic knowledge. Lack of orthographic knowledge also creates problems in spelling (Arter & Mason, 1994; Couper, 1996; Moodley, 2004; Nater & Thale, 1994; Orsini-Jones, 2009). Arter and Mason (1994) indicated that correct spelling is socially significant; however, VI students are more likely to experience difficulties in achieving levels of accuracy in spelling. Also, Orsini-Jones (2009) pointed out that blind students encounter problems while improving their writing and reading skills due to the difference between spelling and pronunciations of words. Since the existing computer technologies are not capable of meeting the needs of the blind, orthographic knowledge and spelling continue to be problematic. As Stein et al. (2010) stated, blind foreign language students are not provided the orthographic feedback in existing applications to the same level as sighted students. The situation in Turkey is even worse since the special needs of blind and VI students are inadequately met (Açıkgöz, 2006).

Despite all these challenges, there is one thing that should be emphasized, which is that VI and blind people share the same common goals and interest in the learning of

a foreign language, the same as their sighted counterparts. Correspondingly, as indicated in the report of the Grundtvig Learning Partnership (2008-2010), there are no significant differences between the motives why blind or sighted people learn a foreign language. Reasons to learn include obligatory education requirements, professional motivation, and personal motivation. Guinan (1997) and Millian (1996) also indicated that EFL is essential for VI or blind individuals in seeking competitive employment. As well as sharing the same purposes for learning a foreign language, VI or blind individuals possess the same abilities to do everything like a sighted person, if they are only given the chance. Regarding this issue, Rao (2002) stated that blind or VI students can achieve almost every task as a sighted person, with the exception of flying a plane. Thus, by taking into consideration the special needs of blind or VI students it is possible to compensate for some of the problems they face related to their vision.

To conclude, sighted people have many opportunities in terms foreign language learning; however, existing research makes little contribution to the literature in highlighting the challenges of blind or VI EFL learners and possible solutions (Nicolic, 1987; Wu, 1994). Hence, EFL literature has failed to perceive the special needs of the blind and VI (Guinan, 1977). Especially in Turkey, the special needs of the blind and VI are disregarded and there is a shortage of adapted materials that require no or limited visualization (Açıkgöz, 2006). This situation has caused inequality between the sighted and non-sighted due to the fact that they are assessed based on the same standardized exams. Since the studies in the literature show that visual impairment does not affect language acquisition (Barraga & Erin, 1992; Conroy, 2005; Donley, 2002; Nicolic, 1986; Spungin & Ferrell, 2000; Warren, 1994), instructors and researchers should explore the specialized needs of the blind and thereby make improvements to the EFL education available for the blind.

1.2 Purpose of the Study

As limited research studies or projects to date have specifically covered the area of EFL for VI and blind students in Turkey, the primary purpose of this dissertation study

was to design, develop, and test the instructional effectiveness of a web-based drill program developed specifically for 8th grade VI and blind school students. In line with that purpose, it was aimed to understand the improvement and implementation process of the developed web-based drill program and the kind of program deemed adequate to, and dependent upon, the target groups' needs. The pedagogical goal guiding the development process was to enhance students' vocabulary knowledge in terms of spelling and semantics. The value of that goal was that participants' spelling and semantics knowledge could lay a foundation for improvement in their EFL skills.

It should be pointed out that this situation is specific to VI students since they particularly experience problems in the learning of spelling. Thus, rather than improving their broader language skills, this study focuses on their individual vocabulary. For that purpose, a web-based drill program was designed and developed according to the characteristics of the target student population. Thus, the results of this study can shed light on the improvement of education for VI students' learning spelling and semantics in EFL.

The goals of the study can be summarized as:

- To contribute to the EFL vocabulary learning processes in terms of spelling, and semantics of VI and blind students by taking into consideration their individual characteristics;
- To provide VI and blind students with EFL learning opportunities equal to their sighted counterparts;
- To examine the effects of a customized web-based drill program to the spelling and semantics improvement of VI and blind children.

Depending on the purpose of the study research questions are:

1) How do participants describe their experiences toward the web-based drill program?

a. How do *VI students* describe their experiences toward the web-based drill program in terms of affordances and challenges?

b. How do *experts* describe their experiences toward the web-based drill program in terms of affordances and challenges?

2) What are the families' opinions about the students' experiences with the web-based drill program?

3) What is the contribution of web-based drill program on VI students' spelling and semantics knowledge in English vocabulary?

4) What are the participants' experiences pertaining to the design principles of web-based drill program for the VI?

a. What are the participants' experiences pertaining to the design principles of web-based drill program for the VI in the *pilot study*?

b. What are the participants' experiences pertaining to the design principles of web-based drill program for the VI in *cycle1*?

c. What are the participants' experiences pertaining to the design principles of web-based drill program for the VI in *cycle2*?

d. What are the participants' experiences pertaining to the design principles of web-based drill program for the VI in *cycle3*?

1.3 Significance of the study

Based on the aforementioned issues, this study aims to develop the design principles of a web-based drill program for teaching spelling and semantics of English vocabulary to VI students by considering the experiences of students, experts, students' families as well as students' vocabulary scores. Considering it is obligatory for the VI to learn English as a foreign language in Turkey and they highly dependent on technological solutions, which implies that this research study is highly significant

to both the target population and to pedagogy. It is believed that this study will contribute to the EFL literature for people with vision loss and also provide valuable insights for educators, practitioners, and researchers.

The primary significance of this study is its potential to contribute to the foreign language education of VI or blind people through the matter of provision of an accessible learning environment. Historically, VI or blind people faced two primary challenges in their education; a lack of accessible information, and the absence of meaningful experience (Mason & McCall, 1997; McLinden & McCall, 2002; Turnbull et al., 2007). In order to compensate their vision loss or any other such challenge, they have relied upon assistive technologies. However, materials in providing an accessible language learning environment to VI and blind people are limited (Turnbull et al., 2007), especially in Turkey (Açıkgöz, 2006). In view of providing an accessible EFL environment, the product designed and developed in this study has the potential to address the gap stemming from the lack of an accessible EFL environment.

Second significance of this current study is its contribution to the literature in several aspects. The results will provide valuable insights in terms of understanding the contribution of the product developed in the study to the achievement of VI and blind students, the unique educational needs of VI or blind students, and the design principles necessary to consider in designing and developing such an environment. In the literature, there are several studies that concentrate on training educators for assistive technology, with results showing that the majority of teachers of students facing several disabilities described themselves as being inadequate in assistive technologies (Conroy, 2005; Lee & Vega, 2005; Milian & Ferrell, 1998). For this reason, there is limited usage of assistive technologies in VI and blind education, which perhaps explains the limited research about the effect of assistive technology on student achievement. Thus, providing results in the achievement process of VI and blind students' after having used the product could contribute to the literature.

In terms of understanding VI and blind students' unique educational needs, studies in the literature showed that educators, researchers, and scholars seem are incapable of

understanding those needs (Grundtvig Learning Partnership, 2008-2010; Guinan, 1997; Warren, 1994). However, in this study, the design and development process was completed by studying with the students and taking into consideration their feedback. Involving the target group in the design process enabled the researcher to understand their special needs; especially what kind of design principles are deemed appropriate for them. As a result, by providing the product developed in this study, it was possible to present an environment based on the target groups' needs. The other aspect is that visually impaired language learners need individualized instruction which is modified based on their needs (Guinan, 1997; Kashdan & Barnes, 1998). Especially in terms of providing an individualized instruction, this study will contribute to the literature by implementing a study that meets the particular needs of VI and blind learners.

Another contribution of this study to the literature is in terms of finding solutions to the additional barriers that VI or blind people face. There is a growing body of research in terms of foreign language learning (Carson, Carrell, Silberstein, Kroll, & Kuehh, 1990; Liuolienė & Metiūnien, 2006; Stern & Cummins, 1981; Wang, 2008; Zhang & Fu, 2008); however, there has been relatively little research about the foreign language learning of people with visual impairment (Conroy, 2005; Jayakody et al., 2016). Moreover, regarding EFL education for VI or blind learners, very few contributions have been made that provide solutions to the barriers they face while learning a language. In order to help the VI and blind cope with such barriers, the affordance of technology cannot be disregarded (Aiazzi, 2008; Hub, Diepstraten, & Ertl, 2005; Kashdan, Barnes, & Walsh, 2002; Milian & Pearson, 2005). This study integrates web-based technology to provide insights to other research in terms of finding solutions to the barriers faced by the VI or blind throughout their EFL education.

Additional significance of this study worth mentioning is its potential to provide equality between sighted and unsighted people. Technological tools for language learners are often designed for sighted people, and information is lost when blind users access the tool via a screen reader. Despite being able to access the content, they lose orthographic information (Gompel et al., 2003; McCall, 1999; Stein et al., 2010) which is seen as being of significant importance to their vocabulary learning. Also, the loss

of orthographic knowledge creates problems in spelling (Couper, 1996; Moodley, 2004; Nater & Thale, 1994; Stein et al., 2010). "Learning to spell is more difficult than learning to recognize words because spelling requires not only learning grapheme-phoneme correspondences but also developing an orthographic lexicon" (Bahr, Silliman, Berninger, & Dow, 2012, p. 1587). Computer technologies enable users to make enough practice in writing words and gives instantaneous feedback in terms of orthographic mistakes. Such issues show the need for a customized computer-assisted software in order to meet the specialized needs of VI or blind learners. For this reason, the product developed for this study has the potential to narrow the gap in terms of true reading and spelling of EFL words between sighted and unsighted learners.

Visual impairment does not create a handicap for learning a foreign language; despite this, if the appropriate methodological and pedagogical conditions are created, their aural sensitivity and memory place them in an advantageous situation (Araluc, 2002). According to the literature, direct instruction (DI) approach has been found effective and useful in providing high degrees of success when designed appropriately (Fisher et al., 1980; Gersten & Keating, 1987; Slavin, Madden, Dolan, & Wasik, 1996). A study conducted by Gersten and Keating (1987) showed that DI children achieve significantly better in terms of academic performance and higher college admission. Direct instruction of skills is necessary for teaching vocabulary to the blind or VI (Huebner, 1986). Integrating DI into a web-based drill program for VI students may provide valuable opportunities in terms of their language learning needs.

1.4 Definition of Terms

Visual Impairment (VI): Visual impairment is an inclusive term that covers a wide variety of vision problems (Bailey & Hall, 1989).

Blind: Blind refers to total vision loss without visual light perception which is clinically known as NLP, the abbreviation for "no light perception".

Congenitally Blind: Related to the blindness condition that is present from birth, as opposed to blindness that occurs later on in life.

English as a Foreign Language (EFL): Learning and teaching English in countries where English is not the official or main language.

Computer-Assisted Language Learning (CALL): Usage of computers and software programs in language education both in traditional class and out of class.

Assistive Technology: "Any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability. The term does not include a medical device that is surgically implanted, or the replacement of that device" (IDEA, 2004, n.p.). Assistive technologies for visually impaired people are supported with the senses of touch, hearing and smell.

Web Accessibility: "People with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web. Web accessibility also benefits others, including older people with changing abilities due to aging" (Web Accessibility Initiative, 2005, n.p.).

Braille: A tactile system, consisting of raised dots that enable people who are VI or blind to read written materials (Sherer, 2004).

Screen Readers: Software that reads computer text and "speaks" it through voice output (Sherer, 2004).

CHAPTER 2

LITERATURE REVIEW

This chapter begins with an overview of visual impairment and some technical terms, consequences and educational implications of visually impairment in terms of barriers and enablers. It then continues with a comprehensive review of the literature addressing to foreign language education of visual impaired people and the role of technology in their education. This chapter also clarifies direct instruction method and its possible contributions to the education of VI learners.

2.1 Visual Impairment

Many people think visual impairment (VI) implies only total blindness. However, VI is a cover term used for describing varying degrees of vision loss from low vision through total blindness (Bailey & Hall, 1989). The eye has different parts working together to enable people to see, if one of the parts does not work well visual impairment occurs. According to the Special Education Guide (2013-2017) common indicators of VI are:

- "Irregular eye movements
- Unusual habits (such as covering one eye or frequently rubbing eyes)
- Sitting abnormally close to a television or holding a book close to the face" (n.p.)

In order to understand the particular VI a person has, it is helpful to understand types of VI. The terms *partially sighted, low vision, legally blind* and *total blind* are often used to describe and categorize levels of vision by National Dissemination Center for

Children with Disabilities (NICHCY, 2017) and American Foundation for the Blind (AFB, 2017). These terms are clarified in the following part.

Partially Sighted

Partially sighted people have some type of visual problem that is not severe even though they need special education. Seeing partially adversely affects a student's educational performance.

Low Vision

People with low vision have severe VI who are able to learn with visual sense but cannot read normal text size which cannot be improved with regular eyeglasses (Scheiman, Scheiman, & Whittaker, 2007). In order to read, they may need special requirements like magnified print, contrast colors, additional lighting, text size change and different fonts (Web Accessibility Initiative, 2005).

Legally Blind

Legally blind is a term used to define level of vision loss that has been legally accepted to determine eligibility for benefits. This level is determined by 20/200 measurement in which 20 represents the distance in meters needed by a VI person to see an object, while 200 represents the distance for sighted people to see the same object (NICHCY, 2017).

Totally Blind

Totally blind people do not see anything with their eyes since they do not perceive any form of light. NLP which is the abbreviation for no light perception is used to define total blindness (AFB, 2017). Totally blind students use braille and any other nonvisual media.

In this study, VI was used as an inclusive term to refer to both total blindness and low vision. According to the data of the World Health Organization (WHO, 2014), 285 million people are recorded to be VI worldwide; 39 million are blind and 246 million

have low vision. Turkish Statistical Institute (TUIK, 2015) published a report and indicated there are approximately 5 million disabled people and 8.4 % of them are VI which is equal to 216.077.

2.2 Educational Implications of Visual Impairment

The magnitude of VI is a distinct and multidimensional phenomenon that cannot be ignored in today's society. Due to the lack of ability to observe objects and interactions, VI students may have fewer learning experiences. For this reason, educational implications of VI should be clarified in detail.

The first issue regarding the educational implications is to understand the learning areas which are adversely affected by visual impairment. Some of those learning areas are concept development, communication, life skills, orientation and mobility skills, and academic development (Alberta Education Special Programs Branch, 2004). Piaget (1952) indicated that vision is the main source for the building of sensorimotor intelligence (as cited in Dote-Kwan & Chen, 1995). In the literature there are studies that show the challenges VI individuals face with. In their study, Rogers and Puchalski (1988) found that VI infant face with challenges in achieving object performance tests due to their vision loss. Similar to this issue, another challenge occur during the transition from “an interactive process to abstract level” (Bishop, 2004, p. 94). During primary education, learning is concrete with the focus on hands-on practices and interactivity which does not create much trouble for VI students to attend (Bishop, 2004). However, during learning abstract concepts VI students may face with difficulties if they are not provided with more time to learn. Vision loss cause inability in giving meaning to their perceptions of the environment and without hands-on experience VI students cannot perform skills. As a result, those challenges increase unique educational needs of VI students (Jones, Minogue, Oppewal, Cook, & Broadwell, 2006) in order to enable them to learn incidentally.

The second implication is related to the research studies conducted in neuroscience. A study was conducted by Röder et al. (2001) with 11 congenitally blind and 11 sighted people which showed that blind people have superior memory functions. In that issue,

Pring (2008) indicated that VI individuals outperform sighted people in memory related situations and as a result they have better retention. This memory advantage may be the result of the attentional effort of VI individuals on auditory processing (Pring, 2008). A similar contribution to the literature was done by the study of Raz et al. (2007) who gave 20 words to both VI and sighted individuals. In the end, VI recalled more words in the sequence of original list.

In terms of foreign language education of VI people, research studies reveal different views about the effect of visual loss. Some scholars believe that visual loss may reversely affect foreign language education while others support there is not a regressive outcome of vision loss on foreign language education. By tradition, it is believed that to be successful in foreign language learning all senses which are reading, writing, listening, and speaking should be utilized (Brown, 1994). However, VI people may not use all these senses effectively and lack of visual cues prevent VI people to make semantics associations (Guinan, 1997; Warren, 1994). Also, visual loss causes limited incidental learning which adversely affects students' potential in social skills or language skills (Turnbull et al., 2002). Regarding the negative consequences, Spungin and Ferrell (2000) pointed out that if VI individuals receive appropriate intervention those negative influences will not last too long. On the contrary of negative aspects, some scholars agreed upon the idea of visual impairment does not negatively affect language learning process (Barraga & Erin, 1992; Gray, 1997; Nicolic, 1986; Warren, 1994). VI people, who do not have additional impairment, may face with some difficulties in speech development. However, at last they catch their sighted peers (Ferrell & Raver, 1991). The challenges that may occur as a result of vision loss do not prevent VI people to learn a foreign language at the same level like their sighted peers (Nicolic, 1986; Warren, 1994). The key issue for the classroom teacher is firstly to understand how VI students learn their first language (Bigelow, 1986) and then to provide comprehensible input (Conroy, 2005). According to Donley (2002), VI and blind people can learn a language through input and social interaction as well as the sighted classmates.

Notably, VI people are responsible for learning the same levels of information processing like the sighted people and access to technologies (Presley & D'Andrea, 2009). It should be emphasized that VI individuals are able to overcome the negative aspects of vision loss and achieve similar levels of educational success like sighted people (Cattaneo & Vecchi, 2011; Pring, 2008). The key issue to compensate the restrictions is an understanding of how VI affects learning and what VI students' unique needs, which can provide a basis for minimizing the barriers and developing adequate strategies. For this reason, advantages of VI people should be highlighted and by adapting settings properly it is possible to help VI people overcome challenges they face and easily adapt to their environment. To better understand the issues mentioned, firstly the educational barriers VI students face with are mentioned and then the enablers are described in the following sections.

2.2.1 Barriers VI Students Face during Their Education

Vision loss or lack of previous visual experience are not a barrier for the cognitive developments of VI students (Kumar, Ramasamy & Stefanich, 2001). However, the lack of opportunity to learn due to blindness affect development (Bishop; 2004). In addition to the challenges which are the result of being VI, today's fast moving and competitive environment causes VI students to have additional challenges (Presley & D'Andrea, 2009). Those barriers can be grouped under two headings which are teachers' lack of knowledge and no access to information.

Teachers' Lack of Knowledge about VI

One of the additional barriers for VI students is teachers' lack of knowledge about teaching and supporting VI students (Jennings, Long, & Jackie, 2002; Parker et al., 1990) which may cause students to be excluded from the education system unintentionally. First of all, teachers of VI students should be aware of that no matter the VI level a student has, intelligence does not require sight and it is the teachers' role to help students overcome educational challenges to reach their full academic potential (Bishop, 2004). According to a study conducted by Dimigen, Roy, Horn and Swan (2001), teachers' support and knowledge in visual impairment were identified as

significant factors that affect the school experiences of VI students. Teachers' lack of knowledge was also associated with their inability in using assistive technology (Candela, 2003; Kapperman, Sticken, & Heinze, 2002). However, VI individuals need education with assistive technology in order to compensate their vision problems. Thus, teachers should improve themselves in usage of these technology.

In terms of foreign language education, Guinan (1997) and Warren (1994) stated most teachers of foreign languages in mainstream schools have no knowledge of the individual needs of a VI student. This studies are outdated but the current situation is unfortunately similar. As indicated in Grundtvig Learning Partnership (2008-2010), one of the barriers VI students face in the area of EFL education is lack of awareness what blindness and VI is. Also, in the report it was indicated that language teachers as well as other teachers do not have familiarity with VI and its possible effects on students. Therefore, this unfamiliarity results in many problems for VI in regular classrooms and also for the teacher. In brief, it must be teachers' responsibility to explore every aspect of teaching and learning process for VI students.

No access to Information

Another additional challenge for VI students is no access to information (Lowenfeld, 1973) which directly affects their teaching and learning process negatively. Information access is the key point to be successful in education, life and employment (Kapperman, & Sticken, 2000).

Although VI students do not face with problems in accessing information in the schools special to them, situation changes adversely in mainstream school system (Mason & McCall, 1997; McLinden & McCall, 2002). Traditional ways of representing information with written textbooks, presenting information, and having students demonstrate their knowledge create barriers to access information (Turnbull et al. 2007).

This situation becomes more complex in foreign and second language learning area. In mainstream settings, language textbooks are colorful and highly visualized which

are confusing for VI students since it is a tough thing to follow with a braille (Araluc, 2002). Also, this gap cannot be narrowed by teachers since it is impossible to accommodate a VI student to the regular class. For this reason, VI or blind students have to spend extra effort to search for information missed in language class due to highly visualized materials (Grundtvig Learning Partnership, 2008-2010).

Students with VI should have access to all information in the class including the written materials and visual information which can be achieved by properly adapting educational settings. Therefore, performance of VI students can be improved likewise their sighed peers. Taped versions of the lessons may be an option, however, since they will not see the written forms in that format, spelling in foreign language will continue to be a problem. Assistive technologies are very helpful for VI students in order to reach information and compensate their loss of vision. On the other hand, those technologies are rarely available in language learning environments.

2.2.2 Enablers for VI Students

Attempts to conceptualize the educational implications of VI have been resulted around understanding the unique needs of VI people. Understanding and recognition of those needs is essential to provide meaningful experience. As Tobin et al. (1997) pointed out all stakeholders in education should focus on particular and changing needs of VI individuals. Those unique needs can be divided into three categories as equal treatment, auditory input, and assistive technology.

Equal Treatment

Based on the aforementioned challenges, the first critical thing that should be considered in the education of VI is treating all disabled students equally no matter what their disability is (Araluc, 2002; Armstrong, 2011; Nikolic, 1987). United Nations Convention on the Rights of Persons with Disabilities (CRPD, n.d.) indicated that: "State parties shall ensure that persons with disabilities are able to access general tertiary education, vocational training, adult education and lifelong learning without discrimination and on an equal basis with others." This understanding should be gained

by all of the people but it is not enough in order to provide the equality. One of the global acts focusing on the equality of the children is No Child Left Behind (NCLB). Americans agreed upon a revolutionary idea which is every child can learn. The mission of NLCB is to ensure student success by raising educational quality and ensuring equal access. This act resembles a good example in order to understand the importance of equal conditions for every person.

Auditory Input

Auditory input is one of the ways that VI students gain information. Listening has been found to be more efficient for VI students when compared to reading (Nolan, 1973). In the same vein, several scholars discussed positive relationship between auditory input and superior performance (Douglas et al., 2009; Röder, Rösler, & Neville, 2000; Weeks et al., 2000). In any educational setting, efficient listening skills help VI individuals to be successful in reading skills and communication, through writing and speaking (Heward, 2000). As indicated by Röder et al. (2000), using a variety of auditory tasks ensures higher activation in occipital cortex of blind people's brain. Also, they indicated that in some of the auditory tasks blind people were more successful than the sighted people because blinds can encode auditory verbal material more effective. Similar to this research study, Douglas et al. (2009) stated that blinds have better auditory localization and their education necessitates appropriate training. In their study, Raz et al. (2005) found that verbal tasks activate blind people's occipital cortex which corresponds to the visual areas of sighted people. Those mentioned issues highlight the importance of auditory access to information for VI individuals.

Assistive Technology

Assistive technology, in the social context, aims to full and equal participation of disabled people into the society and diminish the gap between what they want to do and what the social life permits to do (Hersh, & Johnson, 2008). Historically, VI individuals have challenged with a variety of difficulties. In order to compensate their visual loss and deal with the challenges VI individuals require the availability of

assistive technology (Douglas et al., 2009; Lowenfeld, 1973; Sousa, 2013; Tobin, et al., 1997).

A considerable amount of research study emphasized the educational affordances of assistive technologies for VI people (Douglas et al., 2009; Kelly, 2009; Lowenfeld, 1973; Michaela & McDermott, 2003; Morrow, 1999; Sousa, 2013; Tobin et al., 1997). The crucial educational affordances of assistive technologies are mostly classified as access to content (Kelly, 2009; Michaels & McDermott, 2003; Nikolic, 1986; Sreenivasan, 1996) and individualized instruction (IDEA, 2004; Tobin et al., 1997).

The first and primary educational contribution of assistive technology is ensuring access to information which facilitates learning progress of VI individuals. Assistive technology is the way to reduce the handicapping effect of VI (Tobin et al., 1997) since VI students can instantaneously access to the information presented to sighted children (Kelly, 2009). The second advantage of assistive technology is ensuring individualized instruction which has a major importance for VI education (Tobin, et al., 1997). Kashdan and Barnes (1998) indicated that "all new English learners with visual limitations need some form of individualized instruction and problem-solving specifically adapted to their particular needs" (p.4). As pointed out by another study, VI individuals require individualized instruction most of the time since group instruction may not create a deeper understanding in a meaningful manner for learning specialized skills ("Learning about Blindness", 2000). Assistive technology deals with the issues related to the use of educational tools in meeting the individual requirements of VI students which is critical in diminishing the challenges (Morrow, 1999). During the usage of assistive technology, the key point for educators is to focus on the specific and changing needs of each individual learner (Tobin et al., 1997). This issue brings us to the point of the need for educational programmers who pay attention to individualized instruction focusing on the individual differences. In essence, assistive technology for VI individuals is fundamental which is equivalent to pencil and paper for sighted students (Sousa, 2013) and powerful in changing how VI people are provided with instruction.

Additionally, there are limited studies investigated the relationship between assistive technologies and educational performance of VI students (Koenig & Ashcroft, 1983; LaGrow, 1981). The positive impact of assistive technology on better educational performance was found in the results (Koenig & Ashcroft, 1983; LaGrow, 1981). Another contribution of assistive technologies for all disabled students is providing ways to get organized by setting study reminders which is a difficult task for them (Newton & Dell, 2011).

The most widespread assistive technology necessary for VI individuals in order to access curriculum or any other educational interventions effectively and efficiently are braille printers, screen readers and screen magnification software. In Special Educational Needs in Europe report (European Commission, 2005), the needs of a blind student for learning foreign language are indicated as following: "(1) Braille, (2) extra time, (3) special version of listening test tool, (4) special version of speaking test tool (5) an arrangement which would allow the recording of the answers" (p.184). Those needs are also afforded by accessible electronic teaching documents and computer assistive technologies. As Nikolic (1986) indicated that the emergence of records, tapes and cassettes changed the people's ideas who previously thought vision is important for language learning. However, those technologies have become prerequisites for VI individuals in learning a foreign language.

Some of the common existing assistive educational technologies available for the VI people are explained in the following part:

Braille. A VI person can read text either by listening to text or using the hands by touching the tactile reading materials. Braille, a six-dot system of reading and writing for VI individuals, was invented in early nineteenth (Schroeder, 1989). Braille keyboard stickers can be used with computers to provide keyboard buttons accessible.

Screen Readers. Screen readers are software programs that read out the onscreen data. This system provides auditory feedback when using the keyboard and auditory access to the information on the monitor. Some of the screen-reader software are JAWS, Kurzweil, Outspoken, IBM Screen Reader/DOS, and Thunder.

Computers and Web. The computer technologies have made a huge impact on special education and have a particular importance for VI students since their ability to use written communication is diminished or inefficient. Especially, the introduction of synthetic voice is a breakthrough for VI learners to access information. Similarly, the role of Web cannot be regarded because it provides independent and instantenous access to information (Sreenivasan, 1996). Both the Web and computer technology bring the opportunity to work independently for VI learners. Those technologies enable them to do anything whenever and whatever they want without depending on other people. A study was conducted in Australia in 2001 about the experiences of VI people in the workplace and their use of computer technology and the Web (Williamson, Albrecht, Schauder, & Bow, 2000). The results indicated that the Web enabled them to participate in an information and communication format likewise the other people. In the same vein, as showed by Leonardo Da Vinci Eurochance Project (2003-2006), e-learning is especially promising in terms of solving the mobility difficulties of VI learners face.

The importance of Web for all disabled people cannot be denied. However, the problem in the usage of this technology is the accessibility barriers that make it impossible for disabled people to use them. Web accessibility ensures that disabled people can "perceive, understand, navigate, and interact with the Web, and that they can contribute to" (World Wide Web Consortium, 2017,n.p.). World Wide Web Consortium (W3C) developed Web Content Accessibility Guidelines in order to provide a standard. WCAG 1.0 was published in 1999 and now WCAG 2.0 is used as a reference technical standard. WCAG 2.0 is a comprehensive standard including 61 criteria that are organized under four principles: perceivable, operable, understandable and robust (W3C, 2017). These criteria are included in three levels: A (25 criteria), AA (13 criteria), and AAA (23 criteria). A level criteria are expected to be fulfilled at a basic level; AA level criteria are recommended standards to be fulfilled and AAA level criteria are ideal standards to be fulfilled. Anyone who develops web should follow those principles (W3C, n.d.):

- Perceivable: Information and user interface components must be presentable to users in ways they can perceive.
- Operable: User interface components and navigation must be operable.
- Understandable: Information and the operation of user interface must be understandable.
- Robust: Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies

In conclusion, aforementioned issues bring us to the idea that VI is not really a handicap, instead it is the other factors that create barrier. The improvements in the technology field make it possible to provide opportunities and independence for VI people by removing the obstacles they face in educational settings. For that reason, alternative formats should be developed for VI people by integrating them in the discussions on the production of materials.

2.3 Educational Provision of VI Students in Turkey

The policy in Turkey targeting the students with special educational needs recognizes the need for a continuum of support and provision. Specifically, there are policies aim at meeting the specific needs of VI children. In our country, systematic educational services were started to be applied in 1950s with the contribution of Mitat Enc. In 1950, he established Ankara VI school and in 1952 the Special Education Department in Gazi Education Institute. Nowadays, there are 15 VI schools and also there is one VI printing house and evening art school in Turkey. At these special education schools, the same curriculum applied to primary and secondary schools, and those who complete these schools may have diplomas at regular primary and secondary levels. In addition, with the inclusive education adopted in recent years, students have the opportunity to be together with their peers in social life and education. High school VI students are educated in mainstream schools.

2.4 Research in EFL Education of VI

In terms of foreign language education of VI learners, the tendency during nineteens was to systematically ignore the special needs of them (Guinan, 1997). In 1995, a study was conducted in order to understand the feelings of students and teachers about the

British National Curriculum in foreign languages (Gray, 1997; 1998). The results showed that there are a lot of things to be done in order to provide equality between VI and sighted students in the area of modern foreign languages. Even nowadays some of those problems can be observed in the foreign language education of VI students (Grundtvig Learning Partnership, 2008-2010; Jayakody, et al., 2016). In 2008-2010, a study was conducted for the foreign language learning of VI learners in Europe with the cooperation of several partners and they published a report. Those partners believe that their countries do not provide enough opportunities for the EFL of VI adults and for this reason they targeted to include VI adults in language education by increasing their accessibility. They investigated the status of the VI learners in each country and defined the problems they face. Similarly, Jayakody et al. (2016) conducted a research and indicated that VI learners face with difficulties while learning English and as a result have difficulties in finding a job.

These negative aspects attracted the attention of many researchers. There have been important attempts to solve the problems of VI learners with the technological and pedagogical improvements. Those improvements are detailed under computer assisted language heading.

2.4.1 Computer Assisted Language Learning

Due to the developments in assistive technologies, computer assisted language learning (CALL) has largely effected the improvements in foreign language learning of VI people. CALL was defined as usage of the computer technologies in teaching and learning of any language (Levy, 1997). The aim of CALL is to improve capacity of language learners through computer technologies.

There are several studies applied CALL for teaching and learning process of VI learners which came up with suggestions of different methodological approaches for teaching language (Aiazzi, 2008; Hub et al., 2005; Kashdan et al., 2002; Milian & Pearson, 2005). Aiazzi (2008), based on her self- experiences, suggested to teach English to VI learners by increasing their self-assurance and esteem. She indicated that VI students in her class were aware of the importance of English learning and they had

desire to work independently. In their study Hub et al. (2005), emphasized the importance of environmental cues in language learning according to the study they conducted. They focused on the development of a language learning tool at the same time enabling VI learners to discover the environment. Kashdan et al. (2002) conducted a study about the immigrant VI adults and indicated that a "holistic communicative perspective" (n.p.) is fundamental for VI learners to learn a new foreign language. According to them, understanding the importance of multisensory and multiple intelligence learning processes is critical to help visually limited learners to increase their chances for learning. Another approach in the literature was dual-language education for VI learners which was suggested by Millian and Pearson (2005). Dual-language education is a method used in USA aiming to teach English speakers and non-English speakers to learn a second language together. Millian and Pearson (2005) studied this model with VI learners and found promising results on their behalf. Coşkun (2013) investigated an innovative method, talking tactile technology (T3), which is a touch sensitive device providing immediate auditory feedback. The main goal of his study was to investigate the applicability of T3 to foreign language teaching by training English language teachers. The results showed that teachers were eager to use those technologies and also they wanted to create more technologies to teach English for VI learners.

The role of assistive technologies in the second language writing skills of VI learners was studied by Sousa (2013) in the dissertation study. The researcher suggested that assistive technology is fundamental that can improve basic skills but cannot replace them. Additionally, VI students need assistive technology to access the materials and tools, complete educational tasks and join tasks equally with the sighted peers. Also, Sousa (2013) suggested that VI learners should be exposed to the written text to get familiarized with the writing conventions.

These studies show that there are different methodologies beneficial for implementing CALL in foreign language education of VI learners. Also, these studies mainly related to the implementation of CALL for teaching of any language learning skills. In the following part, computer assisted vocabulary learning (CAVL) which is one of the

subdomains of CALL is clarified in order to provide insight about the improvements related to vocabulary teaching.

Computer Assisted Vocabulary Learning

Vocabulary learning has always been a common subject in CALL programs, particularly in the early stages of CALL (1980s) due to the importance of vocabulary knowledge.

Research in the literature demonstrated the importance of vocabulary knowledge (Allen, 1983; Laufer, 1986; Nation, 1990; Stein et al., 2010) which is at the center of foreign language learning and related to writing, reading, listening and speaking skills. As Nation (2001) stated that "learning vocabulary requires mastering a word's meaning, form and use" (p. 27). Thus, learning a vocabulary correctly necessitates learning spelling and learning spelling necessitates orthographic knowledge. In traditional education, VI learners are disadvantageous in improving their spelling ability (Arter & Mason, 1994; Moodley, 2004; Papadopoulos, Arvaniti, Dimitriadi, Gkoutsioudi, & Zantali, 2009) since they learn the spelling by typing the words based on braille abbreviation (Harley, Truan & Sanford, 1987). Hayes (1922, cited in Birns, 1976, p. 395) indicated that VI learners was "gradewise, a superior speller to the sighted, but agewise he was inferior, mainly because the blind are usually held back in school." Papadopoulos et al. (2009) conducted a study about spelling of VI learners and indicated that the degree of vision loss has a negative effect on spelling performance of them. However, this negative effect can be decreased if the level of education increases. Similarly, orthography may be a tough subject to master, especially when it comes to English. Because "the English language has so many exceptions to its rules that the rules themselves become meaningless" (Arter & Mason, 1994, p.18).

During 1980s, technology was not improved well and for that reason most of the vocabulary applications were simple like gap-filling activities without pedagogy (Ma, 2009). However, in time, with huge improvements in technology, researchers have started to create effective technological solutions under CAVL. In recent years, there

have been studies conducted in order to ensure VI learners to improve themselves in foreign language vocabulary learning (Hub et al., 2005; Jayakody et al, 2016; Stein et al., 2010; Stein, Neßelrath, Alexandersson, & Tröger, 2011). The common argument of those studies is that in order to meet the needs of VI target group, CAVL program should involve auditory outputs while teaching orthography. As emphasized by Stein et al. (2011), target users should be involved in the design process in order to understand their exact needs.

In their study, Hub et al. (2005) developed an orientation assistant for VI students to teach basic vocabulary in their first and other languages while exploring the environment. This assistant has a sensor module and a portable computer, and requires the formation of a 3D model of a particular environment. The results of the study are promising as VI students were able to learn the object names while exploring the environment.

A CAVL study was conducted by Stein et al. (2011) to design a usable software for VI people in terms of vocabulary learning with correct spelling. For that purpose, they developed AVoS, an auditory vocabulary and spelling trainer. They included the target group in the design process to ensure the usability of the system. The prototype was employed to 15 VI children and there were promising result in terms usability of the system. Based on their study, Stein et al. (2011) came up with a customized CAVL program suggestion with two important aspects which are auditory output and effective learning strategies focusing on orthographic forms of vocabulary. Also, they applied a survey with 88 VI adults in order to understand their vocabulary knowledge and computer usage habits. The results showed that due to the mispronunciation of the screen readers, target group finds spelling errors in the texts.

Another mobile application named "An English Eye: Way to Learn English as a Vision Impaired Individual" was developed by Jayakody et al. (2016). This mobile application targeted VI learners at any age and tried to improve their English vocabulary. The system includes translators, speech recognizer, a speech synthesizer

and gesture interactions. During the study, they investigated the design process of the system and finally developed an accessible mobile application.

CALL and CAVL studies that have been mentioned until now were conducted by researchers with their own initiatives. They provided important and beneficial suggestions and directed the path of other future studies, likewise this current dissertation research. In the following part, several comprehensive projects are explained chronologically in order to represent the current situation and importance of foreign langue education of VI learners. Since the results of these projects were not published, only limited information is given.

Eurochance. A European project, "Eurochance", was conducted during 2003-2006 which was co-funded by European Leonardo Da Vinci program in order to increase the employment opportunities of learners with VI (http://eurochance.brailcom.org/index). For that purpose, they developed a learning management system which included English, German, Spanish and Italian vocational language electronic textbooks that are fully accessible. They aimed to improve language and cultural skills of VI learners. Eurochance 2 (http://eurochance2.brailcom.org/index) was the continuation of Eurochance and conducted in 2007-2009 sharing the same purpose. The projects were successful in reaching their goals in two aspects; they increased the qualification of target group in foreign languages and they increased their chance to find a job.

ALLVIP. ALLVIP (Accessible Language Learning for Visually Impaired People) is a Socrates project aimed to teach English and German to VI people. The primary goal of the project was to develop an innovative language learning material using haptic design and 3D sound. Thus, the project created a chance for increasing the interactivity of the users by removing the need for screen readers. For that purpose, they developed "SAITEK" haptic joystick. The advantage of this device is being an innovative language learning environment and also suitable for every curriculum activity (http://www.allvip.org/prod_en.htm). This project was important in showing the possibility to create an interactive language learning software for VI learners.

ELLVIS. ELLVIS (English Language Learning Program for Visually Impaired Students) was conducted between the years 2009-2011 in order to amplify the ALLVIP project. The purpose of the project was to teach English language to VI nonnatives in order to meet their language learning needs. They developed a new technology based on haptic and kinesthetic human and machine interaction. As indicated in the ELLVIS final report (2011), this device involves diverse manual abilities and stimulates coordination between hearing and hand usage which ensures effective learning experience. This device is attributed as alternative solution to the book and tape methodology. The project achieved its goals by opening new perspectives for foreign language learning of VI learners.

VET4VIP. VET4VIP (The Vocational English Training for Visually Impaired People project) was conducted in 2009-2012 and provided an innovative method using a "talking/tactile technology" in foreign language learning. The purpose of this project was to design and develop language learning materials for VI in terms of vocational vocabulary. Also, there was another dimension of the project which aims to train teachers who cater for VI. VET4VIP project was attributed as a turning point since including VI students in class improved teaching of sighted students and for the first time they used ALLVIP for sighted students. In terms of accessibility and feedback, the project was unique.

MoLLVIS. MoLLVIS (Mobile Language Learning for Visually Impaired Students) was conducted between January 2014 and 31st March 2016. The project aimed to create German language learning applications for the blind or partially sighted people based on the results of ALLVIP, ELLVIS and VET4VIP projects. They integrated tandem learning approach which is based on mutual language exchange between native tandem partners. These partners assist each other with a live real time experience in a language course without classroom and paper based materials. The outputs of the project are not published.

A review of literature on foreign language education of VI learners shows that with the technological improvements, individuals with visual limitations have more

accessible educational tools. Progress in CALL over the last years has led to a greater understanding on how to support foreign language education of VI and blind learners. Based on those studies, it can be concluded that designing any kind of tool or program necessitates including the target users in the design process in order provide better solutions. The suggested methodologies, strategies and techniques have shaped this current study and provided insights in terms of integrating technology and methodology together by taking into consideration the opinions of the target group. In this manner, this study implemented web-based assistive technology considering the requirements and characteristics of target group. Especially; those studies were beneficial for the researcher in terms of accessibility, assistive technology, design issues and the needs of VI learners. By taking into consideration of the literature review, the researcher was able to define her own study's content and context.

2.5 Direct Instruction

As mentioned before, VI individuals have special educational needs based on their characteristics. Main special educational needs that have been discussed until now were equal treatment, need for assistive technology and individualized instruction. In this section, the other need of visually impaired students is discussed which is the need for direct instruction of skills which sighted students learn incidentally (Koenig & Holbrook, 2000).

The roots of direct instruction (DI) belongs to behavioral psychology, however, DI still has effect on curriculum, education, and research (Magliaro, Lockee, & Burton, 2005). Rosenshine (1987) described DI as "a systematic method of teaching with emphasis on proceeding in small steps, checking for student understanding, and achieving active and successful participation by all students" (p. 34). The main purpose of direct instruction is to teach basic skills and to ensure that all students learn the subject in the minimum time possible (Watkins & Slocum, 2004). The principle of DI approach is that all students can learn tasks more rapidly if they are provided with well-planned educational procedures. Students do not only achieve the end objective of the lesson or curriculum but they also achieve each task.

There are different effective DI methods which are Basic DI, Rosenshine's Explicit Teaching Model, Good and Grouw's Strategies for Effective Teaching Model, Hunter's Design of Effective Lessons Model, and Gagne's Nine Events of Instruction. It is important to indicate that DI method mentioned in this current study is different than the DI model suggested by Engelmann and Carnine (1991). Basic DI approach involves three stage as introduction, main presentation of the lesson, practice systematic design model. This approach provided instructional researchers with a structure that clearly directs for creating lessons.

Rosenshine (1987) presented the steps of direct instruction in order to guide researchers, educators or curriculum developers. These steps with their brief explanations are provided in the following part:

- **Review and check previous work:** In that phase, teachers activate students' prior knowledge in order to enable them make a connection with the new knowledge. Also, in this phase students are introduced to the focus of the lesson and understand what they will learn.
- **Presentation of the new topic in small steps:** For an effective implementation of DI, teachers should make an introduction to the lesson by explaining goals, structure the materials of the lesson in order to prevent confusion. Then, the content should be presented in small steps which is one of the critical points in DI. While teaching those small steps, teacher should check students' understanding every time by asking questions, making repetitions, or providing more examples. It is important to ensure each student understand the content or at least the ones with low achievement level. Then, teacher can teach the next step and move forward until the topic ends.
- **Guide Practice:** After teaching the content in small steps, teacher should allow students to make practice under his/her guidance. This step gives students a kind of independence and responsibility on the new material they learned. Teachers should enable all students' participation. In an effective

DI integration, a teacher should spend half of the class hour for presenting the content and guiding the practice.

- **Corrections and Feedback:** If students make partially mistakes or they are hesitant, teacher should give process feedback. If students give wrong answers, teachers should provide sustaining feedback by explaining some clues or reteach the content if necessary.
- **Independent Practice:** When students practice the content without any mistake they are directed to independent practice step. Students are mostly on their own and they practice until they become fluent in the topic. Sufficient feedback can be provided by the teacher if it is necessary.

As Magliaro et al., (2005) indicated computer based programs have been designed representing DI approach while using the affordances of technology for providing feedback, presentation and guided practice. This study applied Rosenshine' explicit teaching model (1987) by adapting to web-based environment. The detailed information about the adaptation of the model is clarified in Chapter 3.

Until now, the key issues related to DI approach are covered in order to provide insight about the method of the current study. In the following part, research studies about this approach are explained.

2.5.1 Research in Direct Instruction

There have been several studies in the literature conducted to test the effectiveness of DI approach (Bauman, 1984; Cashwell, Skinner, & Smith, 2001; Gersten & Keating, 1987; Gersten, Darch, & Gleason, 1988; Ilie, 2014; Klahr & Nigam, 2004; Vitale & Kaniuka, 2012; Yeh, 2009). These studies imply that despite being an old approach, DI still keeps its importance in education and shapes the direction of research studies.

In their study, Vitale and Kaniuka (2012) implemented DI reading program with 73 elementary and middle school students during 13 years. The data from evaluation indicated that the implementation of DI revealed significant improvement of student achievement.

Bauman (1984) conducted a research about effectiveness of DI in terms of teaching students with comprehension skills of main idea. He studied with 66-6th grade students. There were three experimental groups; first group was instructed with DI approach, second group was instructed with massed basal lesson and the third one was the control group. He implemented five instruments and conducted MANOVA test. Significant treatment effect was found favoring the DI approach over the basal and control groups.

Another study was conducted by Cashwell et al., (2001) in order to understand whether a program developed with DI can teach the students to recognize their peers' daily prosocial behaviors. The findings showed positive results regarding the integration of DI in teaching prosocial behaviors.

A comparison study between DI and discovery learning in science lesson was conducted by Klahr and Nigam in 2004 with 3rd and 4th grade 112 children.

They investigated the effectiveness of both theories on gaining basic cognitive goals and the transfer and application of this basic skill to broader authentic reasoning. Results showed that children taught with DI learned more than the children taught with discovery learning. In terms of making broader judgements, both group students performed equal.

Another study was conducted with Gagne's instructional model which is one of the DI methods. In this study, Ilie (2014) adapted Gagne's model to a learning context in Romanian educational system. Data were gathered from 894 university teaching activities with observations. Findings demonstrated significant correlation between the method and teaching activity.

Yeh (2009) conducted an e-learning study by incorporating DI method. An experimental study was implemented during 18 weeks with 48 pre-service teachers in order to improve their effectiveness on teaching critical skills. The experimental group has improved their critical thinking skills based on pre and post-tests while the control group showed a decrease.

Literature review on DI showed that this method has been effective thus far and still attracts researchers' and teachers' attention. According to the literature, DI is the most investigated and tested method with positive outcomes shows that it will also find a place in research studies in the future. Regardless of the discipline, subject or field, DI has positive impact and should be used properly.

2.5.2 Direct Instruction in Special Education

Typically, DI has been used in special education. There have been many studies conducted with DI in special education with different types of impaired participants (Corn & Koenig, 2002; Fallon, Light, McNaughton, Drager, & Hammer, 2004; Flores & Ganz, 2007; 2008; MacCuspie, 2002; Swanson, 1999). The research conducted up to now included the experimental or quasi-experimental studies and meta-analysis studies as well. Those studies are detailed in the following part.

The effect of DI on reading skills of speech impaired students was investigated by Fallon et al. (2004). There were five participants in the study whose age was 9-14. The study was based on teaching 14 letters and their corresponding sounds. They implemented single-subject research design with multiple-probe-across subjects. Results demonstrated the effectiveness of DI on reading instruction. All of the participants achieved the goal of the study by reading single-word and even three of participants were able to generalize their reading skills to novel-word reading.

Flores and Ganz (2007) conducted a study about the impact of DI on reading comprehension with developmentally disabled students including autism spectrum disorders (ASD) and reading delays. Participants were four elementary school children. Students were successful in DI program in terms of statement inference, using facts and analogies conditions. Another study was conducted by Flores and Ganz in 2008 with ASD students about the effect of DI for teaching specifically oral language skills. Students were required to identify of materials of objects. There were three participants. Based on the results, it was suggested to use DI in teaching oral language skills to ASD students.

In his study, Swanson (1999) examined 180 intervention studies conducted with learning disability participants. The main purpose of this study was to understand the instructional components that contribute to the education of learning disability students. Different from the abovementioned studies, in the results he found that the effect size of combination of DI and strategy instruction (SI) was higher than the other instructional methods. He suggested to use both methods combined to remediate learning disabilities.

In their study, Corn and Koenig (2002) studied with low vision students in order to teach them literacy skills and identified the levels of DI needed. They implemented multiple rounds of surveys with 40 respondents who work with low vision students. At the end, Corn and Koenig (2002) suggested that low vision students should be provided with DI especially in their early education years in literacy skills. Thus, they will have chance to overcome their frustration and self-esteem problems stem from low vision.

MacCuspie (2002) conducted a study in Canada with 14 blind or VI teachers who teach blind or VI students. In terms of literacy development, all of the teachers indicated that intensive DI is necessary for teaching blind or VI learners.

In a report, written by Texas School for the Blind and VI Outreach Programs (2015) teaching blind and VI students with DI was strongly recommended in various fields.

To conclude, studies conducted in special education consistently demonstrate the positive outcomes of DI in special education. The skills sighted students can acquire incidentally are difficult for VI and blind learners without taking intervention with DI.

2.5.3 Direct Instruction in Language Education

Research has shown that both native and foreign language education with DI benefits students which is also the focus of this current study (Becker et al., 1981; Cervantes-Kelly, 2010; Cordero-Ponce, 2000; Ganschow & Sparks, 1995; Pearlman, 1980; Sparks & Ganschow, 1993b; Theisen, 2002).

Theisen (2002) stated that in order to target varying ability levels of students in foreign language education, teachers need to provide more DI with more concrete examples and practice options. In the literature, there are studies conducted with varying disabilities and levels of students to investigate the contribution of DI.

In their study, Sparks and Ganschow (1993b) investigated the DI in Spanish in terms of native and foreign language learning aptitudes. 16 high school students who are at risk for foreign language learning attended this experimental study. Based on the pre- and post-test results, researchers indicated that DI was effective for at risk students in teaching the phonology and syntax of EFL. A similar study was conducted by Ganschow and Sparks (1995) to investigate the effectiveness of DI on the orthography of Spanish in terms of native language skills and foreign language aptitude. The study lasted one year and 14 at risk high school women and 19 at non-risk high school woman attended the study. At risk group received DI and non-risk group received traditional language methodology without DI. Pre and post-test results revealed that both of the groups showed substantial growth on foreign language aptitude tests. Additionally, at risk students made significant gains in terms of orthography.

Cordero-Ponce (2000) carried out a study to test the effectiveness of DI in teaching summarization rules on reading comprehension in learning French. Participants of the study were 64 undergraduate students who were learning intermediate French. They were enrolled in four sections. Two of those sections were taught with DI and the other two were the control groups. Findings revealed that DI was effective in improving students' ability to summarize the foreign language reading texts.

In her dissertation study, Kelly (2010) conducted a mixed-methods study to understand the effect of DI in Spanish-English translation and interpretation. The participants of the study were 24 high school students in the quantitative part, and six students in the qualitative part. They attended a three-week language development program. According to the results, researcher suggested the usage of DI in academic vocabulary learning in terms of translation and interpretation. At the end of the study, there was an increase in the participants' language proficiency.

In vocabulary instruction, there are various methods in the literature such as mnemonic approaches, cognitive strategy, DI, constant time delay. According to the report of National Reading Panel (2000), vocabulary may be taught directly and indirectly, but DI is emphasized as necessary for teaching vocabulary. Studies also showed the effectiveness of vocabulary instruction with DI (Dole Sloan, & Trathen, 1995; Jitendra, Edwards, Sacks, & Jacobson, 2004; Marulis & Neuman, 2010; Pearlman, 1990; Rinaldi, Sells, & McLaughlin, 1997; White, Graves, & Slater, 1990). Those studies conducted with different target groups and with different focus.

In their study, White et al. (1990) focused on socio economically disadvantaged children at first through fourth grade and it was suggested that DI may have role in teaching decoding and word meanings.

Coyne et al. (2009) worked with 42 kindergarten students to compare two DI methods with incidental learning in order to teach nine target words. DI methods used in the study were embedded instruction and extended instruction. In embedded instruction, words were explained briefly in time efficient manner. In extended instruction, they spent more time on each word. Results showed that both embedded and extended instructions are significantly effective over incidental learning. They suggested that DI should be used in vocabulary instruction over time and students after learning the words should continue to experience those words. In the same vein, Sonbul and Schmitt (2010) explored the effectiveness of DI on learning new vocabulary in reading a text. For this purpose, they conducted an experimental research to compare DI with incidental learning. They tested the three levels of vocabulary knowledge. Participants were twelve years old and 40 native Arabic speakers learning English. Based on the results, researchers suggested that DI should be incorporated in order to teach deeper levels of vocabulary. Also, they stated that the time spent to integrate DI is worthy because it provides effective instructional gains.

In their study, Marulis and Neuman (2010) concentrated on examining the effect of vocabulary instruction on children's oral language development. They conducted a

meta-analysis and examined 67 studies. They found larger effect size with the programs that use DI in teaching words.

In another study, Pearlman (1990) compared keyword and DI methods in order to facilitate vocabulary learning of handicapped primary grade students. Participants were developmentally handicapped and learning disabled based on their IQ scores who were fourth through sixth graders. They were taught 16 "survival skills" words during the study. There was a significant difference in the results favoring the DI method. Participants taught with DI were able to define words correctly more than the ones taught with keyword method.

Jitendra et al. (2004) examined some research studies on vocabulary instruction with learning disabled students. They analyzed 19 studies which were conducted with different vocabulary teaching strategies. The most noticeable results of their research was that educators should focus on direct teaching of vocabulary.

In conclusion, above mentioned studies accumulated in favor of DI as an effective approach in teaching. Guided by the positive findings of DI in special education and language education, this study incorporated DI in teaching English vocabulary to VI impaired learners. During the process of DI, students were frequently assessed and the words that are missing based on the assessments were taught again. At first, during teaching process responsibility belonged initially to the teacher but then responsibility was transferred to the student.

2.6 Chapter Summary

The literature review in this chapter shows that there is a growing body of research in terms of foreign language learning (Carson et al. 1990; Liuolienė & Metiūnien, 2006; Stern & Cummins, 1981; Wang, 2008; Zhang & Fu, 2008); however, there has been relatively little research about the foreign language learning of people with visual impairment (Conroy, 2005; Jayakody et al., 2016). This situation indicates a tendency to ignore the foreign language needs of VI or blind people (Araluc, 2002; Grundtvig Learning Partnership, 2008-2010; Guinan, 1997; Jayakody et al., 2016) by overpassing

their language abilities (Couper, 1996; Donley, 2002; Nicolic 1986). Several scholars highlighted that foreign language educational needs of VI people have not been understood by educators and researchers (Conroy, 2005; Guinan, 1997; Warren, 1994). The limited research in VI education directed scholars to understand the educational implications of VI and special needs of VI individuals. Studies in educational implications of VI show that when the special and unique needs of VI people met, they can learn any foreign language like their sighted counterparts. Those unique needs can be divided into three categories as equal treatment (Armstrong, 2011; Nikolic, 1987; Araluc, 2002), auditory input (Douglas et al., 2009; Röder et al. 2000; Weeks et al., 2000), and assistive technology (Douglas et al., 2009; Lowenfeld, 1973; Sousa, 2013; Tobin, et al., 1997). With the changing understanding in foreign language education of VI individuals, there has been an increase in the studies conducted with the existing technologies. Stein et al. (2010) highlighted that despite existing technologies, VI individuals face with problems in spelling and orthography since text-to-speech technologies lessen their exposure to the written form of words.

By designing and developing a specific web-based drill program, this study aims to address the spelling problems of VI students in Turkey.

CHAPTER 3

METHODOLOGY

In this chapter, the research methodology that guided the study is presented. Firstly, research methods employed throughout the study are presented in two sections. Design-based research is explained first, which formed the general framework of the study. Next, single-subject research design and its implementation in this study are explained. Then, the procedure of the study is explained in parallel to the design-based research steps. Finally, data gathering instruments, data collection procedures, the data analysis process and trustworthiness of the study are described.

3.1 Research Questions

As mentioned in the introduction section, the aim of this study was:

- Design and develop a web-based drill program in order to enable eighth-grade VI school students to improve their EFL vocabulary;
- To teach the spelling and the semantics of English words;
- Evaluate the design and development process of the web-based drill program and the product itself.

According to the purpose of the study, research questions are:

1) How do participants describe their experiences toward the web-based drill program?

a. How do *VI students* describe their experiences toward the web-based drill program in terms of affordances and challenges?

b. How do *experts* describe their experiences toward the web-based drill program in terms of affordances and challenges?

2) What are the families' opinions about the students' experiences with web-based drill program?

3) What is the contribution of web-based drill program on VI students' spelling and semantics knowledge in English vocabulary?

4) What are the participants' experiences pertaining to the design principles of web-based drill program for the VI?

a. What are the participants' experiences pertaining to the design principles of web-based drill program for the VI in the *pilot study*?

b. What are the participants' experiences pertaining to the design principles of web-based drill program for the VI in *cycle1*?

c. What are the participants' experiences pertaining to the design principles of web-based drill program for the VI in *cycle2*?

d. What are the participants' experiences pertaining to the design principles of web-based drill program for the VI in *cycle3*?

3.2 Research Method

Depending on the purpose and the nature of the study, design-based research (DBR) framework with a qualitative approach was used in the design, development, and evaluation of the web-based drill program. Under the DBR framework, a single-subject research design was applied with a quantitative approach.

Qualitative research, by broad definition, is "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification" (Strauss & Corbin, 1990, p. 17). It has an interpretive character which enables researchers to better understand any phenomenon or to gain more in-depth

information which is not possible quantitatively (Hoepfl, 1997). Characteristics of qualitative research have been identified by several researchers (Bogdan & Biklen, 1998; Fraenkel, Wallen, & Hyun, 2012; Lincoln & Guba, 1985; Patton, 2002) which are the data source being in a natural setting, and the researcher then observes, describes and interprets the settings as they are; the researcher is the key instrument; both process and product are concerned; mostly inductive data analysis is used; has an interpretative character.

Since one of the purposes of this study is to evaluate the design and development process of the web-based drill program and the product itself, the experiences of students and experts and opinions of families were described qualitatively. The qualitative side of the study provides "understanding the meaning, for participants in the study, of the events, situations, and actions they are involved with and of the accounts that they give of their lives and experiences" (Maxwell, 1996, p. 17). By revealing the affordances and challenges of the web-based drill program, the study presents detailed and rich information for researchers and practitioners.

3.2.1 Design-based Research

DBR is usually used interchangeably with design experiments (Brown, 1992; Collins, 1992), design research (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Reeves, Herrington, & Oliver, 2005), and development/developmental research (McKenney & Van den Akker, 2005; Richey & Klein, 2007; Richey, Klein, & Nelson, 2004; Van den Akker, 1999). During this study, the phrase DBR (Design Based Research Collective, 2003; Hoadley, 2004) was used to define the research method. The roots of DBR belong to the work of Brown (1992) who concentrated to "engage in design experiments intended to transform classrooms from academic work factories to learning environments that encourage reflective practice among students, teachers, and researchers" (p. 174). Her works about design experiments have guided many researchers and thus DBR's subsequent developments. DBR has been defined as "the study of learning in context through the systematic design and study of instructional

strategies and tools" (Design Based Research Collective, 2003, p. 5). A more detailed definition by Wang and Hannafin (2005) states DBR as a

> Systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually sensitive design principles and theories (pp. 6-7).

DBR enables researchers to understand the process of the intervention within the affordances and challenges of the educational setting in which the intervention exists (Brown, 1992).

As Anderson and Shattuck (2012) pointed out, DBR has evolved throughout the 21st century; however, there are problems in meeting the promises of DBR. In order to conduct a good example, the major characteristics of DBR should be figured out. Anderson and Shattuck (2012) defined the relative items in order to conduct a quality DBR study.

Being Situated in a Real Educational Context

This item is about the validity of the study which ensures that results represent the practice in the context at hand. As Hoadley (2004) pointed out, by developing theories which are applied in real-life contexts it is possible to create tested and valid theories. This issue was emphasized by van den Akker, Gravemeijer, Mckenney, and Nieveen (2006) as DBR is "utility-oriented" (p.5) because the significance of a design is measured especially by its practicality. The study conducted by Gaydos (2013) revealed that connecting student activity to real-world contexts increases students' motivation since students bring a ring of authenticity.

Focusing on the Design and Testing of a Significant Intervention

Researchers and practitioners collaborate during the selection and creation process of the intervention (Anderson & Shattuck, 2012; Wang & Hannafin, 2005). Anderson and Shattuck (2012) defined the needs for creation which are correct assessment of the context, literature analysis, theory and practice from other contexts. The central goal

of this creation is to find effective solutions to real-world problems (Amiel & Reeves, 2008; Reeves et al., 2005). To reach the effective solution it is necessary to apply iterative refinement cycles which finally enables researchers to reach the optimal intervention and define design principles. Nieveen (1999) recommends criteria for good quality interventions as:

- Relevant: Intervention is necessary and its design should have content validity.
- Consistent: Intervention has construct validity, the indicator of a logical design.
- Practical: Intervention is usable for the designed setting.
- Effective: The product should reach the desired outcome.

Using Different Methods within the Framework of DBR

In order to increase reliability, multiple research methods were applied across the design research process (Bannan-Ritland, 2003; Waang & Hannafin, 2004). Design research is a dynamic and integrative process and based on the needs of the research, both qualitative and quantitative methods can be applied (Bannan-Ritland, 2003). Integrated research approach is effective for dealing with complex research problems (Bannan-Ritland, 2003; Kelly, 2004). Deciding on the appropriate research method(s) depends on a pragmatic philosophy (Anderson & Shattuck, 2012).

Involving Multiple Iterations

Iterative research process is emphasized in DBR, requiring systematic prototype testing while producing design principles (Amiel & Reeves, 2008; Cobb et al., 2003; Reeves et al. 2005). Iterative analysis, design, implementation, and redesign processes are conducted in DBR (Wann & Hannafin, 2005). Conducting an iterative refinement process enables researchers to better understand the process of intervention since one-time studies would not provide significant results. This evolution through multiple refinement iterations is of critical importance to DBR.

Collaborative Partnership between Researchers and Practitioners

During all phases of DBR, collaborative work between researchers and practitioners is conducted from the initial problem identification to the production of theoretical and design principles (Anderson & Shattuck, 2012; Barab & Squire, 2004; Ørngreen, 2015). As Amiel and Reeves (2008) pointed out, DBR starts with negotiation between practitioners and researchers about the research goals.

Evolution of Design Principles

The products of a DBR are design principles and guidelines reached after the iterative process which can be applied by others in similar settings (Amiel & Reeves, 2008; Wann & Hannafin, 2005). Refinement of cycles are conducted until finding the satisfactory outcomes.

There are several differences between DBR and the other research methods. In order for better understanding of these differences key reasons to conduct DBR research should be figured out. According to Collins, Joseph and Bielaczyc (2004), key reasons for conducting design research are (p. 16);

- The need to address theoretical questions about the nature of learning in context,
- The need for approaches to the study of learning phenomena in the real world rather than laboratory,
- The need to go beyond narrow measures of learning,
- The need to derive research findings from formative evaluation.

Implementation of Design-based Research in Current Study

This current study meets the criteria required for conducting a DBR. The first issue that matches with DBR is trying to find an effective solution for foreign language learning spelling problems of VI learners by collaborating with experts, teachers, students, and their families over an extended period. As previously mentioned, DBR enables researchers to make a connection between study and real-world problems (Richey & Klein, 2007). The current study was conducted at the target students' school

computer laboratory which covers DBR's being situated in real-life context characteristic.

The second aspect of DBR is the application of different methods research. First of all, this study was employed based on the DBR research framework and experiences of participants were gathered with qualitative methods. In addition, under the DBR framework, single-subject research design was applied. Students' achievement for EFL vocabulary was investigated in terms of spelling and semantics through quantitative methods.

As indicated, iteration is critical to DBR (Cobb et al., 2003; Reeves et al., 2005). This study included iterative refinement in order to develop a drill program that is adequate to the target groups' needs. Through iteration and redesign, the developed program and activities provided the desired level of support for the students. From the beginning to the end of the study, the researcher worked collaboratively with other researchers and practitioners. Especially, experts in VI and EFL education played active role throughout all stages of the study; and negotiation about the purpose, content and process of the study took place.

The last issue to parallel with DBR is the evolution of design principles. Formative and summative evaluation have been used in order to test the drill program. Eventually, a distinctly appropriate set of design principles were founded based on this particular learning context.

3.2.2 Single-Subject Design

Richey and Klein (2007) pointed out that different types of research methodologies can be used in developmental research like experimental, case study, and document analysis. Under the DBR framework, with a qualitative approach single-subject research design, an important research for evidence-based data in special education (Horner et al., 2005) was undertaken. Single-subject research studies (single-case or single-system) are described as experimental research groups that have been developed on the basis of quantitative research approaches. Horner et al. (2005) defined the

attributes of single-subject research as participant as a unit of analysis, participant and setting descriptions, dependent and independent variables, baseline phase, experimental control, visual analysis, external validity, and social validity.

Single-subject research designs either include one participant or multiple participants, usually between two and eight. The description for "single-subject" research stems from the fact that each participant is being assessed individually. Single-subject design has three important components; repeated measurements, baseline phase, and treatment phase (training phase) (Alberto & Troutman, 1995; Engel & Schutt, 2012; Tekin-İftar & Kırcaali-Iftar, 2004). Repeated measurement is a key point for single-subject research, which necessitates the measurement of the dependent variable at regular timed intervals (Engel & Schutt, 2012). Baseline phase is similar to the control group in experimental designs and enables researchers to understand the status of the dependent variable before undertaking an intervention (Hammond & Gast, 2010; Tekin-İftar, 2012). Taking repeated baseline measurements is an opportunity to reduce internal validity threats. The training phase comes after the baseline phase in order to create the desired change in the dependent variable. Likewise in the baseline phase, repeated measurement of the dependent variable is taken in order to understand whether or not a change occurred during the intervention. When the desired change occurs, this phase may be ended and after a while in order to keep monitoring the subject a *maintenance phase* should be implemented. If the dependent variable is still at the desired level without the independent variable, this is a good indicator as to the effectiveness of the independent variable. Additionally, it is important for the educational and social validity of the both the dependent and independent variables. Visual graphs are used in order to best display the results.

As Tekin (2000) pointed out, there are 14 single-subject design models, ten of which enable testing the effectiveness of one intervention (*AB model, ABA model, ABAB model, Multiple baseline design across behaviors, Multiple baseline design across subjects, Multiple baseline design across settings, Multiple probe design across behaviors, Multiple probe design across subjects, Multiple probe design across settings, and changing criterion model*); the other four models enable testing and

comparing the effectiveness of two or more interventions (*Multitreatments model, Alternating treatments model, Adapted treatments model, and Parallel treatments model*).

Implementation of Single-subject Research Design in Current Study

Multiple probe design across behaviors model was applied in this current study. This model is about investigating the effect of one independent variable over at least three different behaviors. Verhave (1966) defined a probe as "a change in conditions at some arbitrary point in an experiment made to evaluate or test for the conditions currently in control" (p. 529). The dependent variable of the study was students' achievement at the vocabulary groups which are friendship, tourism, chores, and science in terms of learning spelling and semantics. For each unit, 10 words were included and thus, in total 40 words were included in the study. The independent variable is the web-based drill program developed based on the principles of Rosenshine's explicit teaching model (1987).

This study followed four progress stages as baseline, training, generalization and maintenance respectively.

Baseline Procedure

For the baseline level, two types of baseline measures were taken. First, to assess students' spelling skills, they were required to write the words in English after they listened. Second, to assess their semantics knowledge, they were required to write English spellings of words after they listened Turkish. For both measures, three repetitive baseline data were gathered individually from students in a computer laboratory. Those baseline data were pre-test scores of the students in order to understand their achievement in the vocabulary groups before the intervention. Students were assessed about their vocabulary knowledge related to the curriculum. Implementation sessions were started at the first academic period of 2015 and vocabulary groups were included from the next semester in order to prevent the effect of face-to-face lessons. Research was conducted in the computer laboratory of the

Göreneller VI Primary School and started by gathering baseline data of all students at the same time during a 15 minutes class break.

For all units, three baseline measures were conducted. While implementing baseline data for the friendship unit, one probe data was also gathered for the other three units. Similar to this, when collecting the baseline data for the second unit, one probe data was gathered for third and fourth units. Similar to first two units, while collecting baseline data for the third unit, one probe data was gathered for fourth unit. For the first unit there were three baseline points, for the second unit there were four baseline points, for third unit there were five and for the fourth unit there were six baseline points.

Training Procedure

For the training level, at least three data items were gathered in order to understand the effect of intervention on student achievement. This level was conducted until stability for the data was assured. At least three data points were gathered at the training level. Implementation of the study was also conducted in the school's computer laboratory and each intervention lasted between two and three hours.

As already mentioned, this study followed Rosenshine's Explicit Teaching Model (1987). This study included three main stages: the first presentation of new topic, the second guide practice and corrections and feedback, the third independent practice. These stages were implemented for each unit separately and 10 words were aimed to teach at each unit.

In the study's first stage, presentation of new topic, all words were read and spelled by the drill program and Turkish meanings were provided. In order to ensure students' understanding, repetition was allowed by the program. Students had chance to listen several times.

In the study's second stage, guide practice, students were allowed to make practice in order to gain independence and responsibility on the new topic. They tried to write the

words after listening. Also, they were required to practice Turkish meanings of the words. Additionally, Rosenshine's corrections and feedback principle was implemented in that stage. Drill program provided process and sustaining feedback based on the students' performance.

In the study's third stage, independent practice, students practiced the content independently. Students were challenged in the time required to write the words. Drill program informed students about their progress by providing scores. Following two pictures are taken during training sessions.

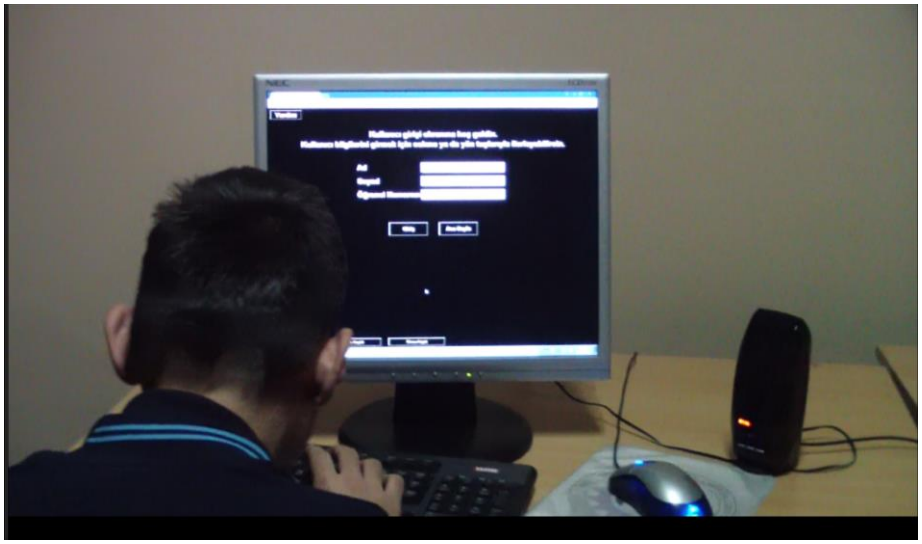

Figure 3.1 A picture from training session

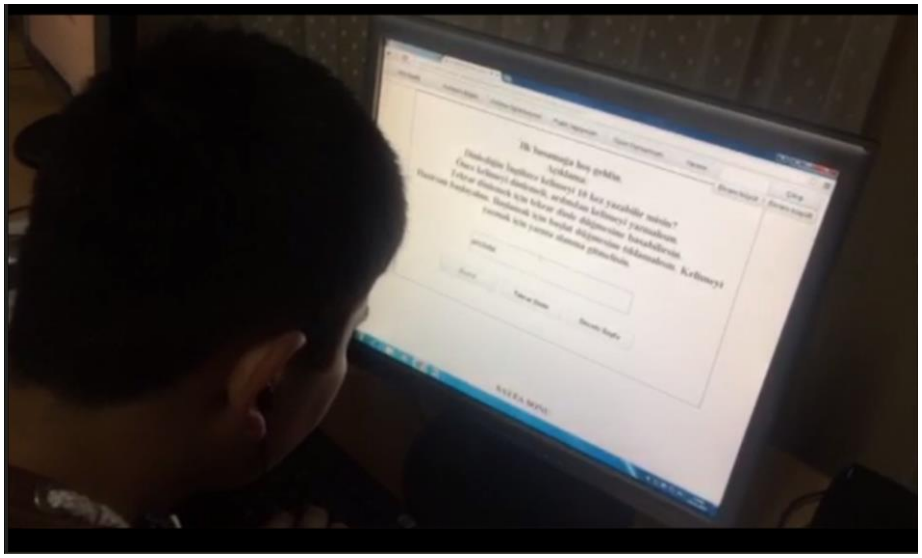

Figure 3.2 A picture from training session

Generalization Procedure

In the current study, students were taught vocabulary groups divided into units and they were assessed based on these units. However, in their actual educational life, students are assessed based on exams including words randomly and mix. Thus, the study attempted to determine whether students can spell the words if they are provided words mixed from all units. In generalization phase, students were required to write all 40 words randomly.

Maintenance Procedure

The maintenance level was conducted in order to understand when the intervention had ended, and whether or not students were able to remember the words. For that purpose, after completing each unit's intervention, at least a break of six weeks was given. Following the break, three data points were gathered every two weeks.

Details of the stages mentioned above are explained based on the units in the following part.

Friendship Unit. Baseline data for the friendship unit was gathered three times in three weeks. Thus, for the friendship unit, three baseline data were gathered. After assuring stability for the baseline data of the first unit for six students, the training phase of the first unit was implemented directly after. Three data were gathered in the training phase during the fourth, fifth and sixth weeks of the study respectively. Generalization phase was conducted one week after training phase. After completing the training phase and generalization phases for the first unit, the maintenance phase was conducted. Three data were collected in order to understand whether or not students were able to remember the words. For that purpose, a six week break was left after the training phase and maintenance data were collected during the 17th, 19th and 21st weeks.

Tourism Unit. One probe data for this unit was collected during the first week in parallel to the friendship unit. Then, the actual baseline data were gathered at the fifth, sixth and seventh weeks of the study while the training phase of the first unit was being conducted. After giving a break of two weeks, the training phase started and three training data were gathered from the students. Generalization phase was conducted one week after training phase. Similar to the friendship unit, after a break of six weeks break, during the 22nd, 24th and 26th weeks, the maintenance data were collected.

Chores Unit. The first probe data for this unit was collected during the first week, in parallel to the friendship unit. The second probe data was collected during the fifth week when the actual baseline for the tourism unit was started. Then the actual baseline data were gathered during the 11th, 12th and 13th weeks. After a two week break, the training baseline started and three training data were gathered. Generalization phase was conducted one week after training phase. After a break of six weeks, maintenance data were collected during the 25th, 27th and 29th weeks.

Science Unit. The first probe data for this unit was collected during the first week, in parallel to the friendship unit. The second probe data were collected during the fifth

week and the third probe during the ninth week. Actual baseline data of this unit were collected during the 17th, 18th and 19th weeks. After two weeks, the actual baseline data were gathered during the 22nd, 23rd and 24th weeks. Maintenance data were gathered during the 30th, 32nd and 34th weeks of the study.

3.3 Methodological Framework of the Study

During this study, the stages proposed by Reeves (2000) on how to use DBR in the instructional technology field was followed. Figure 3.3 graphically presents the whole end-to-end process of the study.

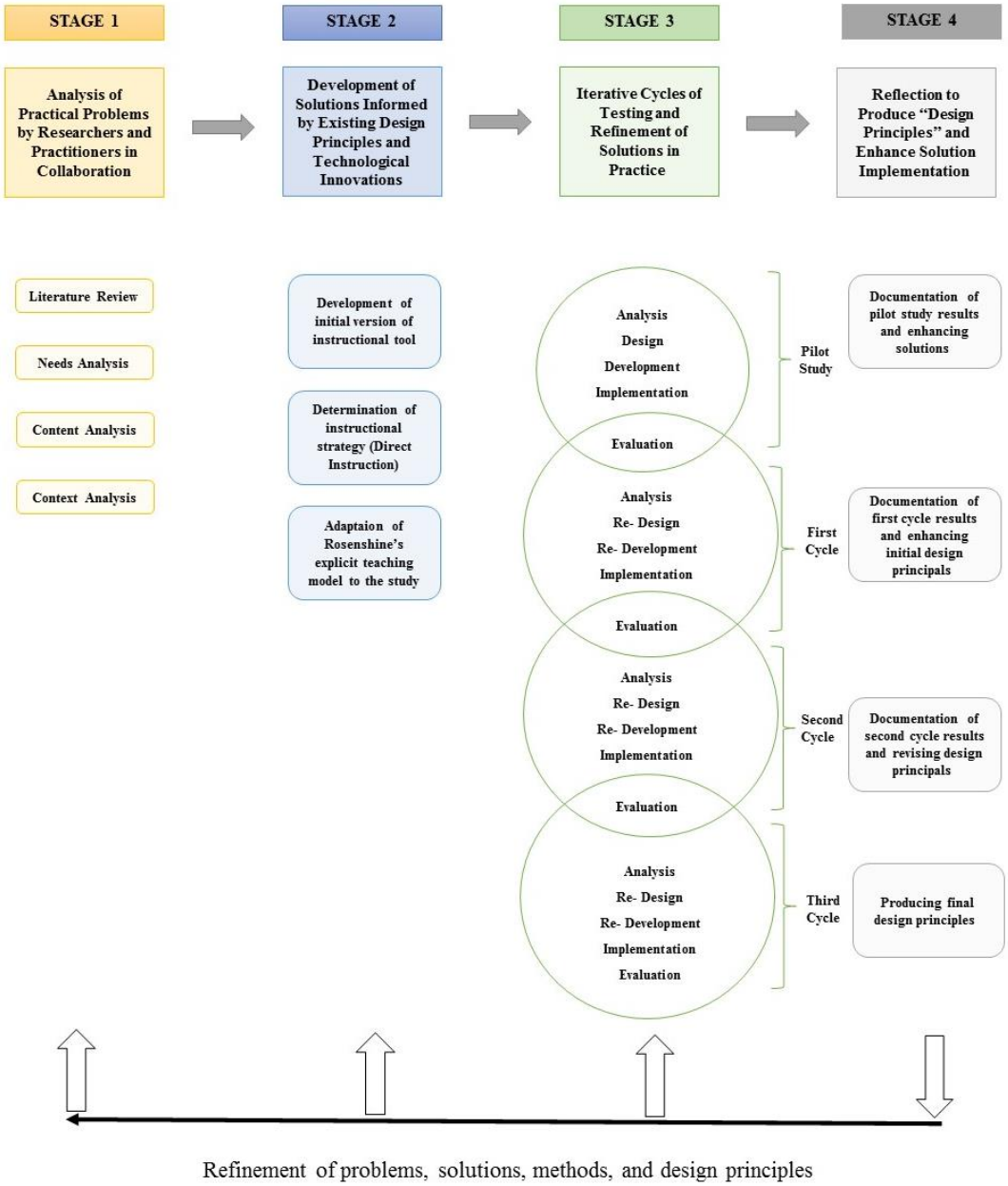

Figure 3.3 Procedure of the Study

3.3.1 Stage 1: Analysis of Practical Problems

During this stage, negotiation for the research goals was achieved based on the results of needs analysis and a literature review between researcher and practitioners.

Firstly, based on the meetings, a real-world problem of this study was determined, which was agreed as the difficulties VI people face while learning spelling of the English vocabulary. Spelling has key importance for vocabulary knowledge and consequently for reading achievement (August, Carlo, Dressler, & Snow, 2005; Blachowicz, Fisher, Ogle, & Watts-Taffe, 2006).

In order to better understand this problem, a literature review was conducted for the possible solutions and meetings were held with practitioners to determine the topic, target group and boundary of the study. Based on decisions taken during the meetings, a comprehensive needs analysis was conducted.

Literature Review

After determining the problem, a literature review was undertaken. Based on the literature review analysis, it was understood that the problem was not specific to Turkey but that other countries were also developing solutions. The details are presented in the literature review section.

Needs Analysis

The needs analysis was conducted with the assistance of the Disability Support Office of Middle East Technical University (METU) (http://engelsiz.metu.edu.tr/en/); Mitat Enç Visually Impaired Middle School in Ankara, Turkey; Göreneller Visually Impaired Primary School in Ankara, Turkey; The Educational Society for the Blind (http://www.gormeengelliogrenciler.com/node/507), and the Visually Impaired Technology Center.

Firstly, a survey and interview questions were prepared in order to better define the real-world problem of this study and purpose.

In the first phase of the needs analysis, interviews were conducted with three totally blind teachers, two of whom were English teachers and the other was a pre-school teacher. During the face-to-face meetings, it was seen that accurate spelling of the vocabularies was relatively difficult and that VI people need apposite solutions. Interestingly, one of the blind English teachers indicated that he was teaching vocabularies in class by reading them in their written forms. For example, instead of spelling as *"fadır"*, he said "father" while teaching that specific vocabulary. For this reason, students were learning the vocabularies based on their writings which also creates problem in spelling. The other problem regarding this issue is that VI people learn English vocabularies based on their braille abbreviation, for example "fr" means friend, "c" means can, "d" means do. The reason for learning like that is braille-printed books have many pages which makes it difficult to study with such kinds of material. One of the teachers indicated that "Students learn the abbreviations, but in regular education there is no such thing. And also we have technology now. When you are communicating over the Internet you need to know the long forms of the vocabulary".

Based on those arguments, the questions for the survey were clarified and then distributed via the METU Disability Support Office. In the survey, participants were asked about their problems regarding EFL, what kind of technological solutions they need for EFL learning and especially which of the language learning skills was difficult for them. 15 volunteer university students answered the questions, of which ten of the students were 100% blind and the other five were 90% VI. They were also asked about their language levels and nine of them indicated that they were at the beginners level, four of them were intermediate and two were advanced. They were mostly asked about which language skills they face problems with while learning English. Twelve indicated that spelling was the most problematic skill for them. The other area questioned was regarding the solutions they needed to deal with the problems and most answered that computer-based modules can help language learners. More specifically, one of them stated that "an entertaining game can be developed that can teach spelling in which audio is embedded like clapping". Likewise, another

participant stated that “something like dictionary game can be developed that teaches the spelling of the vocabulary”.

Based on the needs analysis and the literature review, it seems that similar to other countries, Turkey cannot adequately meet the educational needs of VI people in foreign language education. Technological solutions may be good since it enables the VI to make adequate practice in order to fill the gap. As a result, the researcher initiated a research study for eighth-grade VI students to provide a web-based drill program in order to improve their EFL vocabulary in terms of spelling and semantics. The target group was chosen as eighth-grade since those students would sit a national exam that year (known as TEOG) that included an English language section. In this exam, vocabulary knowledge plays a major role and their problems with spelling necessitated an improvement.

3.3.2 Stage 2: Development of Solutions

Based on the needs analysis, content analysis and literature review undertaken, three important traits of the web-based drill program were defined as educational content, the feedback types offered to the user, and the technical details. The content of the drill program was prepared based on the curriculum of the Ministry of National Education (MoNE) in Turkey. According to the eighth-grade curriculum, there are ten units covered in the year. Four of the units were included during the implementation and its relative vocabularies were covered.

As previously mentioned, the instructional model used in this study was Rosenshine’s Explicit Teaching Model (1987). Based on the literature, DI was thought to be the most effective strategy for teaching EFL vocabulary to VI students. Since the educational needs of each student vary widely and blind students do not bring the same visual experiences to the classroom, their curriculum needs will not be met without systematic direct instruction by knowledgeable persons (Texas School for the Blind and Visually Impaired, 2015). Instruction should be provided directly to the student with guided practice and intensive direct instruction that should reduce over time as mastery increases

The content and the structure of the system were prepared based on Rosenshine's (1987) explicit teaching model. However, this current study's model was adapted based on the web-based module. Rosenshine's explicit teaching model (1987) was embedded into DBR, and the instructional solutions were designed, implemented and evaluated in a real-world learning environment.

The features of the drill program was based on the characteristics of the target group. Since those students are VI, visualized materials were not used in the instructional program. All of the content was prepared as auditory. Also, auditory feedback was provided for the orthographic errors of the participants. All of the content was compatible with screen readers.

The technical interface of the web-based drill program was developed with Asp. Net and C# programming languages. The database was programmed with MsSQL. For application and database services, azure cloud system was used.

As a result of the literature review, content, and needs analysis, the initial version of the drill program was decided upon and which included four user sections as "user information, dictionary, practice, and game". The screenshot of the menu section is provided in Figure 3.3.

Figure 3.3 Screenshot of Menu Section

Users were required to register to the system in order to save their data. After registration, users were directed to the main menu. Under main menu dictionary, practice and game sections were included with one level and thirthy words. Those words were from the eight-grades' English book of Ministry of Education in Turkey. Following part includes information about the sections of the initial program.

Dictionary section was developed to teach spelling and semantics of words which were divided into units. All of the words were read and spelled by the program and the Turkish definitions were provided. Students had chance to listen several times. This section was compatible with the "Presentation" phase of Rosenshine's explicit teaching model.

Practice section was developed to ensure students practice the words. Words were given randomly, read by the system and the students tried to write what they heard. This phase was related to "guided practice" phase of Rosenshine's explicit teaching model.

Three options were provided for the students' answers as "correct, partially correct, and wrong". The feedback provided here was designed based on the corrections and feedback principles of Rosenshine's explicit teaching model.

If the user input was:

- Correct: System gave positive feedback and provided the next word.
- Partially correct (maximum 3 mistakes): The system gave an encouraging feedback and then the user had chance to try again.
- Incorrect: The system gave a short feedback and spelled the word in English.

Flowchart of practice section is provided in Figure 3.5.

Game section was developed to inform students about their progress in learning words by providing scores and requiring them to compete with time. There were three different levels based on different time options; first level with 30 seconds, second level with 20 seconds, and third level with15 seconds. Students gained scores based on their performance. This part was linked to the "independent practice" phase of Rosenshine's explicit teaching model. Flowchart of game section is provided in Figure 3.6.

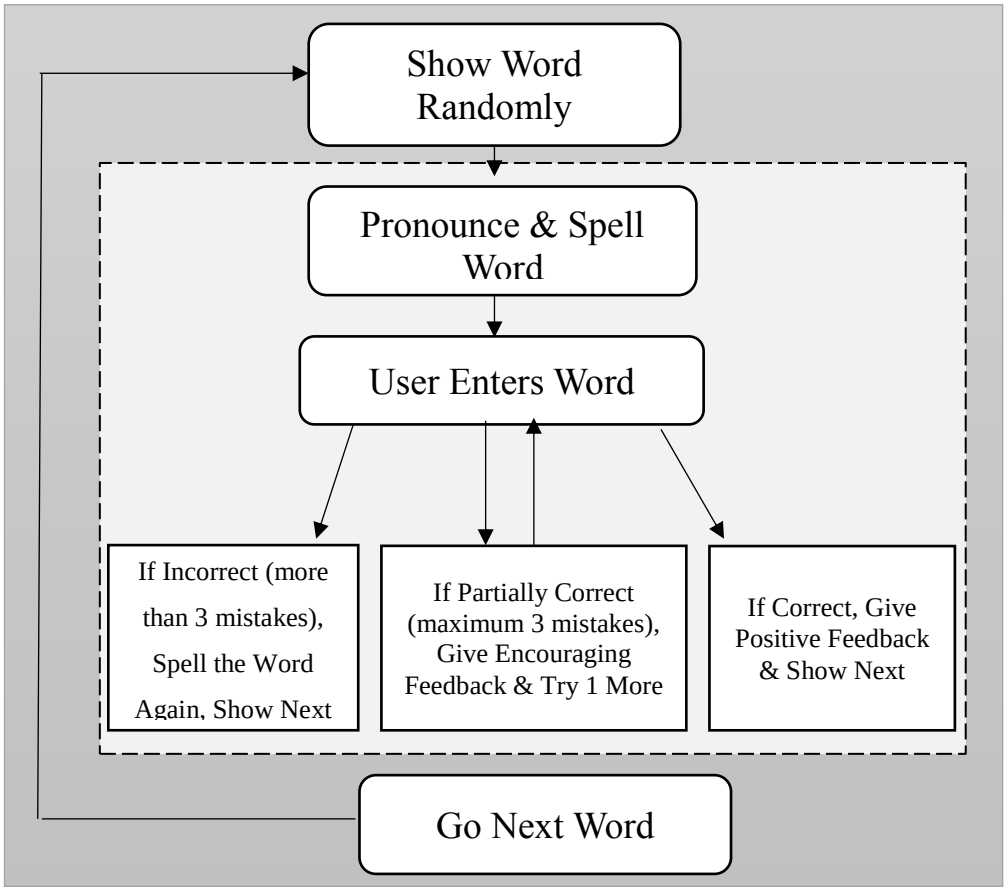

Figure 3.5 Flowchart of Practice Section

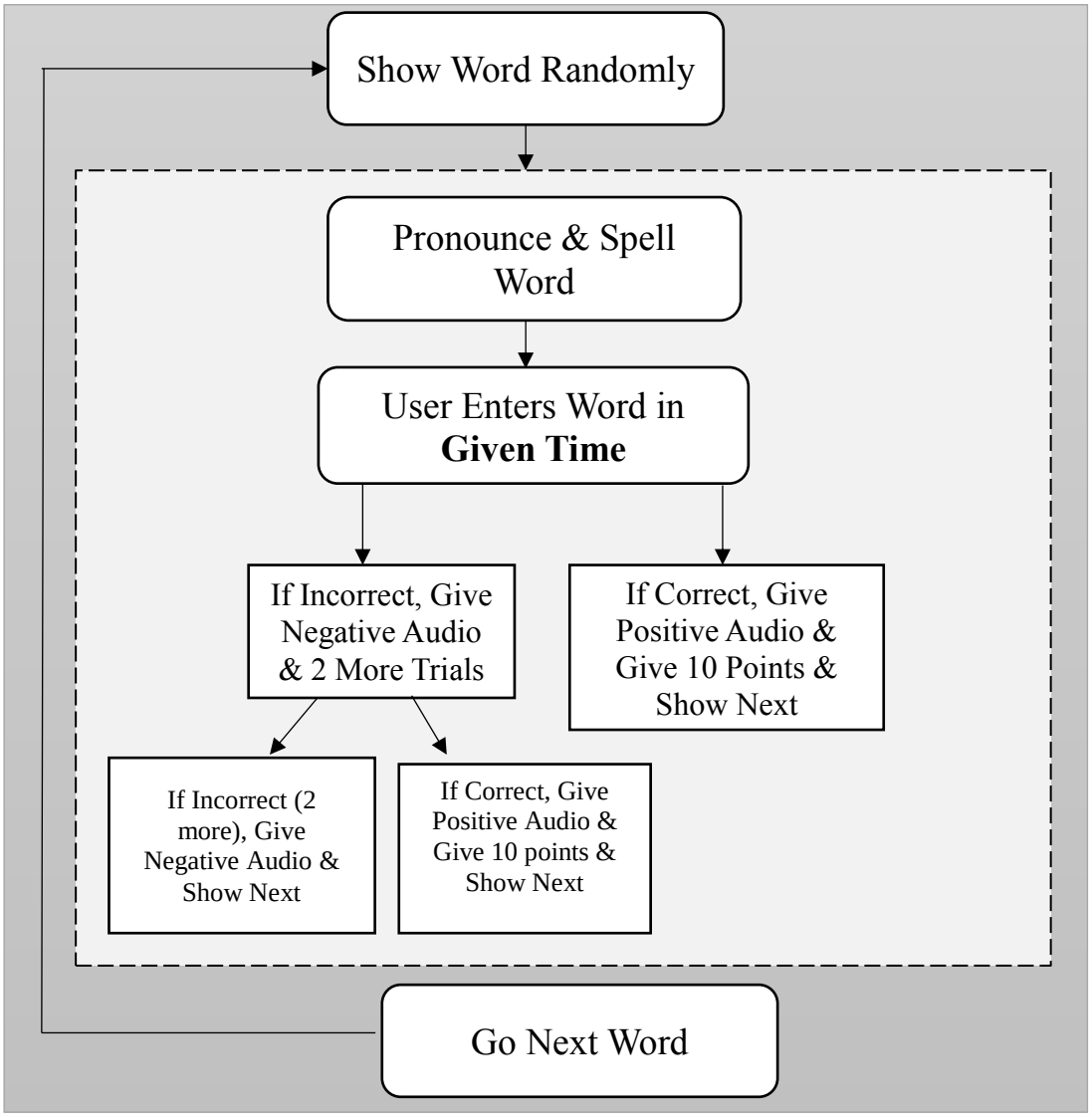

Figure 3.6 Flowchart of Game Section

3.3.3 Stage 3: Iterative Cycles of Testing and Validation of Solutions

Research Setting

The research setting of this study was an English language course offered by the Ministry of National Education in Turkey during fall of 2015 and the spring of 2016.

The spring semester curriculum of the EFL course was included in the study. There are two public schools for VI students in Ankara, Turkey, which are Mitat Enç Visually Impaired Middle School and Göreneller Visually Impaired Primary School. After obtaining approval from the university's Institutional Review Board (IRB) and Ministry of National Education, the study was conducted by the researcher at both of the schools but mostly at Göreneller Visually Impaired Primary School due to the convenience of the laboratories and access to the teachers. The computer laboratories of the school were used during all implementation stages conducted between October 2015 and February 2016. During the spring semester, summative evaluation of the study was achieved with the help of teachers and students. Again the computer laboratories of the two schools were used.

Participants

In terms of sample selection, purposeful sampling method was administered in the study. Purposive sampling techniques are mainly used in qualitative studies (Patton, 2002; Teddlie & Yu, 2007) and defined as choosing participants built on specific purposes in order to answer the research questions. Maxwell (1996) defined purposive sampling as a type of sampling in which, "particular settings, persons, or events are deliberately selected for the important information they can provide that cannot be gotten as well from other choices" (p. 87). Purposeful sampling is about the discovery of noteworthy cases or events as a replacement for reaching a population from the selected sample by generalizing (Patton, 2002). There were three groups of participants in the study; students, experts, and families.

Students. The participants of the study were seventh and eighth-grade students, who actively participated during the implementation, refinement, and evaluation stages of the study. Based on the purposive sampling, a total of 15 participants attended at least one cycle of the study.

Convenience sampling was implemented in this study which is one of the purposive sampling strategies. Convenience sampling method relies on data collection from members who are available to participate in a study. Two cycles of this study were

conducted after official school hours in the evening which made convenience sampling a necessity. Six of the participants were able to attend all cycles of the study. This was necessary for following the achievement progress of some students in order to test the program's effectiveness. Information about the students is provided in Table 3.1. The six students who attended all of the cycles are coded as WP (wholly participant), with the rest coded as PP (partially participant).

Table 3.1 *Information about the Students*

Participant	***Cycles Attended***	***Visual Impairment %***	***Gender***	***Grade***
WP1*	All	100	Male	8th
WP2	All	100	Male	8th
WP3	All	100	Male	8th
WP4	All	80	Male	8th
WP5	All	80	Male	8th
WP6	All	90	Male	8th
PP1*	Second	100	Male	7th
PP2	Second	100	Female	8th
PP3	Second	100	Female	8th
PP4	Second	100	Male	7th
PP5	Second	100	Male	7th
PP6	Second	90	Female	7th
PP7	Third	100	Female	8th
PP8	Third	100	Female	8th
PP9	Third	100	Male	8th

* WP1 = wholly participant1, attended all cycles of the study.

* PP1 = partially participant1, attended at least one cycle of the study

Experts. Used as a general label to refer English teachers, computer teachers and programmers who are VI or at least have experience in VI education and accessibility issues. Purposive sampling strategy was also used in the group of four expert

participants. During the analysis, design, development and evaluation phases, two English teachers participated in the study as subject matter experts. Especially, vocabulary included in the system was determined with the help of the experts. One blind expert who is both a computer programmer and a pre-school teacher participated in the study. He was a specialist in programming and deeply knowledgeable in the design field for the VI. Thus, he actively cooperated with the researcher during all stages and cycles of the study. The other participant was a blind computer teacher who guided the study in terms of design principles and experiences of the students.

Information about the experts are provided in Table 3.2.

Table 3.2 *Information about the Experts*

Participant	***Cycles Contributed***	***Visual Impairment %***	***Gender***	***Job***
E1	All	100	Male	Primary School teacher & Computer Programmer
E2	All	100	Female	English Teacher
E3	All	NO	Male	English Teacher
E4	Second (formative evaluation)	100	Male	Computer Teacher

Families. For the summative evaluation part at the end of the study, three student family members participated in order to understand their opinions regarding students' experiences related with the study. Families play an important role in understanding

students' experiences. In this current study, researcher had spent time with families and their children. Thus, families had detailed information about the study and its reflections at their home. Their understanding of the study was critical since they provided information about the motives of children to participate the study. Also, they provided information about the possible contributions of the study to their own child. The three family members were selected based on the convenience strategy of purposeful sampling, selected from students who attended all implementation cycles. Since the mothers of the students were closely following the study, interviews were conducted with the mothers of WP1, WP4 and WP5.

Researcher's Role. Qualitative studies have different epistemological, ontological and methodological perspectives and reality is socially constructed by its participants (Lincoln & Guba, 1985). Thus, the researcher shapes the research process based on his/her ontological, epistemological, and methodological beliefs. The researcher in a qualitative study is involved in all stages of the study. Due to the nature of qualitative studies, the interaction between researcher and participants may raise some ethical issues since the researcher is an integral part of the process. In order to address any ethical concerns, the researcher(s) should take into account certain matters. First, personal experiences and bias with regard to the topic of the researcher should be clarified (Yin, 2009). In this study, the researcher's role was that of an instructor and also an evaluator.

The researcher has an undergraduate (BSc.) and a graduate (MSc.) degree in Computer Education and Instructional Technology and has been working as a Research Assistant at a university in the same field. The researcher's role in this study was clarified in more detail as follows.

The researcher had an active role throughout; from the analysis, design, and development, to the implementation and evaluation parts of the study. During the analysis step, the researcher conducted investigations in order to define the problem and relative solutions for those problems. Since the researcher is from a different background, she worked cooperatively with an academician from the department of

education for the blind. Together they studied research methods and data collection processes for special education. The researcher improved her knowledge of single-subject research design. In the design and development phase, the researcher worked collaboratively with subject-matter experts and software developers. The researcher studied web-based design for VI learners with a blind computer programmer. During the implementation phase, the researcher implemented cycles, and collected and analyzed data. All implementation cycels were conducted parallel with the requirements of single-subject research design. Researcher was responsible to apply both design-based research and single-subject research principles. During the implementation, the researcher was observed by another researcher in the face-to-face environment. Also, the school's English teacher observed the researcher from time to time. The researcher conducted the interviews, transcribed them herself, and then analyzed and verified the data, and reported the concepts. As Patton (2002) pointed out, trustworthiness of the research depends on the "skill, competence, and rigor of the person doing fieldwork" (p. 14). The researcher's background experience in qualitative studies provided an advantage in minimizing bias concern. Also, in the analysis phase, two researchers checked coded data in order to increase the credibility.

Iterative Cycles

DBR includes iterative cycles in order to better understand the process. This study included one pilot study and three cycles and redesigning issues until finding the most useful and appropriate web-based drill program. Iterative cycles were applied from October 2015 to February 2016 parallel to the face-to-face sessions. Each session represents a three-hour face-to-face class.

The pilot study was conducted in three sessions between October 8th and 15th with the participation of ten students. During the pilot study, the researcher implemented the first prototype of the drill program which was clarified in stage 2, development of solutions section. Data were gathered from both students and experts through interviews. Observation notes were taken by two researchers and demographic information was also gathered. Based on the feedback obtained, relative changes were

applied and the first cycle was implemented in six sessions from October 24th to November 27th with six students participating. Interviews were conducted with students, observation notes were taken and vocabulary tests were applied. Based on the results, relative changes were applied and the second cycle of the study was implemented. This second cycle was implemented in six sessions from December 2nd to 18th with 14 students. Interviews were conducted with both students and experts, and observation forms were completed by two researchers. Additionally, in this cycle, interviews were conducted with three of the students' families. After applying the changes the drill program reached its final version and a final cycle was implemented during a period of two weeks in January with 15 students. During that part, final interviews were conducted with students and observation forms completed by the researcher. Table 3.3 shows the timeline of the whole study. The process of the pilot study is explained in the following part.

Table 3.3 *Timeline of the Study*

Date	***Process***
December, 2014 – March, 2015	Problem definition, needs analysis, content analysis
April – August, 2015	First prototype design and development.
October, 2015 (8th and 15th)	Pilot study implementation, evaluation, redesign, redevelopment and formative evaluation.
October 24th – November 27th, 2015	First cycle implementation, redesign, redevelopment and formative evaluation.
December 2nd – 18th, 2015	Second cycle implementation, redesign, redevelopment and formative evaluation.
December, 2015 – February, 2016	Final implementation, evaluation and summative evaluation.

3.3.3.1 The Pilot Study

The purpose of the study was to examine to the EFL vocabulary learning of VI students by designing and developing a web-based drill program for them. For that reason, this cycle was started with the literature review and the needs analysis which were explained in detail before. Based on this investigation, researcher and practitioners agreed upon the initial problem identification and decided on the structure of the product to be developed.

The implementation and evaluation of the pilot study was conducted in three sessions between October 8th and 15th 2015 with the participation of ten students in Göreneller VI Middle School. During the pilot study, unit-sixth (friendship) was covered. Redesign, redevelopment and formative evaluation of this cycle was accomplished after the implementation session. For that purpose, interviews were conducted with

three experts, two of them were the English language teachers of the school and the other one was the expert in computer programming and accessibility issues. Based on the data, relative changes were applied. The changes were grouped under three headings as accessibility, content and auditory input.

Accessibility

Accessibility refers to people with disabilities who can perceive, understand, navigate, and interact with the Web, and also contribute to the Web. This cycle was more focused on accessibility issues.

Perceivable. This principle indicates that all information and components on a website should be perceived by the users. One of the experts used the website in order to determine the problems and indicated that users should be informed when they navigate to the end of the page. For this reason "end of the page" link was added at the end of the all buttons and links to show the users they are going back from that point to the first item of the web site.

Operable. This principle requires all of the components to be operable. In line with this principle, the problems related to two guidelines were corrected based on expert review. Thus, all of the functions of the program became operable with the keyboard. Additionally, all the tasks were done non-time-dependent and especially in registration and login parts users were not limited to time. However, this guideline was not followed for the tasks that require time dependent input.

Understandable. This principle implies that users understand all the information and can operate throughout the website. During the pilot study, all students faced with difficulties in login and registration parts. Students indicated that they were confused easily and did not figure out how to register and then login to the program. For this reason, more detailed explanation was added to clarify what the system requires and what they should do. Audio was added which informs the students about the registration requirement of the program.

Robust. This principle necessitates the content to be robust enough to be interpreted reliably by the users or assistive technologies. In order to inform users when they make mistakes, auditory input was also added in the registration and login parts. When the user information is incorrect or missing, the system warns auditory as "You should control your information and try again".

One of the experts, who was working as computer programmer, indicated that there was not descriptive label to distinguish buttons and texts. Associated text labels were added to all buttons and text inputs.

All of the participants faced with problems related to the incompatibility between the screen reader and the website. They mentioned about the difficulty in accessing information because the screen reader did not sound appropriately. In order to provide the content distinguishable, relative code changes were done. In the HTML code, the start and end tags were fully inserted. Thus, screen readers can read the content completely and correctly.

Content

Number of Words. As mentioned before, there were 30 words provided for each section. Firstly, students were learning in the dictionary part, then practicing, and finally playing the game. However, all of the students stated that the number of words is too much and get them mentally tired while trying to accomplish all the tasks. Observer of this cycle mentioned about the same problem and indicated that due to high number of words students were cognitively overloaded and could not focus on the content. For this reason, number of words was decreased to 20.

Explanation. Each section provided explanations in order to clarify what was expected from students. They were directed to the inside of sections after listening those explanations. However, all of them faced with problems understanding what the explanation was. For this reason, with the directions and feedback of the expert, necessary updates were done based on the characteristics of the target group. For example, in the practice section it was indicated that "in order to write the words you

hear, you should go to writing field". Clear language is very critical especially in teaching process of VI learners.

Speed Level. In the game section, there were three levels based on the time provided for writing each word. All of the students stated that the time was too high which does not create a competitive environment. Especially, 30 second was too much. For this reason, the time was decreased for first level to 20 seconds; for second level to 15 seconds, and for third level to 10 seconds.

Auditory Input

Sound Effect. Regarding practice section, all students indicated that they need a distinguishing sound effect in order to understand that they completed writing each word in required time. They had difficulties when the website directed them to the new word. For this reason, a distinguishing sound was added which informs users they completed the task with success. Table 3.4 summarizes the changes applied at the end of pilot cycle.

Table 3.3 *Summary of the Changes Applied in the Pilot Study*

	Accessibility
Perceivable	*"End of page" code was added to all pages in order to inform VI users.*
Operable	*All page functionality is available using the keyboard.* *All functionality of the content has become operable in a non-time-dependent manner through a keyboard interface.*
Understandable	*Titles, headings, and labels have become descriptive.*
Robust	*The website has become compatible with the screen readers.* *Associated text labels were added to all buttons and text inputs.*
	Content
Number of Words	*The number of words per unit was decreased to 20 from 30.*
Explanation	*The explanations at the beginning of the sections was changed based on the suitable language (e.g. In order to write go to writing field.)*
Speed Level	*In the game section the speed of the levels changed from 30/ 20/15 to 20/15/10.*
	Auditory Input
Sound Effect	*In practice section a distinguishing sound effect was added.*

Design Principles Constructed in the Pilot Study

Based on the findings of the pilot study, some of the design principles of the web-based drill program were constructed. Those design principles were related to the interviews and observations. Design principles of the pilot study are:

- Providing an accessible content should be the main purpose of the instructional program.
- Content should be presented with activities that overlap with the learners' and should not cause cognitive overload.
- Content should be presented with clear and understandable instructions considering the characteristics of VI learners in order to prevent confusion and enable them to be successful.
- Activities should have competitive nature that triggers the motivation of VI learners.
- Distinguishing auditory sounds can be effective in informing students about their performance and also motivate them.
- Providing an accessible and usable environment is crucial.

3.3.4 Stage 4: Reflection to Produce "Design Principles"

After the implementation sessions were completed, the last step included the design principles of the program. Throughout the study, the purpose was to design a web-based drill program, and the major output of the study was the drill program itself. The steps for producing the design principles are clarified in the Results chapter and all principles are summarized in the Discussion chapter.

3.4 Data Collection Instruments

Due to the nature of DBR, a large qualitative and quantitative dataset of various types was collected (Dede, 2004) in order to determine whether or not the intervention is effective and why (Reinking & Bradley, 2008). Also, multiple data sources are

necessary for data triangulation in order to validate data and research by cross-verification.

This study incorporated both qualitative and quantitative data collection instruments. In line with the purpose of this study, gathering multiple sources of data enabled the researcher to gain a rich perspective about the phenomena being studied. Interviews, observations, vocabulary and retention tests were the primary data sources of this study.

3.4.1 Demographic Questionnaire

Prior to the study a demographics questionnaire was administered in order to gather information about the participants' characteristics, vision disorders, and their perceptions towards the English language and also technology. Knowing the participants' vision disorder level was important as this influenced the intervention and design processes. The questionnaire included one section with 11 questions about their vision disorder, the problems they faced in their traditional English class, their expectations, and their opinion toward the books they were currently using. Five of the questions were multiple-choice and six were open-ended (see Appendix C).

3.4.2 Interview Schedules

Interviews are the most common data gathering techniques used in qualitative research as they enable researchers to obtain large amounts of data (Marshall & Rossman, 1999). Interviews add strength to understanding the participants' perspectives and how they make meaning of their own experiences, and obtains information that otherwise the researcher cannot observe directly (Patton, 2002).

Interviews are categorized as structured, semi-structured, and unstructured (Yıldırım & Şimsek, 2013). Semi-structured interviews were administered in this study which are the most common types of interviews. Hoepfl (1997) stated that "although it is prepared to insure that basically the same information is obtained from each person, there are no predetermined responses, and in semi-structured interviews the

interviewer is free to probe and explore within these predetermined inquiry areas" (p. 52). Depending on the flow of the interviews the researcher asked further questions.

Semi-structured interviews were conducted with the students, experts, and some of the students' families. Guiding questions in the interview schedules were prepared based on the research questions of this study. For this purpose, an extensive literature review was conducted in order to look for information related to the topic of the study. Similar studies were found to be limited in the literature; however, valuable information was gathered especially in the area of theoretical framework and the conducting of effective interviews.

The first interview schedule was developed for the students (see Appendix D). An interview guide was prepared by the researcher considering the target groups' age characteristics and the research questions of the study. This interview protocol was piloted during the pilot cycle, and followed-up with any necessary editing. Few major changes were applied. The changes related to the organization of the questions, the language used and detailing in the questions. The second interview schedule was developed for the experts (see Appendix E) and the third for the families (see Appendix F). Due to time-related issues, these two interviews were not piloted.

Prior to using the interview protocols, expert opinion was sought in order to increase the credibility of instruments. Three interview protocols were sent to two faculty members in the Instructional Technology field and to one faculty member in the field of Special Education. They were asked to check the clarity, validity and organization of the interview protocols.

Student Interview Protocol

The final version of the interview protocol included twelve questions plus relevant question probes. Student interview protocol was divided into two sections. First section included eight questions and were about the general experiences of the students, course educational content, accessibility, design issues, and their suggestions. First section questions were asked after each cycle. Second section

included four questions and were about general opinions of students in terms of the study. This section questions were asked at the end in order to ensure social validity of the study. Interviews were audio-recorded following consent taken from the school and the families.

Expert Interview Protocol

The expert interview protocol included 15 questions plus relevant question probes parallel to the student interview protocol. They were asked for their general opinion about the study, their ideas relating to the accessibility of the program, the content structure of the program, and for any further suggestions. Furthermore, they were asked about their in-class observations. Especially, it was attempted to understand whether or not the students were able to reflect an improvement in their traditional class and national exams. The four experts were interviewed after each cycle at their convenience.

Family Interview Protocol

The family interview protocol included five questions aimed at understanding their opinions with regard to the study and for observations regarding their child (the participant student). They were asked about what they knew of the study, for their impressions about their own child's experiences, and also for their own suggestions.

Interviews were conducted once with the families at the end of the third cycle. The three family members were interviewed at their convenience. The other families were unable to participate in the interviews. Interviews were held with three families of students who had attended all cycles of the study.

3.4.3 Observation Forms

Observations play a critical role in qualitative inquiry. Through observation the researcher can observe behaviors directly and take note of body language and its effect. "Observation entails the systematic noting and recording of events, behaviors, and

artifacts (objects) in the social setting chosen for study" (Marshall & Rossman, 1999, p. 79).

Two different observation forms were used in this study; one of which was for participant observation and the other for researcher observation.

This study involved prolonged observation of the participants. Holistic description of events was undertaken by the researcher and one other researcher. During the implementation at the Göreneller Visually Impaired Primary School, different researchers observed each implementation session. The observation form for the students was prepared by the researcher after the first and second implementations of the study. The reason for this was to have a general understanding of patterns of behavior in the classroom. After identifying the patterns an observation form was prepared with themes to be filled accordingly. Field notes were taken based on educational content, design, accessibility, feedback, and student experiences (see Appendix G).

For observing the researcher, an observation checklist was prepared based on the steps of Rosenshine's explicit teaching model (1987). Another researcher acted as observer in order to check whether or not the researcher was applying Rosenshine's explicit teaching model (see Appendix H).

3.4.4 Vocabulary and Retention Tests

Since the aim of this study was to develop a web-based drill program to teach English vocabulary to VI students, the effectiveness of the program was investigated by implementing frequent vocabulary tests and retention tests. Also as previously mentioned, repeated measurement is central to single-subject research which requires to measure DV at regular timed intervals.

Vocabulary tests were prepared based on the four units covered in this study. There were ten vocabulary questions for each unit and participants were required to write the vocabulary they had listened to and write the Turkish meanings for each of them.

Vocabulary tests were included in the website and were conducted online. The results were saved in the database.

Before the study (baseline phase), vocabulary tests were applied three times in order to ensure internal validity and understand the status of DV before the intervention. Vocabulary tests were applied regularly during the intervention until the desired change was noted. After the intervention was completed and all the units had been covered, retention tests were applied during the 6^{th}, 8^{th} and 10^{th} weeks in order to monitor participants. Table 3.4 summarizes the research questions, data instruments and analysis.

Table 3.4 *Summary of Data Collection*

RQ	*Instrument*	*Data Source*	*Data Analysis*
1) How do participants describe their experiences toward the web-based drill program?	a- Student Interview Guide b- Expert Interview Guide c- Observation Form	Students Experts *(Teachers, Computer Programmer)* Researcher	Content Analysis
2) What are the families' opinions about students' experiences with web-based drill program?	a- Interview	Students' families	Content Analysis
3) What is the contribution of web-based drill program on VI students' spelling and semantics knowledge in English vocabulary?	a- Vocabulary Test b- Retention Test	Students	Visual Graphs
4) What are the participants' experiences pertaining to the design principles of web-based drill program for the VI?	a- Student Interview Guide b- Expert Interview Guide c- Observation Notes	Students Experts *(Teachers, Computer Programmer)* Researcher	Content Analysis

3.5 Data Analysis Procedure

Since this study included both qualitative and quantitative data collection, both of the processes are explained in the following parts.

3.5.1 Qualitative Data Analysis

Qualitative data analysis is central to this study since the main data sources are qualitative. Qualitative data are complex and cannot be converted into standard measurable units of objects, vary in level of abstraction (Marshall & Rossman, 1999) and involves interpretation of "meanings made both by the social actors and by the researcher" (Miles & Huberman, 1994, p. 8). Raw data have no meaning and an interpretive framework brings meaning to data and shows this meaning to the readers (Marshall & Rossman, 1999). Common analytic procedures are suggested by scholars for qualitative data analysis (Miles & Huberman, 1994; Marshall & Rossman, 1999). The researcher followed the analytic procedures suggested by Marshall and Rossman (1999) which includes five modes.

Organizing Data

First of all, the researcher read all the observation notes that had been taken by all of the researchers and made notes based on the research questions. Next, the researcher transcribed verbatim all of the audio-recorded data. After the transcription was complete, the researcher read all the data again and again in order to become thoroughly familiar with the data and to ensure a strong insight had been gained. During the reading process the researcher wrote findings in the form of memorandums as an initial pre-sort process (Creswell, 2007).

Generating Categories, Themes, and Patterns

This mode is the most difficult of the data analysis process since it requires creativity in converting raw data into meaningful categories (Hoepfl, 1997). Data analysis begins with determination of themes emerged from raw data which is termed as 'open coding' (Strauss & Corbin, 1990). During open coding, the researcher generated descriptive

and multi-dimensional themes. In this study, the themes emerged from the data, which was termed an inductive analysis by Patton (2002). As the student interview analysis progressed the researcher split the major themes into subthemes to end up with two major themes containing six sub-themes. Similarly, as the expert interview analysis progressed the researcher end up with two major themes and five sub-themes. For family interviews, the researcher end up with one major theme and two sub-themes. Next, the researcher developed a codebook which included a detailed description of each code. Considering the content analysis, the researcher coded each unit for each theme and sub-theme in the codebook (Denzin & Lincoln, 2000).

Then, the researcher searched for the plausibility of the analysis and credibility of the study (Marshall & Rossman, 1999). In questioning whether or not the data answers the questions being investigated, the researcher worked with two researcher assistants. Together they examined the codes and gave feedback about what they considered was misleading data. Credibility issues are described in detail in the section on Trustworthiness.

Searching for Alternative Explanations

This mode is about being critical against the data and searching for alternative explanations, even where everything seems totally apparent (Marshall & Rossman, 1999). This mode was deemed necessary since the data gathered from the VI students necessitates the contribution of experts from the field of special education. Thus, the researcher discussed the data and codes with an expert from special education and together they finalized the analysis by trying to find the most plausible codes.

Writing the Report

Writing a report about qualitative analysis cannot be thought of as a separate part of the process. As a final step the researcher summarized the data by engaging in an interpretative act.

3.5.2 Quantitative Data Analysis

This study implemented the single-subject research design in order to evaluate the effectiveness of the intervention in terms of student achievement. Data were gathered from vocabulary and retention tests. There are two data analysis methods in single-subject research design, which are experimental criterion and clinical criterion. Experimental criterion is about evaluating the effectiveness of intervention and usually this evaluation is utilized by analyzing the data with visual graphs (Tekin-İftar, 2012).

In this study, experimental criterion was used as an evaluation method and data were analyzed with the aid of visual graphs. During the process, the data that had been gathered regularly were processed on graphs. The visualized data enabled the researcher to make decisions about the performance of the participants and the implementation process, and thereby make relative changes where necessary. The researcher made a formative and summative evaluation for achievement based on those data. In order to visually analyze the data, time series graphs were used which requires the gathering of data within regular time intervals. Graphs were developed based on the intervention times.

According to Gast (2010), graphical analysis has many advantages for the researcher:

a- Graphical analysis is an effective method for evaluating the single or small group of participants;
b- Graphical analysis is a dynamic process as it allows to process data on graphs during intervention and to assess data concurrently;
c- Graphical analysis allows the researcher to make data-based decisions during the whole intervention time;
d- Graphical analysis allows to make individual decisions based on the individual performances of participants and make necessary changes for each individual.

Researchers should be careful about some critical items while implementing graphical analysis. The first item of importance is developing the true graph in a true format. In order to achieve this, the researcher developed the graphs with an expert in the field of

special education. Another important item is certainty analysis, which is investigating uncertainty in data points. Uncertainty is determined based on the ascent and decent of data points. If the variability is too great and/or unexpected, relative arrangements should be applied during the intervention in order to minimize such uncertainty. For ensuring certainty, at least 80% of data points should not be no more than 15% distant from the average. Data in this current study showed certainty based on certainty analysis.

3.6 Trustworthiness

In order to strengthen the study design the researcher took trustworthiness issues into consideration during the data collection and analysis process. Trustworthiness of a study is about ensuring validity and reliability which are traditional quantitative-oriented criteria. Different criteria were proposed by Lincoln and Guba (1985) in qualitative studies which are credibility, transferability, dependability, and confirmability. Since the main approach of this study is qualitative, the aforementioned terminology will be used. In addition to these terminology, social validity was also ensured in this study due to single-subject research design.

3.6.1 Credibility

Credibility, termed as internal validity in quantitative study, is about the outcomes of the research that investigates what it is actually intended. Qualitative researchers have to prove that their studies are credible (Creswell & Miller, 2000) and various common procedures for establishing credibility in qualitative studies were suggested by scholars (Lincoln & Guba, 1985; Maxwell, 1996; Merriam, 2009; Patton, 2002). Among various credibility techniques, triangulation, prolonged field engagement and peer debriefing were used in this study.

Triangulation

Triangulation is the most common procedure of searching for consistency among results by using multiple methods, data sources, researchers and perspectives (Gast, 2010; Merriam, 2009; Patton, 2002).

Data triangulation was achieved in this study by providing multiple data sources through interviews and observations in order to validate the results. Observational data were compared with interviews, and interviews were conducted several times with the same people in order to check what they said about the same thing over time. Methods triangulation was performed in order to check the contribution of the website on the participants' achievement by comparing the qualitative data gathered from interviews and observation with quantitative data gathered from vocabulary and retention tests. Investigator triangulation was also performed in order to minimize the potential bias. For that purpose, another observer was used during the data collection process. Additionally, qualitative data were analyzed independently by two researchers and findings then compared.

Prolonged Field Engagement

Prolonged field engagement is another credibility strategy which is the investment of adequate time in the research site in order to learn the culture, testing for possible misinformation and for the building of trust (Lincoln & Guba, 1985). The researcher in this study conducted repeated observations and multiple in-depth interviews and stayed for a prolonged time at the research site. First, the researcher spent time in understanding the characteristics of VI people and how best to communicate with them. Meetings were conducted for this purpose with two field experts in order for the researcher to gain knowledge about VI. During the design and development phases, the researcher worked collaboratively with experts in the VI field in order to better understand the target groups and their needs. For implementation, the researcher spent five months with the target group in their schools. Thus, it can be said that the researcher spent sufficient time in the field during throughout all steps of the study,

and was on hand and reachable to the students, teachers and the students' families at all times, not just during implementation.

Peer Debriefing

Peer debriefing which is another strategy to ensure credibility (Creswell, 2007; Lincoln & Guba, 1985; Maxwell, 1996; Merriam, 2009) was defined by Merriam (2009) as "asking colleagues to comment of the findings as they emerge" (p. 204). Through peer debriefing, the researcher examines the whole research process from multiple perspectives with one or several colleagues serving as critics who hold independent views of the study (Figg, Wenrick, Youker, Heilman, & Schneider, 2010). In this study, peer debriefing was used during different stages including data gathering, analysis and evaluation of the drill program. For example, one colleague of the researcher, who had experience in collecting qualitative and quantitative data, provided feedback during the data collection process. Two other researchers, who were experienced in qualitative analysis, also provided feedback during the data analysis process. They examined the transcripts and coding structure, and one also examined the final reports and the general methodology implemented by the researcher. The other researcher was able to question the research both fundamentally and methodologically. Additionally, the Doctoral Steering Committee provided continuous feedback about the methodology and the findings.

Repeated Measurement

As previously mentioned, one part of this study is quantitative and vocabulary tests were used in order to measure the student's success throughout the process. Repeated measurement is a method for single-subject research design and ensures internal validity.

3.6.2 Transferability

Transferability, termed as external validity in quantitative study, is "concerned with the extent to which the findings of one study can be applied to other situations" (Merriam, 2009, p. 57).

Unlike the quantitative studies, it seems impossible to generalize the results of a qualitative study. However, as suggested by Stake (2010), despite results being unique in qualitative studies, the possibility of transferability should not be directly rejected or ignored. In order to ensure transferability, Merriam (2009) suggested four strategies which are thick description, multi-site design, modal comparison, and sampling within.

Thick, Detailed Description

Thick, detailed description requires documenting enough quotes and field notes of the phenomenon to present evidence for the researchers' analyses and conclusions (Creswell & Miller, 2000; Lincoln & Guba, 1985; Merriam, 2009). McKenney, Nieveen and van den Akker (2006) indicated that "while the generalizability of design research is limited, full descriptions will help the readers of such portraits gain insight on what happened during research stages and make inferences based on (or transfer) the findings to other situations (external validity)" (p. 86). In this study, full description of the design and development processes and adequate contextual information is provided to enable other researchers to benefit from such a transfer.

Multi-Site Design

Multi-site design is the usage of different sites, cases, and situations, especially those demonstrating some degree of variation (Glaser & Strauss, 1967, as cited in Merriam, 2009). Different cases participated to this study in order to develop an environment that can be used by all VI learners of English vocabulary. Firstly, participation of both partially and fully blind students created a variation and the design at the end can be used by both groups. Secondly, the study was implemented with both eight-graders

and seventh-graders in order to understand whether or not there is a difference in terms of their needs. The study was also implemented at two different schools in Ankara in order create a variation in situational context. During all stages of the study, various field experts and subject-matter experts have actively participated in the study and have provided feedback.

Sampling Within

As Merriam (2009) pointed out, the phenomenon being studied should have several component parts including students, teachers, and administrators in order to be potentially considered for generalization. As previously mentioned, there are various stakeholders in this study including students, field and subject-matter experts, teachers and families.

3.6.5 Social Validity

Social validity is about measuring the social impact, acceptability and importance of the intervention (Kennedy, 1992). For that purpose, four open ended questions were prepared in current study in order to understand the impact of the intervention. Social validity questions were presented in Appendix D section 2. Questions were asked to the students at the end of the study.

3.6.3 Dependability

Dependability, termed as reliability in quantitative studies, is about whether or not research can be replicated with similar situations. Merriam (2009) stated that "the more times findings of a study can be replicated, the more stable or reliable the phenomenon is thought to be" (p. 55). However, qualitative studies seem to be problematic for providing reliable results due to the changing nature of the phenomena. Instead of reliability, Lincoln and Guba (1985) suggested to label as dependability or consistency which concerns whether or not the results of a study are parallel to the data gathered. Dependability can be achieved in qualitative research in various ways (Silverman,

2000) and among them are audit trail and intercoder agreement, which were both used in this study.

Audit Trail

Audit trail is another credibility strategy proposed by Guba and Lincoln (1982), and defined as researchers providing clear documentary evidence of all research decisions and activities. For an audit trail, researchers need to keep track of interviews and dates spent observing in order to demonstrate that adequate time was spent researching so as to establish dependable and confirmable results (Gast, 2010). Audit trail in this study was achieved by recording and documenting the whole process in order that any external observer is able to trace the research step-by-step. This chapter provides detailed description of the data collection and analysis process, the context of the study and participant selection.

Intercoder Agreement

In order to establish dependability, intercoder agreement or intercoder reliability is one of the strategies requiring different coders to analyze transcribed data (Creswell, 2007; Miles & Huberman, 1994). This is essential in order to achieve consistency with codes and themes. There is flexibility in the intercoder agreement process and researchers need to decide upon key issues like "determining what exactly the coding are agreeing on, whether they seek agreement on codes names, the coded passages, or the same passages coded the same way" (Creswell, 2007, p. 210).

This study did not aim for exact match coding, but for consistency among the codes and categories. For that purpose, two other research assistants (also from the CEIT department) helped in the data analysis and interpretation processes. Both had previously conducted extensive qualitative studies and one had experience working with VI people. At first, the researcher segmented the transcribed data into students and experts prior to coding. Then, the researcher debated with one interrater and jointly come up with a codebook based on the initial reading. The codebook was then shared with the other researcher and detailed explanations provided. As a next step,

Intercoder 1 and Intercoder 2 were given a sample of responses for them to code independently. The researcher discussed and modified problematic codes with the two intercoders. Next, a modified codebook was given to the coders and each was tasked with coding the one set of responses. Finally, the researcher discussed with intercoders separately in order to finalize the codebook.

3.6.4 Confirmability

Confirmability, termed as objectivity in quantitative studies, is a qualitative investigator's comparable concern to objectivity (Shenton, 2004). The techniques suggested for confirmability are triangulation, audit trail, and researcher reflexivity (Lincoln & Guba, 1985).

As previously mentioned, different sources, researchers and methods were used for triangulation which also has a role in ensuring confirmability in order to reduce the effect of researcher bias (Shenton, 2004). Audit trail was also previously explained for dependability. Providing a detailed methodological description enables the reader to understand the procedure step-by-step and to make an informed decision about the objectivity of the researcher.

Researcher Reflexivity

Researcher reflexivity is about being aware of biases, values, and experience brought to the qualitative research process and being forthright about position and perspective (Creswell & Miller, 2000). Ahern (1999, p. 408) indicated that "subjective awareness is beneficial to qualitative researchers" and in light of this suggestion, the researcher explained her role and kept trace of the process in order to be more aware of the researcher role.

3.7 Ethics

One of the distinctive concerns of qualitative research is ethics and it is necessary to determine whether or not the study can be ethically conducted. Ethical considerations are attributed as a motivator and a guide for qualitative study by Lincoln and Guba

(1985), while Miles and Huberman (1994) attributed it as an imperative. Ethical problems seem to be typical for qualitative research; however, it is also possible to minimize potential problems through mitigation. There are ethical principles to which every researcher should adhere, and in this study the principles proposed by Fraenkel et al. (2012) were applied. The researcher purposefully kept an awareness for ethical issues during the study, and was inexorably cautious throughout.

Before the study, the researcher applied to the Institutional Review Board (IRB) to obtain the necessary permissions to conduct such a study. Then, permissions were obtained from the Ministry of National Education since the target group was special education students from a middle school. With the permission of Ministry of National Education, researcher contacted with two VI schools in Ankara in order to explain the study and the planned process. At the outset of the study, the researcher informed the participants about the purpose of the study and to assure them about confidentiality. Any data gathered during study was kept confidential and names of participants are not shared in any publication.

The consent form has a critical role in qualitative studies and researcher is responsible to inform participants about different aspects of the research in clear language, including the nature of the study, the participants' and the researcher's role, the purpose of the study, and how the results will be presented (Orb, Eisenhauer, & Wynaden, 2001). The researcher and the students' English teacher informed the participants about the study in a face-to-face class and also by way of the website where relative information was provided.

In addition to the natural ethics procedures, researcher paid special attention throughout the study due to situation of target group who has special education requirements. In order to address ethical issues in special education, researcher followed the guidelines published by National Association of Special Education Teachers (NASET) and Council for Exceptional Children.

The most important issue during a research conducted with people, especially with children, is protecting them from physical or psychological harm (Fraenkel et al.

2012). The researcher was conscious and careful about this, and interventions were conducted conscientiously under the strict observation of the school management. Before each intervention, school management and teachers were informed clearly about purpose, content, and required time for the intervention. Also, throughout the study researcher actively cooperated with families and teachers of students in any educational decision making. In order to prevent any misunderstanding or making unintentional misinformation, this step was crucial.

3.8 Limitations

Limitations are expected issues in any kind of research which should be considered by readers. First of all, this study had limitation due to small sample size. As a requirement of DBR framework, too many iterative cycles were implemented throughout the study which made it impossible to conduct the study with all VI middle school students. Only 8th grade students from Göreneller VI School were available to participate to the study through two school semesters. Wholly participants of the study limited to this group which limited the number of wholly participants to six. However, by implementing additional sessions, 7th grade students in Göreneller VI School and also 8th grade students in Mitat Enç VI School also participated the study only for gathering qualitative data.

Second, this study had limitation since it was only conducted in Ankara. If resources and time would be enough, the study could have been conducted with 15 schools in Turkey with more sample size.

Third limitation is about the content of the study. In order to ensure students to learn a specific content, there was a limitation in the number of words provided in each unit. If there was not a restriction in time issues, more words could be included during the implementation of the study.

Fourth limitation is about developing a web-based dill program. If the resources would be enough, the researcher would have developed an application that can be used with mobile devices. This could provide students or any type of users more flexibility.

CHAPTER 4

RESULTS

In this chapter, the findings of the current design-based research study are presented based on cycles. The development and the design process of web-based drill program for VI students is presented under four cycles. The pilot study is presented in methodology chapter. Pilot study was conducted with the simplest form of the program. Based on the feedbacks gathered from the participants the necessary improvements were done and then the first cycle of the study was implemented. Firstly, the first cycle is presented including relative improvements. In the same vein, findings of the second and third cycles are presented. The third cycle includes information about the final product.

Following the DBR framework, iterative cycles with "analysis, design, implementation, and redesign processes" were conducted. The iterative cycles were implemented until finding the kind of program deemed adequate to, and dependent upon, the target groups' needs. Since the aim was to provide a program to be used in real educational settings, primary users were involved in the study.

The content of the product was prepared based on the curriculum of Ministry of Education in Turkey. According to the curriculum of the eight-graders there are ten units covered in a year. Four of the units were included during the implementation and relative vocabularies were covered. Since the implementation was conducted during the first semester of school year, the units of the second semester was covered. This was done in order to prevent the vocabulary and retention test results to be effected from the face-to face classes.

4.1 The First Cycle

After completing the pilot study and applying the changes the first cycle of the study was conducted. The implementation and evaluation of the first cycle was conducted during six sessions between October 24th and November 27th with six students in Göreneller VI Middle School. During the first cycle, unit-seven (tourism) was covered. Similar to the pilot study; redesign, redevelopment and formative evaluation of this cycle was accomplished after the implementation session. Interviews were conducted with students and three experts. Also, observation notes were taken by two researchers. Additionally, vocabulary tests have begun to be implemented in this cycle. The changes were grouped under three headings as accessibility, content and auditory input.

Accessibility

In terms of accessibility, students with less vision made comments for changing some functions of the program according to their preferences. Three of the students in this cycle were congenitally blind. Two of them had 80% visual impairment and the other one had 90% visual impairment.

Perceivable. Three less vision students stated that they need contrast colors for the text given in the website. In order to distinguish the text from the background they needed different color options. By following the WCAG accessibility principles, four contrast color options were provided between the text and background as white/black; black/white; yellow/blue and black/gray. Contrast tests for the colors was done in http://snook.ca/technical/colour_contrast/colour.html website.

Similarly, those three students stated that they need to use zoom option to read the explanations and menus. After taking the view of the expert, the zoom option was added with the 10% change for each click of zoom in and zoom out which is an international standard. Also, 200% has been arranged as the limit for zoom in and zoom out.

Content

Number of Words. Despite decreasing the number of words to 20, students faced with difficulties again. They indicated that trying to complete dictionary, practice and game sections with 20 words is time consuming. After taking the opinions of their English teachers, the number of words for each unit was decreased to 15.

Speed Level. At the beginning of the study, students were required to follow the levels of game one by one. However, since students have different level of keyboard usage, three of them indicated that they do not need to write in slower speeds because they are fast. For this reason, the level of the games have changed as preferable.

Regarding the same issue, all of the students stated that the speed is still not challenging for them. Thus, the time for each level was changed from 20/15/10 to 15/10/7 respectively.

New Sections. Since the only purpose of the vocabulary test was to collect data, it was not included in the program and provided with an extra link. Without any exception, all students indicated that they like vocabulary tests and being evaluated. They suggested to add the vocabulary test to the program and to include as a section. Based on these opinions, new section, vocabulary test, was added.

Also, for the words that students do not know or remember, they suggested to add pass attribute. Pass attribute was provided only for this new section, vocabulary test.

Considering the suggestions of the expert, a help section with detailed information about the website was added.

Practice. During the implementation of the first cycle, students mainly mentioned about the problems in the practice section. The first problem was about writing the words incorrect. If students wrote the same words incorrect three times over and over, the program was directing them to the next word. However, all of them indicated that if the program does not provide them the correct spelling they do not learn spelling of that word and they got lost. For that reason, after three trials program provided the correct spelling and then students continued to practice the same word again.

Additionally, in the practice section students and teachers suggested to add a new section to teach the Turkish meanings of the words. Because as a requirement of the curriculum, students had to learn Turkish meanings. Thus, the practice section was separated into two different sections as English to English and Turkish to English. In the new section English to Turkish, students listened the Turkish words and wrote the English meanings once.

Section Definition. For the names of sections, students suggested to use more personalized definitions. Based on their suggestions, section names were changed as from dictionary to "I am learning vocabulary"; from practice to "I am practicing"; from game to "I am playing a game". Those sections were grouped as a separate menu and inserted at the top of the website.

Buttons. Based on the observers' and one of the expert's feedback, new buttons were added to the website in order to increase the user control. For that reason; start, repeat, next and previous page buttons were added. The function of start button was to enable the user to control when to start to listen the words in each section. Repeat button was added in order to enable the users to listen the same word several times if they want. When the students finished listening or typing the required word, they wanted to control when the next word will be spelled. Next button was added to enable the students to control word change. Previous button was added in order to direct students to the previous page. Those new buttons were grouped as a separate menu inside of the website.

Auditory Input

Spelling Voice. When the system was first designed, voice for the spelling had been embedded from an external source. All of the students found the voice mechanical and too strong, especially in spelling part, which distracted their attention too much. Thus, for the spelling, voice of a native person was recorded and embedded to the website.

Presentation of Words. Another problem in practice section was related to the words shown on the website. For example, on the screen it was written "black" and students were required to practice that word. However, both blind and less vision students had

chance to copy and paste that word in the practice area. Thus, they did not write the words by typing. In order to prevent that problem, the words were just given auditory and the written forms were hided.

Feedback. All students indicated that in practice section they were confused since they could not figure out how many correct or wrong answers they gave. They suggested to add an auditory feedback that informs them about their number of correct answers. After each correct answer they were informed auditory as first correct, second correct, third correct and so on. The summary of changes applied in the first cycle are summarized in Table 4.1.

Table 4.1 *Summary of Changes Applied in the First Cycle*

	Accessibility
Perceivable	*For the students with less vision, texts and background were presented with contrast colors.* *Zoom in and zoom out options were added. The amount of change was arranged as 10% for each click of zoom in and zoom out and 200% has been arranged as the limit.*
	Content
Number of Words	*The number of words per unit was decreased to 15 from 20.*
Speed Level	*The levels of the game have become preferable.* *In the game section the speed of the levels changed from 20/15/10 to 15/10/7.*
New Section	*Vocabulary Test section with pass attribute was added.* *Help section was added.*
Practice	*In practice section, after three trials the correct spelling of the words was started to be given by the system and students were given chance to practice again.* *Practice section was separated into two different sections as English to English and Turkish to English.*
Section Definition	*Section names were changed to I am learning vocabulary, I am practicing and I am playing a game. Those sections added to the top of the page as a menu.*
Buttons	*Start, repeat, next and previous page buttons were added.*
	Auditory Input
Spelling Voice	*New spelling voice was recorded with a male native English speaker.*
Presentation of Words	*Words were presented as auditory only and written forms were hided.*
Feedback	*In practice section, system counted each correct trial and provided auditory feedback as first correct; second correct and so on.*

Based on the applied changes, the web-based drill program reached its first version. Figure 4.1 shows a screenshot from the first cycle.

Figure 4.1 Screenshot from the first cycle

4.1.1 Design Principles Constructed in the First Cycle

Based on the findings of the first cycle, some of the design principles of the web-based drill program were constructed. Those design principles were related to the interviews and observations. Design principles of the first cycle are:

- Considering the individual differences between students, content should provide preferable features in order not to lose learners' attention.
- Content should include frequent assessment activities in order for VI students to self-evaluate.

- Personalized description of components may increase VI learners' sense of belonging.
- Auditory feedback should be given based on the users'correct and incorrect answers.
- Instructional design should give users control over pacing and instruction.

4.2 The Second Cycle

After completing the first cycle and applying the changes, the second cycle of the study was conducted. The implementation and evaluation of the second cycle conducted during six sessions between December 2nd and 18th with 12 students in Göreneller VI Middle School. In this cycle, both eight-grade (eight) and seventh-grade (four) students participated. During the second cycle, unit-eight (chores) was covered. Redesign, redevelopment and formative evaluation of this cycle was accomplished after the implementation session. Interviews were conducted with students, experts and families. Also, observation forms were filled by two researchers. Additionally, vocabulary tests were implemented. The changes were grouped under four headings as design, accessibility, content, and auditory input.

Design

Grouping Sections. Since new sections and new functionalities have been added to the program after the first cycle, some problems were observed about navigation between sections during the second cycle. As observers noted that students had trouble during finding the necessary sections and completing the tasks. In order to simplify the usage of the program, sections that have similar functionality have been grouped. Thus, at the end of this cycle, there were two separate groups as page layout and main sections.

Menu Replacement. For better controlling of the sections and ensuring page layout, menu bar was replaced to the left side of the website. This issue was suggested by the experts. Page layout menu have been added to the upper side of the menu and the other menu was added to the bottom side.

Accessibility

Understandable. After menu related arrangements completed, it was necessary to arrange the focus order as logical. As one of the experts stated that the content should be presented logically and intuitively. Since this program included both a menu on the left and other buttons in the middle, it caused problems to understand which component should be used first. For solving the problem, the sections on the left menu were given as links instead of buttons. The buttons on the middle of the page remained as buttons. The reason behind doing this was, VI users while accessing the websites via screen readers are using "L" on the keyboard for links and "B" for the buttons. Thus, separating components as links and buttons, it became easier for VI students to access the components.

The other change was about on focus property. In order to prevent any confusion, when students were listening the words the buttons were disabled. They had to wait until spelling of the word finished.

Operable. Since the content was repeated on multiple web pages, students got bored while trying to reach necessary components each time. For that purpose, on the top of the left menu "Bypass Blocks" link was added. This link skips the left menu and directs users to the buttons in the middle of the page. Thus, students had chance to skip the repeated content if they want.

Perceivable. In order to increase the readability of the left menu, highlight function has been added to attract less vision students' attention.

Content

Font. Expert2 indicated that serif fonts were very tiring for language readers and less vision students. Instead of a serif font, sans serif fonts should be used. All the text font in the program was changed to Arial. Also, Expert2 added that for the less vision students who prefer to read the explanations from the screen, the font size should be

increased and arranged as left-sided. The relative changes were applied based on the suggestions.

New Section. As mentioned before, seventh-grade students also attended this cycle and their experiences were observed and they were interviewed. The main problem of seventh grade students was that they were unfamiliar with the English alphabet. Because, as they indicated, they were learning the spelling of English words with Turkish alphabet. For that reason based on their arguments, a new section "Let's remember alphabet" was added. Thus, students who have troubles with the spelling of English alphabet had chance to practice it.

Another important issue especially emphasized by all students was that they need a more challenging section which could be scenario based. Also, they indicated that game section could be more entertaining and challenging. Five of the students said that with a new section instead of providing words classified based on the units, all the words should be asked randomly. For that purpose, after talking with the experts following changes were applied:

- Existing "I am playing a game" section was renamed as "I am trying my speed". This was done since this section was only developed for testing the speed of students while writing words.
- As a new section "I am playing a game" was added. This time the game included a scenario and three levels. Purpose of the game was to rescue a sinking ship. To reach that purpose students had to collect enough points and deserve to be a vice admiral. At each level, students had to achieve a goal and move forward to the next level. Also, in this section words were given randomly as mixed, not separated with units.

Auditory Input

Feedback. In order to motivate students and notify them about their progress, clapping voice was added to the "I am practicing" and "I am playing a game" sections. In "I am practicing" part clapping voice was played after students wrote each word ten times. In "I am playing a game" section, clapping voice was played after students pass each

level successfully. The summary of changes applied in the second cycle are summarized in Table 4.2.

Table 4.2 *Summary of Changes Applied in the Second Cycle*

	Design
Grouping Sections	*The menu has been added to the left side of the website.* *The components that have similar functionality have been grouped. The page layout functions have been added to the upper side of the menu.*
	Accessibility
Understandable	*The sections on the left menu were given as links instead of buttons. The buttons on the middle of the page remained as buttons.* *The reading and navigation order (determined by code order) has become logical and intuitive.* *At all sections, while students were listening a vocabulary the other buttons were done disabled in order to prevent the confusion.*
Operable	*A bypass blocks link was provided to skip navigation and other page elements.*
Perceivable	*Highlight function was added to the menu in order to attract attention of the less vision students.*
	Content
Font	*Text font was changed to Arial, a sans-serif font, increased in size and left-sided.*
New Section	*"Let's remember alphabet" section was added.* *Existing I am playing a game section was renamed as "I am trying my speed".* *A new "I am playing a game" version was added with a scenario and mixed words from all units.*
	Auditory Input
Feedback	*Clapping voice was added to the "I am practicing" and "I am playing a game" sections.*

The web-based drill program has reached its final version based on the final changes applied at the end of the second cycle. Following Table summarizes all the sections of the program. Figure 4.2 and 4.3 present screenshots of the final program.

Table 4.3 *Sections of Web-Based Drill Program*

Bypass Blocks	To jump to the content part without moving on the left menu one by one.
User Information	Includes the most mistaken vocabulary and the scores for relative sections.
Let's Remember Alphabet	Provides practice for learners who do not know English alphabet.
I am Learning Vocabulary	Words are given unit by unit. All of the words are read and spelled by the program and the Turkish definitions are provided. Students have chance to listen several times.
I am Practicing	Vocabularies are given randomly, read by the program and the students try to write ten times what they heard. If the user input is: • Correct: System gives positive feedback and provides the next vocabulary. • Partially correct (maximum 3 mistakes): The system gives an encouraging feedback and then the user has chance to try again. • Incorrect: The system gives a short feedback and spell the word in English. In here system does not give more chance.
I am Trying my Speed	Provides practice for improving keyboard usage while learning the spelling. First they are given 15 seconds for each single word, then 10 seconds and finally 7 seconds. This section provides a score for each correct answer.
I am Playing a Game	Provides to complete scenario-based tasks. Scores are increasing gradually based on the levels.

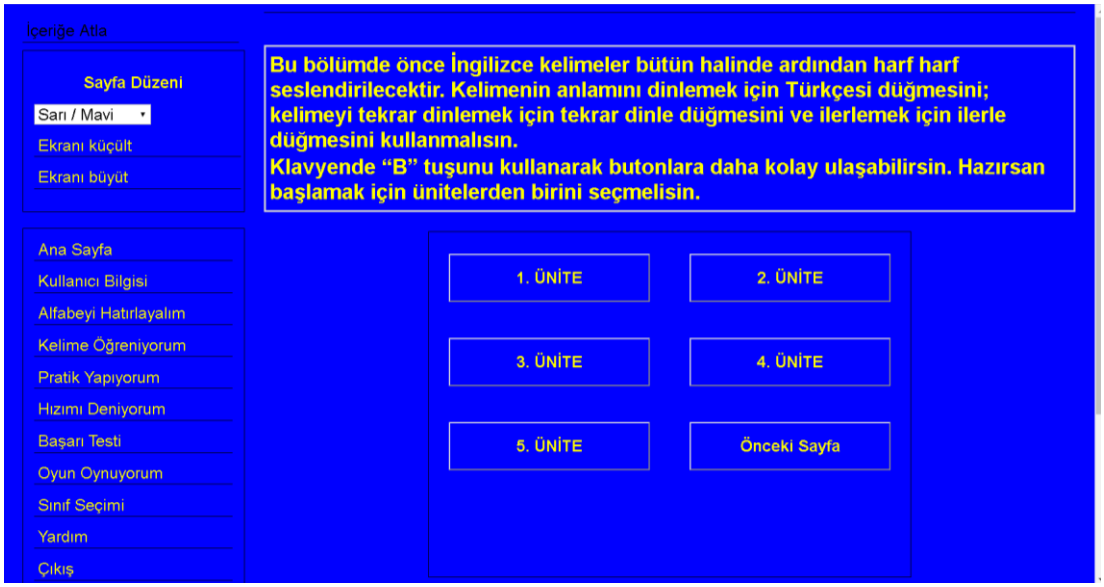

Figure 4.2 Screenshot of the final version of Web-based Drill Program

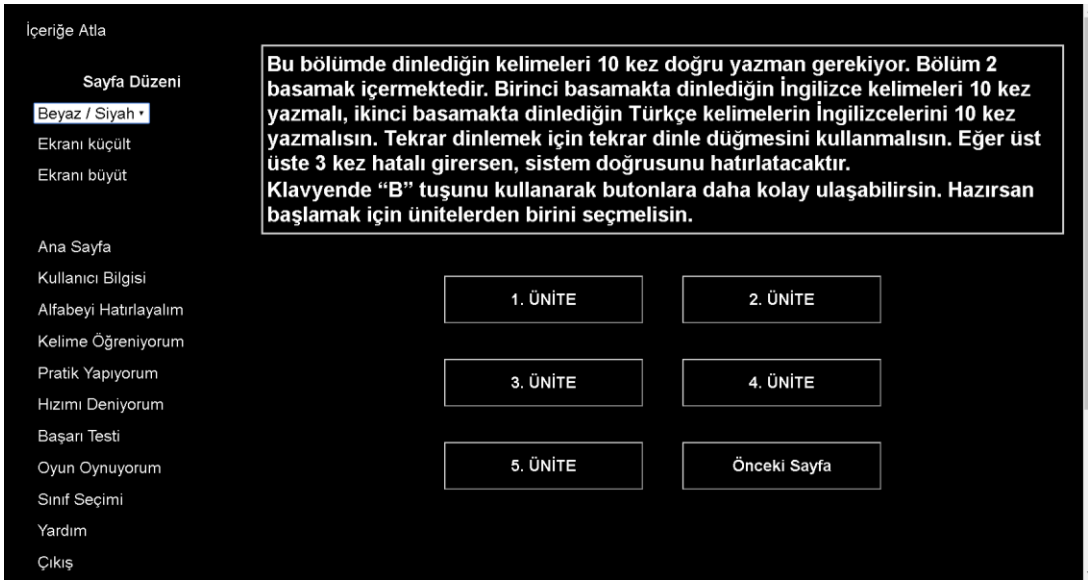

Figure 4.3 Screenshot of the final version of Web-based Drill Program

4.2.1 Design Principles Constructed in the Second Cycle

Based on the findings of the second cycle, some of the design principles of the web-based drill program were constructed. Those design principles were related to the interviews and observations. Design principles of the second cycle are:

- Content should be attractively presented considering the characteristics and individual needs of VI learners.
- Navigation parts, menus and other components should be designed and replaced based on the VI learners' characteristics.
- Auditory feedback plays a major role in the education of VI learners. The system design and structure should be based on auditory feedback and guidance.
- Navigation parts should be designed to allow learners, especially students with low computer skills, control webpage easily and without difficulty.

4.3 The Third (Final) Cycle

After completing the second cycle and applying the changes, the web-based drill program reached its final version. Final cycle was implemented during two sessions in January 2016 with 9 students in Göreneller VI Middle School and Mitat Enç VI Middle School. In this cycle, eight-grade students from both schools attended. During the final study unit-ninth (science) was covered. Final interviews were conducted with both students and experts; observation forms filled by two researchers. Additionally, vocabulary tests were implemented. This cycle only included summative evaluation by considering the experiences of students and experts, and opinions of families.

When students were asked about positive and negative experiences in this cycle, they agreed upon that the program was capable enough to meet their requirements and there was not a need for any change. They mentioned about their positive experiences. All of them liked the content, design, auditory input and accessibility related features of the program. The qualitative analysis of interviews and observation notes were presented in the following.

4.3.1 Experiences of Students

During the implementation of cycles, in addition to collecting data about generating design principles of the web-based drill program, students' and experts' experiences were also gathered. In the first part, students' experiences are clarified and then experts' experiences are mentioned.

Experiences of students are explained under two sections as affordances and challenges. The categories were revealed from coding of the interview data. Those interview data were the ones gathered during the final cycle considering the final version of the program. Furthermore, categories were supported with the researcher's notes and observations forms. Table 4.4 presents the affordances and challenges of the study according to students' interviews.

Table 4.4 *Frequencies of Affordances and Challenges by Students*

Students (*N* = 15)		
	N	*f*
Affordances		
Facilitator Role in Learning Process	15	91
Presentation of Content	15	88
Better Educational Performance	15	68
Challenges		
Technical Issues	7	7
Low Level of Knowledge	4	5
Disliking the Spelling Voice	3	3

f = Code frequency

4.3.1.1 Affordances of Web-based Drill Program

In this part, affordances of the program were investigated based on the experiences of students and observations of the researchers who attended at least one cycle of the study. Results revealed that affordances of the program can be grouped as *facilitator role in learning progress, presentation of content* and *better educational performance*. In the following section, those affordances were detailed and students' responses were presented.

Facilitator Role in Learning Progress

Results revealed that the program has a facilitator role in VI students' learning progress which was the most striking affordance of the web-based drill program developed throughout the study. All students underlined this factor. Especially by comparing this program with their face to face class environment, they emphasized how much this program had a facilitator role in their learning progress. This affordance was mainly related to the issues that reduce the handicapping effect of VI and thus enable students to access information.

Qualitative analysis of the students' comments showed that there were sub-categories of that factor namely practicality, tracking progress and individualized instruction. Those three sub-categories were three major ways of facilitating learning process in this study.

Practicality. This sub-category of facilitating learning progress was mainly related to evaluation of whether or not the designed and developed program contributes to the target setting and target users can work with the intervention effectively. Based on the interviews conducted after several iterations it was possible to say the program resulted with an actual practicality. Ten of students emphasized that the program was clear, accessible and time-efficient. Their comments were mainly focused around two important factors as enough practice opportunity and time efficiency.

Regarding enough practice opportunity students mentioned that they found a chance to practice the words in an efficient way and in an accessible environment. They were able to repeat the content in different activities. Nine students especially mentioned about that factor. They compared with their face to face classes and indicated that in face to face class environment they do not have chance to practice enough in order to catch the lesson. One of the students stated that:

> WP 4: In this environment [web-based)] we are easily making enough practice, I think I am learning. It makes us form a habit while writing. Teaches writing. Even we do not know the word as a whole after writing that much we can remember it.
>
> *WP 4: Bu ortamda [web tabanlı] kolay bir şekilde yeterince pratik yapabiliyoruz, öğrendiğimi düşünüyorum. Alışkanlık yapıyor yazarken, Yazmamızı öğretiyor. Kelimeyi tam bilmiyorsak o kadar yazınca aklımıza geliyor*.

In terms of time efficiency, seven students made comments. They were mainly satisfied since they had chance to learn the words in a short time when compared to the face to face class environment. One of the students mentioned that:

> PP3: In regular class [face-to-face] we learn the words within three four weeks however here [web-based] we learn in one day.
>
> *PP3: Normal derste [yüz yüze dersler] üç dört haftada kelimeleri öğreniyoruz ama burada [web tabanlı] bir günde ögreniyoruz.*

Tracking Progress. The second advantage of this program in terms of facilitating learning progress was to enable students track their own progress. Ten of the students stressed that issue. This was an important factor for the students because by following their progress they can estimate their level and encourage themselves to study more. Also, they emphasized that they did not have that chance in their regular class environment since only tracking progress option in that environment was done under the control of the teacher.

Students favored three features of the program in terms of tracking progress as auditory feedback, scores and user profile section.

The study results revealed that auditory feedback was prerequisite in teaching and learning process of VI students. By providing regular auditory feedback, it was possible to catch their attention and also keep their attention active. Eight students emphasized that with the auditory feedback they received in the program, they were able to be aware of their performance. One of the students mentioned that:

> PP9: This webpage is really very good since it tells us our correct answers, if we give wrong answers webpage warns us. It teaches correct writing, when we make three mistakes system tells you are wrong.
>
> *PP9: Bu site gerçekten çok güzel doğrularımızı falan söylüyor, yalnış yaparsak o bizi uyarıyor. Doğru yazmayı öğretiyor yani sonuçta üç defa eğer hatalı girersen sistem zaten sana söylüyor yani.*

The students stated that gaining scores was very crucial in order to figure out their performance during the intervention which motivated them to study more. They were satisfied by receiving scores in different sections of the program such as I am playing a game, I am trying my speed and vocabulary test. All these sections informed them about how they progressed throughout the study. One of the excerpts of the students is as follows:

> WP5: Ultimately, a person understands what she/he has done. You are taking feedback about what you did yourself. If you did wrong it means you have to study more. Besides, it informs you about how you learned a word. For example if you get a 50, it means you have to study more. If you get 70 you have to still study more, if you get 90 a little bit more. If you get 100 you completed the words of that unit.
>
> *WP5: Sonuçta insan kendi yaptığını görüyor. Kendi yaptığın şey hakkında bilgi alıyorsun. Yanlış yaptıysan demek ki daha da çalışacaksın. Hem bir kelimeyi mesela ne kadar öğrendiğini söylüyor. Atıyorum 50 aldınsa bu demektir ki biraz daha çalışman gerekiyor. 70 aldınsa biraz daha, 90 aldınsa birazcık daha bakman gerekiyor. 100 aldınsa o ünitedeki kelimeleri tamamladın demek ki.*

User profile section in the website recorded data about the highest score of the students from vocabulary test, I am playing a game, I am trying my speed sections, and their most mistaken words. Three of the students mentioned about the benefits of user profile section since they saw the whole picture of their performance.

Individualized Instruction. This factor was related to focusing on individual differences. As supported with the results, VI individuals may not benefit from the group education in a meaningful manner which as a result demotivates them. The main reason behind this factor was that those students have difficulties in following the content in face to face class and ten of them mentioned about the benefits of this factor. One of the students stated that:

> WP4: It helps us to improve our English (web-based). In face to face class there are too many people, but here we are learning individually. For this reason we learn better and study more willingly. In class there is too much voice which distracts our attention.
>
> WP4: *İngilizcemize yardımcı oluyor (web tabanlı). Sınıfta çok kişi oluyor, burada teker teker öğreniyoruz. Bu yüzden iyi aklımıza giriyor ve daha istekli çalışıyoruz. Sınıfta çok ses oluyor aklımız dağılıyor*.

The other aspect that was discussed under the individualized instruction part was students had chance to learn based on their paces. According to the students' interviews, self-paced learning has a paramount significance in VI students' learning because they think that due to individual differences they have difficulties in traditional education. One of the students stated that:

> PP3: In class, teacher reads book at the same time wants us to write. But we cannot catch the teacher every time. Thus, we get bored easily. But here [web based] we are alone, we can practice based on our pace if we do not learn… I gained a positive attitude and I understand English can be learned by having fun.
>
> *PP3: Sınıfta öğretmen kitaptan okuyor ve aynı zamanda bizim yazmamızı istiyor. Ama biz her zaman öğretmeni yakayalamıyoruz. Bu yüzden kolay sıkılıyoruz. Ama burada [web tabanlı] kendi başımızayız, Eğer öğrenemezsek kendi hızımızda daha çok tekrar yapabiliriz…Olumlu bir tutum geliştirdim ve eğlenerek de İngilizce öğrenilebilirmiş.*

Presentation of Content

Presentation of content was the second most mentioned affordance of the program and all of the students considered this as important. Results indicated that the sequenced and structured content provided in the web-based drill program was advantageous for

students in terms of enjoyment and motivation. All of the students including the ones that have low grades in their English classe highlighted that they enjoyed participating to the study and they were motivated to learn the vocabulary. Students mentioned that in general they are motivated to study in computer based environments; however, in this study web-based drill program with its content design had a major role in increasing their motivation to learn.

Qualitative analysis of the results revealed that presentation of the content was strong because of two aspects; challenging content and scenario based game.

Challenging Content. The content of the web-based drill program was prepared based on the principles of Rosenshine's explicit teaching model. For that reason, the sections of the program included similar activities in different contexts which ensures that students were challenged in their learning progress. The challenging activities in different contexts were found effective by students because they had chance to repeat the content in an enjoyable format. Results showed that there was a great deal of enjoyment and therefore, motivation wrapped up in the program due to the challenging content presented in the sections. Trying to write ten times in I am practicing section; competing with time in I am trying my speed and also trying to accomplish the tasks in I am playing a game sections by gaining enough scores were challenging, which motivated students generally. One of the students mentioned that:

> PP6: The webpage is very beautiful… Gaining scores in the game is very exciting. I like competing with time…Because since there is time constraint it makes it more enjoyable. We have to move quickly, we can focus better.
>
> *PP6: Site çok güzel olmuş… Oyunda puan veriliyor onlar falan heyecanlı oluyor. Süreyle yarışmayı seviyorum…Çünkü böyle hani süre sınırı oluyor ya daha eğlenceli oluyor. Hızlı hızlı hareket etmemiz gerekiyor, daha iyi odaklanıyoruz.*

Enjoyment factor was crucial in increasing students' motivation and thirteen students expressed how they enjoyed the environment. They pointed out that during intervention, they found chance to have fun while learning. One of the striking comments of the students was that in face to face class they got bored easily due to the

limitless educational materials and intense course content. However, the activities presented in different contexts in this environment was the thing students needed. One of the students commented that:

> PP7: Really I can say that I found what I looked for. It teaches without being overwhelmed. I can learn the spelling and meaning of the words easily and by enjoying…I was … having troubles in memorizing words. However, with this webpage, there are too many enjoyable and challenging activities. I will learn by enjoying.
>
> *PP7: Gerçekten tam aradığım siteyi buldum diyebilirim. Çok güzel sıkmadan, insanı bunaltmadan öğretiyor resmen. Kelimelerin yazılımını ve anlamını daha kolay ve eğlenerek ezberleyeceğim... kelime ezberleme konusunda…zorlanıyordum. Ama bu sitede çok fazla eğlenceli ve düşündürücü aktivite var. Eğlenerek öğreneceğim.*

Scenario Based Game. Scenario based game as expected was the section that students enjoyed most and six of the students stressed this issue. Students expressed that trying to accomplish the tasks in a scenario based environment triggered their motivation despite they were doing the similar tasks in other sections. One of students stated that:

> WP6: Including a scenario has made the game more exciting. The game is no more a mechanic game, it is now more enjoyable. Because trying to save the ship is good. I want to finish the game.
>
> *WP6: Senaryo olması oyunu daha böyle heyecanlı hale getirmiş. Mekanikten çıkarmış hani daha bir eğlenceli hale getirmiş. Çünkü gemiyi geçirmek güzel oluyor. Oyunu bitirmek istiyorum.*

Similarly, observers also pointed out that issue and mentioned about the motivating factors. One of them stated that

> Observer 1: In game section, competing with time increased the exiting level of the students. Even two of the students competed with each other during the implementation.
>
> *Observer 1: Oyun kısmında zamana karşı yarışmak öğrencilere heyecan katıyor. Hatta 2 öğrenci birbirleriyle yarıştılar.*

Better Educational Performance

Better educational performance was the most expected result of this study since the aim was to design and develop a program that helps VI students improve their EFL

vocabulary knowledge. Results revealed that the program was beneficial for the students due to abovementioned affordances and as a result they perceived that they had a good progress throughout the study.

Ten students noted that they improved knowledge in terms of vocabulary and computer literacy.

Vocabulary Knowledge. Although this issue was also tested with the vocabulary tests, ten students emphasized that they improved their vocabulary knowledge. In parallel with the goals of the study, this result was very promising. Further examination of the results revealed that students thought this intervention was beneficial in terms of teaching them the spelling and semantics of the words and also remembering the words they learned. One student highligted that issue as follows:

> WP5: We can learn both the spelling and pronunciation of the words in a good way. Because at first in I am learning vocabulary part we can learn both the spelling and pronunciation of the words. Then in I am making practice part...you are writing the word from its spelling...In the Turkish part of the word you can see the meanings.
>
> *WP5: Kelimelerin hem yazılışını hem de okunuşunu iyi öğrenebiliyorsun. Çünkü başta kelime öğreniyorum kısmında kelimenin hem yazılışını hem de okunuşunu öğreniyorsun. Sonra Pratik yapıyorumda...okunuştan yazılışını yapıyorsun...Kelimelerin Türkçesi kısmından anlamlarını da görebiliyorsun.*

Regarding the retention issue one of the students stated that:

> WP2: Friendship, excuse (examples from the words in this study) was asked in TEOG exam (National 8th grade exam)…this intervention contributed me to do correct. Especially in learning spelling, this method is good.
>
> *WP2: Friendship, excuse (bu çalışmadaki kelimelerden örnek) TEOG sınavında çıktı (Ulusal 8. Sınıf sınavı)…çalışma yapmama katkı sağladı. Özellikle yazılışı öğrenmeyi geliştirmek için güzel bir yöntem.*

Computer Literacy. One of the interesting results of the study was about how students found it beneficial in improving their computer literacy. Some of the students were not practical in keyboard usage and also about the necessary shortcuts to easily use screen

reader. They faced with some difficulties at the first implementations, however, in time they overcame those troubles by competing with time and making too much practice. Five of the students mentioned about this issue:

> PP1: Program has two advantages. First, spelling English words and second, faster keyboard usage, improving keyboard techniques.
>
> *PP1: Uygulamanın faydaları ikiye ayrılıyor. Birincisi İngilizce kelimeleri yazma, ikincisi de klavyeyi hızlandırma, klavye tekniğini hızlandırma.*

4.3.1.2 Challenges of Web-based Drill Program

Challenges of the program were investigated based on overall experiences of the students and also observations of researchers who attended at least one cycle of the study. Results revealed that there were two challenges faced during the implementation of the study namely *technical issues* and *low level of knowledge.*

Technical Issues

The webpage of the study was developed with Asp. Net and C# programming language. Database part of the website was programmed with MsSQL. For the webpage and database service, azure cloud system was used. In order to reach the webpage, Internet connection, a computer with headset, and Jaws screen reader program were needed. Due to the incapability of the computers in the Göreneller VI School, there were too many technical problems which caused sometimes to delay the implementation sessions. The other challenge was about the Internet connection of the school due to the problems about infrastructure.

In addition to these technical problems, students mentioned about other problems related to screen reader and login-logout. Results revealed that the most challenging issue of the study was technical issues because they prevented students to reach the content and use the webpage.

Screen Reader Problems. This problem was common among all students which affected their motivation adversely in some sections. When the computers were not

good enough, screen readers did not work properly and students could not use the functions effectively. As a result, they could not reach the content. Observer2 mentioned about this issue and stated that when students had problems with screen reader, they were totally isolated and distracted. Similarly, one of the students stated that:

> WP2: For example last week I could not use too much due to the Jaws… We had to reopen the web page, or we could not push enter button. But this week since the computer was good there was not a problem with Jaws.
>
> *WP2: Mesela geçen hafta ben çok fazla da hani böyle Jawstan dolayı kullanamadım. Siteyi tekrar açmamız gerekiyor, entera basılmıyor. Ama bu hafta bilgisayar iyiydi Jawsu falan kesintisi sıkıntı yoktu.*

Login-Logout. While using the webpage, three of the students faced with problems in login and logout since this part of the website was complicated for the students. Especially, when students were required to write their e-mails they were confused or they do not have an e-mail account.

Since the webpage was continuously in development process this problem was solved based on the students' requirements. Login and Logout parts were simplified and too much information was not required in the login part including e-mail information.

Low Level of Knowledge

Low level of knowledge was one of the unexpected challenge of the study. Students faced with problems due to the low level of knowledge in English alphabet and computer literacy. This limited knowledge caused them to demotivate and got lost while using the program.

Low Level of English Alphabet. This problem was faced by four students who were seventh-graders. Eighth-graders did not mention about this issue. Since seventh-graders were not familiar with the English alphabet, they were not able to use the webpage properly. Those students mentioned that in face to face class they learn English words with Turkish alphabet. This was a difficult issue to overcome but by adding a new section as "I am learning English alphabet", they were required to

practice the letters and then they were better in other sections of the program. Regarding this problem, one of the students mentioned that:

> PP5: Saying English letters in English is a nuisance…In classes [face to face] since we learn with Turkish letters, because teacher teaches like that. Suddenly this [webpage] was shocking.
>
> *PP5: İngilizce harfleri İngilizce olarak söylemesi sıkıntı oluyor... Biz derslerde [yüz yüze] hep Türkçe harflerle öğrendiğimiz için, öğretmen öyle söylüyor birdenbire bu [web sitesi] gelince şoklama oldu.*

Low Level of Computer Literacy. This problem was not common but five students faced with challenges due to the keyboard differences and their low level of keyboard usage. Keyboard difference was related to the differences between Q keyboards and F keyboards. Q keyboards have bulges on F and J keys, while F keyboards have those bulges on A, K and five. Two of students mentioned that since they were familiar with F keyboards they had troubles while writing with Q keyboard. Five of the students indicated that they were not good in computer keyboard usage and they could not write fast enough. For this reason, they faced with problems especially in the sections that require competing with time. Fortunately, after a while by practicing too much, they were faster in keyboard usage and this challenge was removed.

Also, similar to this issue, the other problem was the conflict between the voice of screen reader and the spelling voice of the webpage. This was actually became a problem for the students who did not know to click on "ctrl" key to mute the sound of screen readers. After they learned this feature, they did not face with problems.

4.3.2 Experiences of Experts

Experiences of experts were explained based on affordances and challenges of the program similar to the students. The categories were revealed from coding of the interview data from four experts. Expert1 was both a primary school teacher and a computer programmer. Expert2 and Expert3 were the English language teachers of Göreneller VI School. Expert4 was the computer teacher at the same school.

4.3.2.1 Affordances of the Web-based Drill Program Based on Experts' Experiences

According to experts' interviews, the major affordances of the study were grouped into three titles as *facilitator role in learning progress, presentation of content* and *better educational performance*. These major affordances are the same as the students' experiences.

Facilitator Role in Learning Progress

Expert interviews also supported the facilitator role of the program in terms of students' learning process. Experts also mainly mentioned about the problems and barriers of traditional education and in that respect, they focused on how the program was effective in facilitating students' learning progress. As a result of these features, experts pointed out that this study was effective in promoting students' motivation. Motivation was important since these students had additional barriers in their general education when compared to the sighted students. Those additional barriers decreased their motivation and caused them to be isolated.

Qualitative analysis of the experts' comments showed that there were sub-categories of that factor, namely practicality and tracking progress.

Practicality. Experts' comments also supported the students' arguments in terms of practicality. In the same vein, experts indicated that students can work with the program effectively. Their comments mainly focused around two important factors as enough practice opportunity and time efficiency.

Experts strongly emphasized the practicality feature of the program as they thought that especially enough practice opportunity is a missing point in the face-to-face class education of VI students due to limited time issues. Experts indicated that ensuring students to make enough practice with repetitive activities was one of the affordances of the study. Repetition was attributed as a key point in the education of VI students due to limitations they have. Thus, experts informed that this program provided opportunities for the students to make enough practice with different activities. One of the experts indicated that:

> E2: You reflected very well the importance of repetition on this webpage. It has everything that I think. You are writing words ten times which is very good in language education. It reads whole word and then letter by letter…
>
> *E2: Tekrar yapmanın önemini bu sitede çok güzel yansıtmışsın. Düşündüğüm her şey var. Kelimeleri on defa yazıyorsun, çok güzel dil öğrenmede. Kelimenin telaffuzunu okuyor sonra tek tek İngilizce harflerini söylüyor…*

Furthermore, two experts indicated that students face with barriers in traditional education because lesson hours were not enough to complete the curriculum in that specific time. For this reason, they cannot allow students to make enough spelling practice. This issue was also mentioned in the needs analysis part as teachers indicated that they had to teach the words based on their readings, which caused problems in spelling. For this reason, providing students with an appropriate program that allows to practice enough without time related challenges was crucial.

Tracking Progress. Experts also mentioned about the tracking progress as an affordance since auditory feedback embedded into the program enabled students to understand their performance during the study. Experts indicated that auditory feedback was one of conditions that should be implemented in VI education. They noted that this program was providing positive and negative feedbacks very often which was very important in informing the students, especially if they are VI. The main feedback issues pointed out by the experts were counting the correct numbers in I am practicing session, giving positive sound effect after students write correctly ten times or giving a negative sound when the students write incorrect. The other point they mentioned was the sounds provided in I am playing a game session. They indicated that steamboat sound and water sound were very effective in gaining students' attention.

Presentation of Content

Presentation of content was the second most mentioned affordance of the study which was also reinforced by experts. Experts mentioned that they found the study motivating for all students due to the content structure.

Qualitative analysis of the experts' interviews revealed that presentation of the content was strong because of three aspects as, accessible content, challenging content and teaching strategy.

Accessible Content. As pointed out by the experts providing accessible content to the VI students was their first educational purpose. For this reason, all experts mentioned about the importance of accessible content provided. Expert2 and Expert3 indicated that as teachers they generally face with problems since they are trying to teach the same curriculum in the same amount of time. This is big challenge for them because the books are not accessible for VI students. For this reason, the most critical issue for them is finding accessible content. All of the experts stated that this program was appropriate in terms of accessibility issues and very good in providing the content with clear instructions, clear functions, and easy navigation features.

Regarding that issue one of the experts stated that:

> E4: Actually every time…we first look whether the web site is accessible or not. Whether the webpage can be used with Jaws or not? For example, in your webpage many of the components are used with buttons. Children can easily access those buttons by using the B button on their keyboards. Jaws has those kinds of shortcuts. For this reason, it is important. Also, some arrangements were done for the less visions which is very good…I was able to reach every parts, there is not any part that I could not access.
>
> *E4: Biz aslında yani ilk önce…siteye ilk girdiğimiz zaman erişilebilir olup olmadığına bakıyoruz her zaman. Jawsla kullanılıyor mu kullanılmıyor mu? mesela sitenizde düğmeler şeklinde buton şeklinde yapılmış bir çok şey. Ona da "b" tuşuyla çocuklar çok rahat bir şekilde ulaşabilir. Jawsın böyle kısayolları var. Onun için bu önemli. Bir de az görenler için de bazı düzenlemeler yapılmış. .. . ki bu çok güzel. Her noktasına girdim, ulaşamadığım bir yer olmadı.*

Challenging Content. Experts also shared similar views with students regarding the challenging content. As they mentioned, students should be able to study the content in different activities without losing their attention. As they supported, this could be achieved by challenging the students without overwhelming them. Especially, providing the content with an increasing challenge was concidered very effective by them. One of them indicated that:

> E1: Providing activities with an increasing challenge have been reflected very well. Listening words in I am learning vocabulary section, starting to write in practice section, and then competing with time, presenting mixed words in game. All of them as a whole are very good.
>
> *E1: Aktivitelerin giderek zorlaşarak verilmesi çok iyi yansıtılmış. Kelime öğreniyorum bölümünde sadece dinlemeleri, pratikte yazmaya başlamaları daha sonra sonra süreyle yarışmaları, oyunda karışık kelimeler sunulması. Hepsi bütün olarak çok iyi.*

Competing with time was the most mentioned aspect regarding the challenging content. Experts thought that it triggers students' excitement and enables them to try to complete each session effectively. Regarding the issue, one of the experts highlighted that:

> E3: Competing with time is good, an advantage for the students, in terms of being more engrossing. They are getting excited. PP2 (student) said I felt an ambition…I was very emotional when I heard PP2 was excited. As I said, she did not intend to participate the study before.
>
> *E3: Zamanla yarışması güzel, o çocuklar için bir avantaj yani, daha bir sürükleyici olması bakımından, Heyecanlanıyorlar. Diyor ya PP2 (öğrenci) hırs yaptım diyor…PP2'Nin heyecanını görünce çok duygulandım, Dedim ya niyeti yoktu bu çalışmaya önceden…*

Teaching Strategy. Different from students, experts considered the intervention as very effective for students in terms of the teaching strategy implemented. They believed that the teaching strategy and the content structure of the intervention were one of the affordances of the study. As they indicated integrating Rosenshine's explicit teaching model to the web-based program was done effectively which also had positive impacts on the teaching progress. By integrating direct vocabulary instruction, students were introduced many words in different contexts, which provided an effective practice environment.

Better Educational Performance

Educational contributions of the program was also pointed out by all experts. They advocated that the program helped students to learn the words easier and faster than the face to face class environments. It provided a good practice opportunity. As a result

of these advantages, this program increased vocabulary knowledge, retention and computer literacy of students.

The study had many contributions in terms of improving students' vocabulary knowledge. As experts mentioned, study with all of the components was effective in terms of ensuring success. One of them stated that:

> E2: It has been a program where students can improve themselves very easily. In other words, it flogs them (students)… WP1 has an ambitious and says I will have 20 corrects in 20 questions in TEOG (national exam).
>
> *E2: Öğrencilerin kendilerini çok rahat geliştirebilecekleri bir program olmuş. Yani onları kamçılıyor adeta (öğrenciler)… WP1 şu an hırs yaptı yirmi de yirmi yapacağım diyor TEOG'da.*

Also, they stated that students had found chance to improve their keyboard usage by making much repetition while writing with the keyboard.

> E2: In the program while students learning, they learn computer use also. They are improving their computer skills.
>
> *E2: Burada öğrenirken bile programı öğrenirken bilgisayarı da öğreniyorlar. Bilgisayarlarını da geliştiriyorlar.*

Retention. Expert2 and Expert3 made comments about the effect of the program on retention since they had chance to observe the students in the class after the study was completed. Also, they had information about students' TEOG performance. They indicated that students achieved a good degree of retention and the study was effective in that manner too. One of them indicated that:

> E3: In the last class something happened. When teaching the subject students knew the word. They remembered immediately. When I asked them how you know this, they said that they learned in your study.
>
> *E3: Geçen derste şöyle bir şey oldu. Konuyu işlerken öğrenciler bildi kelimenin ne olduğunu. Hemen hatırladılar. Nereden bildiklerini sorduğumda da sizin yaptığınız çalışmada öğrendiklerini söylediler.*

4.3.2.2 Challenges of the Web-based Drill Program Based on Experts' Experiences

Experts mentioned about the challenges mainly based on their past experiences and perceptions since they did not observe all of the interventions. Teachers of the school strongly mentioned about the disadvantages of the Internet substructure of the school. Since there was a problem in connecting to the Internet this caused time related problems for the teachers and also for the students.

Based on the problems related to the Internet, they criticized the study since it does not provide a mobile application. They mentioned it as a challenge. Regarding this issue one of them mentioned that:

> E2: Actually, I am thinking that we should not depend on the Internet. I mean there could be a special program. I wish a software was developed…a program that just executes right after we plug in USB would be more comfortable. Because we face with difficulties with the Internet.
>
> *E2: Aslında internete de bağlı kalmasak keşke diyorum. Yani özgün bir program olsa. O şekilde bir yazılım geliştirilse…hemen flash belleği taktığımızda çalışabilen bir program olsa çok daha rahat olur diye düşünüyorum. Çünkü internette çok sıkıntı yaşayabiliyoruz*

4.3.3 Perceptions of Families

Families play an important role in understanding students' experiences. Also, the perceptions of the families related to the study and its contributions for their own child was investigated. There were three families available for the interviews. Since the mothers of the students were closely following the study, interviews were conducted with the mothers of WP1, WP4, and WP5. Families' perceptions were related to the affordances of the study in terms of enjoyment and better educational performance.

Enjoyment

Three families stated that their children enjoyed participating to the study and they were happy during the interventions. As they indicated, students' enjoyment was reflected to their family life. Families were aware of their student's eager to participate the interventions. One of the family members stated that:

> Mother of WP1: He is very happy, incredibly happy, they will be upset when it completed. When he is going and coming with you he comes home very happy, despite how much tired he is. By the way, he was taking mathematics course, but he was coming home late… After 8 he could not take the mathematics lesson, his teacher was leaving in the middle. He preferred happiness in your study to this mathematics lesson. I really thank you, I believe you really did a thing that is very useful for my child.
>
> *Mother of WP1: Çok mutlu, inanılmaz mutlu, bitecek üzülecekler. Ben de üzülücem. Sizinle gidip geldiği zaman eve çok mutlu geliyor, ne kadar yorgun olursa olsun. Bu arada matematik dersi de alıyordu, geldiği saat geç ...8'den sonra matematik dersi alamıyor öğretmeni yarım bırakıp gidiyordu, oradaki mutluluğu buradaki derse tercih etti. Ben size çok teşekkür ediyorum gerçekten çocuğum için çok faydalı olduğuna inandığım bir şey yaptınız.*

WP5's mother also emphasized how her child was eager to join the interventions. She indicated that:

> Mother of WP5: I am aware of its effectiveness. At first, he was unwilling to participate, concerning whether he can achieve or not. But when they progressed, I realized the effectiveness and also he realized too. He was more eager and waited for the week coming.
>
> *Mother of WP5: Verimli olduğunun farkındayım. Önceden isteksiz olarak başlamıştı yapabilir miyim yapamaz mıyım diye. Ama kurs ilerledikçe yararının farkına bende vardım kendi de vardı. Daha çok istek başladı, sürekli haftanın gelmesini bekledi açıkçası.*

Better Educational Performance

Families indicated that the study contributed to their children in terms of learning the words which also effected their TEOG performance positively. They indicated that they were aware of the contributions of the study.

> Mother of WP4: He took TEOG exam and he was afraid about failing. As we know, he has only three wrong answers. But we realized the contributions of this… (the study). I also wanted to talk to you, but I did not have the opportunity. We are glad as a family. I am telling again, with the support you provided he was successful.
>
> *Mother of WP4: TEOG sınavına girdi baya bir korkuyordu da hani yapamam diye, bizim bildiğimiz sadece üç yanlışla çıktığı. Ama bunun… faydasını gördük (çalışmanın). Ben hatta konuşmak istiyordum sizle de fırsat olmadı. Biz ailecek memnunuz. Yine diyorum yani siz verdiğiniz destekle de TEOG'da başarılı oldu.*

4.3.4 Design Principles Constructed in the Third Cycle

Considering the results of all findings in the third cycle, the design principles were constructed. Design principles of the third cycle are:

- VI learners should be provided with a practical environment that enables them to practice with the content in order to compensate for their lack of vision.
- VI learners should be able to experience repetition in a variety of ways.
- Scenario based games and contents are good motivators for VI learners; therefore, scenario based tasks should be incorporated into instructional process.
- Considering the barriers that VI students face in their traditional education, instructional program design should provide features that enable VI learners to study in a time efficient manner.
- Providing the content with similar activities in different contexts may result in increased success.
- Integrating direct instruction in web-based learning environments for teaching VI students may be an efficient teaching strategy.
- Providing VI students with scores during all sections is a key factor in improving their motivation and gaining attention.
- The program should have features that allow VI learners to follow their own performance in order to figure out how they are progressing in learning the relative skills.
- The capacity of content features to motivate students and focus their attention with repetitiveness, practicality, increasing challenge, auditory input and feedback may positively affect the acquisition and maintenance of skills.
- Any intervention to teach the skills to VI learners should include activities of varying level of structure.
- Encouraging auditory feedback should inform students about their answers.
- Despite screen readers, instructional programs should also provide auditory input for the critical parts.

- Instructional design targeting VI learners should provide users with individualized instruction and a flexible environment.
- An instructional design should allow VI learners to access non-visual elements through a simple interface.
- Instructional design should provide opportunities to VI learners for self-paced learning.

4.4 Contributions of the Web-based Drill Program to the Achievement

One of the purposes of this study was to understand the effect of the web-based drill program on students' achievement. The dependent variable of the study was students' achivement at the vocabulary groups, which were friendship, tourism, chores, and science, in terms of learning spelling and semantics. The independent variable was the web-based drill program developed based on the principles of Rosenshine's explicit teaching model.

The visual analysis of single-subject data among participants revealed that all students significantly improved their spelling and semantics knowledge in English vocabulary. Results of the vocabulary tests and retention tests were reported for each student seperately.

4.4.1 Results of the Vocabulary and Retention Tests

By implementing Rosenshine's explicit teaching model, teaching of spelling and semantics of English vocabulary related to friendship, tourism, chores and science behaviors were analyzed with the visual graphs. Separate visual graphs for each students with all behaviors are presented in this section. Horizontal axis of the graph represents the implementation sessions while the vertical axis represents the vocabulary scores of the students for each unit. The data represented in the graphs were gathered through three processes as baseline, training, and maintenance. Generalization data were presented in a different graph. Baseline data were gathered before the intervention, training data were gathered during the intervention and maintenance data were gathered after giving at least a six-week break after the study.

Students were required to reach 80% success criterion for each unit and for both spelling and semantics. Based on this criterion; visual graph data revealed that after the first behavior training, the percentage of the baseline level increased, while untaught behavior baseline percentage did not change for all participants. Similarly, after the training of the second, third and fourth behaviors percentage scores increased while the other two data did not change. Based on these findings, it can be concluded that the target behaviors of the students have been achieved based on the intended level accordingly. Only WP3 had changing results in different sections. For the third maintenance datum of the science behavior, WP3 was below the success criteria which was 70%. This decrease was related to the long duration of the study. Another aspect of visual graph data was that students faced with difficulties mostly in the learning process of science behavior. Mostly, they had changing scores for that behavior.

4.4.1.1 Results of WP1 for Each Behavior

Visual graph results of the first student, WP1, for each behavior is provided in the figure 4.4.

Friendship: Baseline achievement percentages of WP1 before the intervention for both spelling and semantics were 0% for three sessions one after the other.

In training phase, spelling percentage increased to 80% and semantics percentage to 90% at the end of the first training. In total, three training data were gathered at 4^{th}, 5^{th} and 6^{th} sessions. During 5^{th} and 6^{th} training, both spelling and semantics percentages were 100% and assured stability.

After the interventions finished, WP1 maintained his achievement during the three maintenance data gathering sessions and got 100% for spelling and semantics at all sessions.

Tourism: Probe data percentage of WP1 at the first session was 0% for both spelling and semantics. Then, WP1's baseline percentage for the next three sessions for spelling was 30% and for semantics was 0%.

In training phase, after the first training WP1's percentages increased to 100% for both spelling and semantics. In total, three training data were gathered at 10th, 11th and 12th, sessions. WP1 was able to continue to his success by taking 100% at the tests.

In the maintenance phase, WP1 got 100% success for spelling and semantics at the three maintenance sessions.

Chores: First session probe achievement percentage of WP1 for chores behavior was 0% for spelling and semantics. The second probe achievement percentage of WP1 was again 0% for both. Three baseline data were gathered and WP1 got 30% three times for spelling, 20% three times for semantics

In training phase, three data were collected for WP1 at the 16th, 17th and 18th weeks. WP1 got 100% in three sessions for spelling and semantics.

In the maintenance phase, WP1 was again able to continue to be successful 100%.

Science: At the first, fifth and ninth sessions probe data were gathered for WP1 and there was 0% success at all sessions in terms of spelling and semantics. Also, right before the training phase three baseline data were gathered at 17th, 18th and 19th weeks and again WP1 got 0% success for both parameters.

After each training session at the 22nd, 23rd and 24th sessions WP1 as 100% successful for both spelling and semantics.

WP1 was able to maintain his success at the 31th, 33nd and 35th weeks by achieving 100% success percentage.

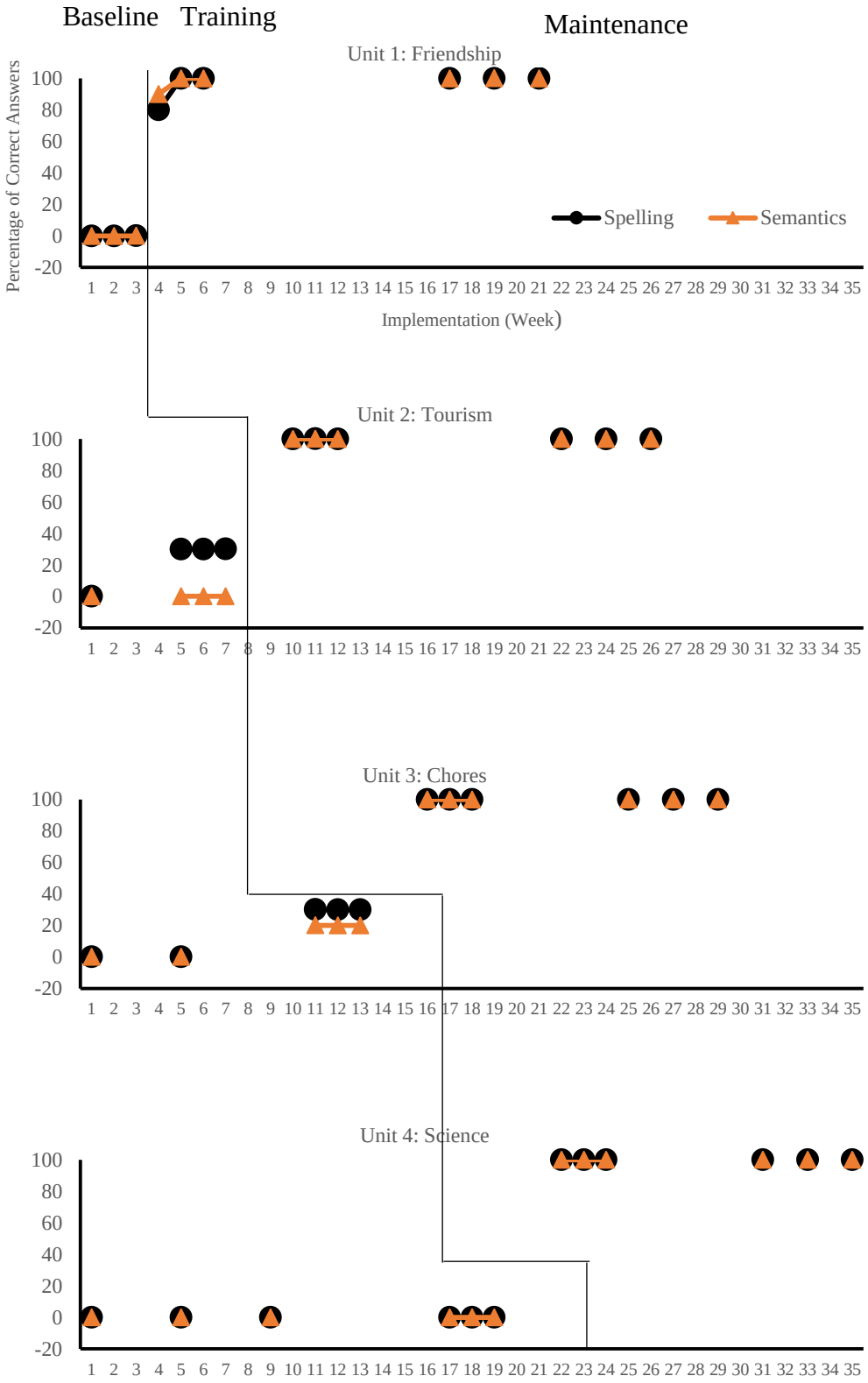

Figure 4.4 Achievement Percentages of WP1

4.4.1.2 Results of WP2 for Each Behavior

Visual graph results of the second student, WP2, for each behavior is provided in the figure 4.5.

Friendship: Baseline achievement percentage of WP2 before the intervention for spelling was 10% and for semantics was 0% at all three sessions.

After the first training session, WP2 was able to reach 60% success for spelling and 80% for semantics. At the second training session, WP2 was successful 90% for spelling and 100% for semantics. After the third training session he was able to reach 100% success for both skills. After two weeks break, two more training data were collected from WP2 and he was able to continue to his 100% success for both semantics and spelling.

In terms of maintenance, three tests were done to measure the retention. For the first maintenance session WP2 had 90% for spelling and 100% for semantics. For the next two maintenance data, WP2 got 100% success for both skills.

Tourism: One probe data and three baseline success percentages for WP2 were 0% at all the sessions for both spelling and semantics.

After the first training session, WP2 got 90% success for spelling and semantics. For the next two sessions WP2 reached 100% achievement percentage for both of the skills.

During the maintenance session, three tests were done. For the first maintenance session WP2 maintained his 100% success. For the next two tests, he scored 90% achievement for both spelling and semantics.

Chores: Two probe and three baseline achievement percentages of WP2 were 0% for both of the skills.

During the training session, four tests were conducted and at the end of the first training WP2 reached 100% achievement for spelling and 80% success for semantics. At the

end of the second training WP2 scored 90% for both of the skills. During two more training sessions, he reached 100% success.

In the maintenance process, three measurements were done and WP2 was able to keep his success at 100%.

Science: Three probe and three baseline level for this unit was 0% for both of the skills at all tests.

During the training, three interventions were conducted and WP2 was able to reach 100% success in both skills and maintained this success for three sessions.

In the maintenance phase WP2 got 100% success for spelling at the three tests and 80% for semantics.

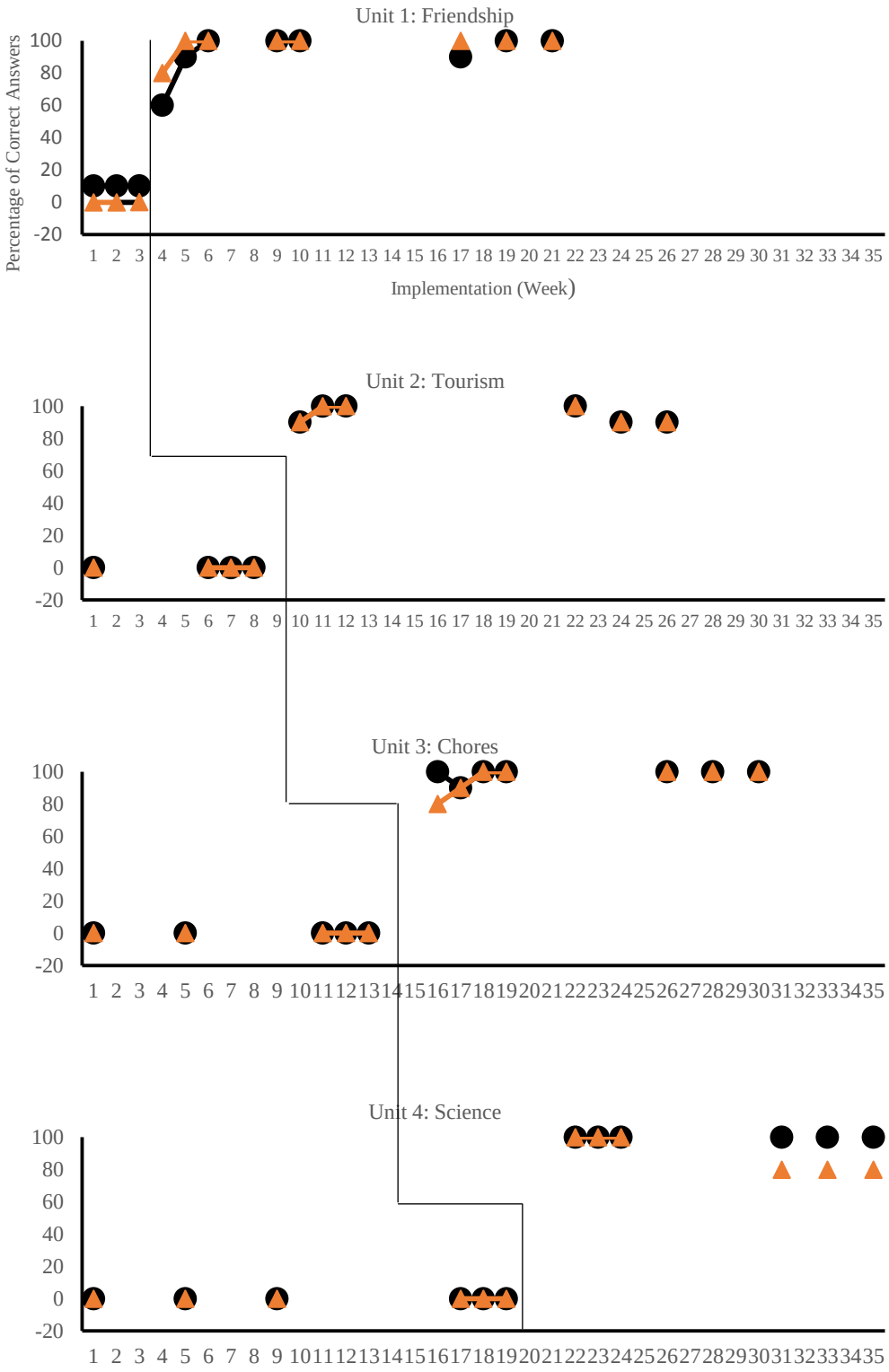

Figure 4.5 Achievement Percentages of WP2

4.4.1.3 Results of WP3 for Each Behavior

Visual graph results of the third student, WP3, for each behavior is provided in the figure 4.6.

Friendship: Achievement score before the intervention of WP3 for this behavior was 20% for spelling and 0% for semantics at the first and second baseline sessions. At the third baseline, WP3 got 30% for spelling and 10% for semantics.

During the first training, WP3 reached 70% success for spelling and 30% for semantics. For the next two training sessions, WP3 scored 100% achievement for both of the skills.

During three maintenance sessions, WP3 got 100% success for both of the skills.

Tourism: One probe and three baseline data were collected for this unit and WP3 got 0% at all four sessions for spelling and semantics.

Five training sessions were conducted for this student until catching the stability for the data. At the first training, WP3's percentage for spelling was 80% and 100% for semantics. After the second training, WP3 success was 100% for spelling and 60% for semantics. At the third session, WP3 got 100% for spelling and 90% for semantics. At the fourth and fifth sessions, WP3 got 100% for spelling and 80% for semantics.

WP3' success was 90% for both of the skills at the first and second maintenance phases. For the third maintenance, WP3 scored 90% for spelling and 80% for semantics.

Chores: Two probe and three baseline data were collected for this behavior and WP3 scored 0% success for both of the skills.

There were three training sessions; for the first training, WP3 reached 80% for spelling and 100% for semantics. At the next two training sessions, WP3 was successful 100% for both of the skills.

During three maintenance sessions, WP3 was able to keep success with 100% for both of the skills.

Science: There were three probe and three baseline data points for WP3 and success score was 0% for both of the skills.

After the first training session, WP3 reached 100% for spelling and 90% for semantics. At the next two training sessions, WP3 was 100% successful for spelling and 80% successful for semantics.

During three maintenance sessions, WP3 was successful 90%, 90% and 80% respectively for spelling and 80%, 80% and 70% for semantics.

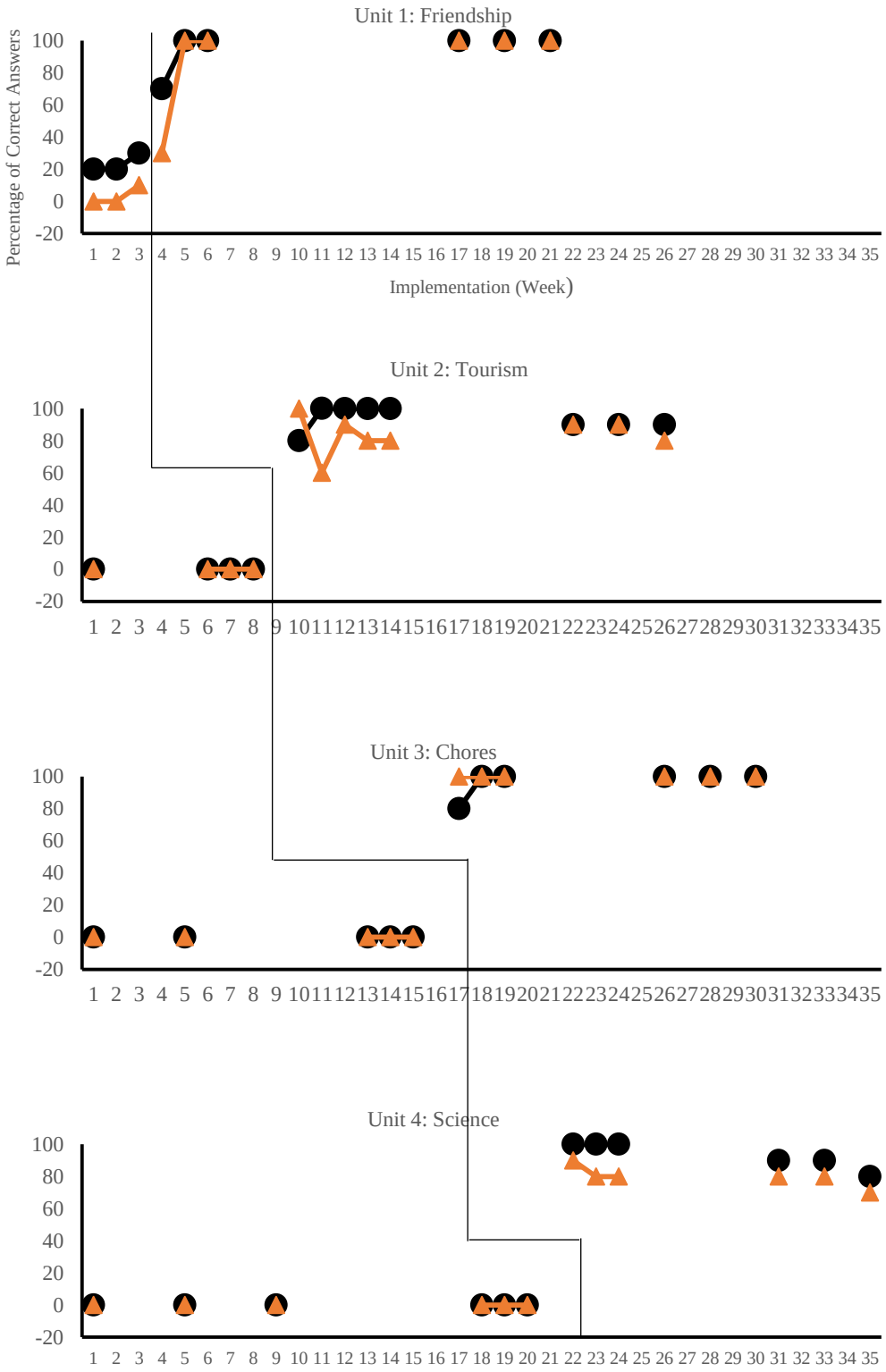

Figure 4.6 Achievement Percentages of WP3

4.4.1.4 Results of WP4 for Each Behavior

Visual graph results of WP4 for each behavior is provided in the figure 4.7.

Friendship: During the baseline phase, success level for WP4 was 0% for all three sessions and for two skills.

In total, five training sessions were conducted for WP4 in order to catch stability. Three sessions were conducted one after the other. WP4's achievement for spelling was 90%, 100% and 100%; and for semantics was 50%, 80% and 80% respectively. After two weeks break, two more training sessions were conducted and WP4' success was 100% for both spelling and semantics in both of the sessions.

During the maintenance, WP4 was able to be successful and through three sessions' percentages for spelling were 100% and for semantics percentages were 100%, 90% and 80% respectively.

Tourism: WP4 had one probe and three baseline scores which were 0% for both of the skills.

In the training phase, WP4 had three training phase one after the other. WP4 reached 100% success in spelling skill at all training sessions. In terms of semantics, WP4's achievement was 80%, 100% and 100% respectively.

In the maintenance phase, WP4 was again successful for both of the skills. For spelling, WP4 was successful 100%, 90%, 80% and for semantics 80%, 90%, 90% correspondingly.

Chores: WP4 had two probe and three baseline scores in teaching of chores behavior and all scores were 0% for spelling and semantics.

Three training sessions were conducted and WP4 reached the success criterion. Based on the results, WP4 was successful in spelling with 70% for the first training and 100%

for the remaining two training sessions. In terms of semantics, WP4 was successful with 70%; 100% and 80%.

WP4 was again successful in the maintenance phase; for spelling the achievement percentages were 100%, 90% and 90% and for semantics 90%, 100%, 90% accordingly.

Science: WP4 had three probe and three baseline scores in science teaching and all scores were 0% in spelling and semantics.

There were three training sessions and according to the results WP4 was successful. Spelling achievement scores were 100% for all training sections. Semantics scores were on the other hand, 80%, 100% and 100%.

In the maintenance phase, WP4 kept being successful with spelling at 100%, 100% and 90%; semantics at 80%, 80% and 80%.

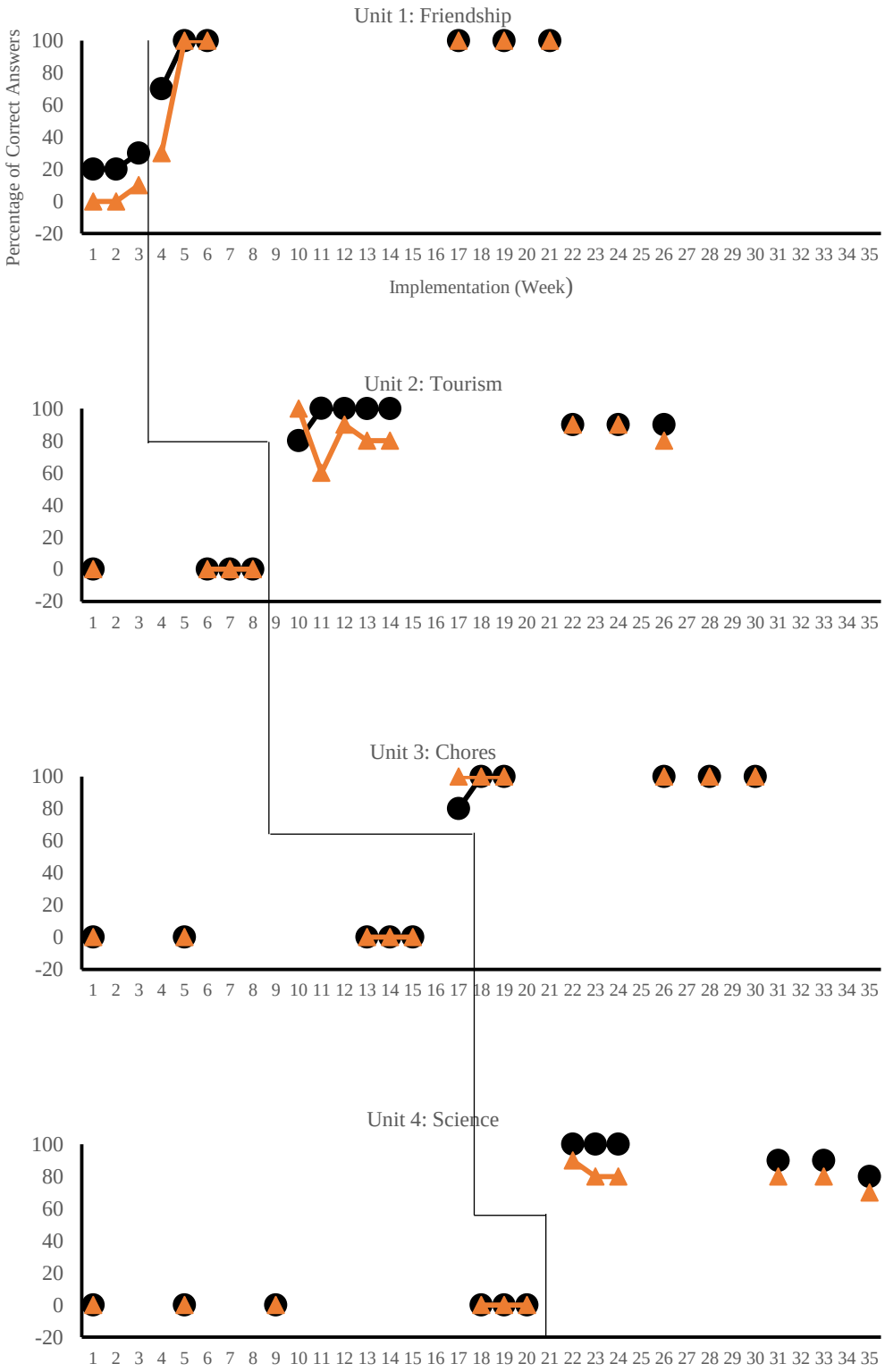

Figure 4.7 Achievement Percentages of WP4

4.4.1.5 Results of WP5 for Each Behavior

Visual graph results of WP5 for each behavior is provided in the figure 4.8.

Friendship: Three baseline measurements were taken for WP5 during friendship teaching. WP5 was 10% successful for spelling and 0% for semantics.

For the training phase, there were five interventions for WP5. After first training, WP5 was 20% successful for spelling and 50% for semantics. After the second training, WP5 reached 100% success for spelling and 80% for semantics. For the next three training sessions, WP5 was 100% successful for both spelling and semantics.

In the maintenance phase, WP5 got 90%, 80% and 90% success for spelling respectively. For semantics, WP5 was 80% successful at three measurements.

Tourism: One probe and three baseline measurements were taken for tourism and WP5 was 0% successful for both of the skills.

During training, three interventions were conducted one after the other and WP5 was able to catch 100% success at all interventions for both spelling and semantics.

In the maintenance, WP5 kept his success with 90%, 90%, 100% for spelling and 80%, 80%, 90% for semantics.

Chores: Two probe and three baseline measurements were taken for chores and WP5 was 0% successful for both of the skills.

After three training sessions, WP5 caught 100% success at all the measurements both for spelling and semantics.

In the maintenance period, WP5 was successful in spelling with 80%, 80%, 90% and in semantics 80%, 90%, 90%.

Science: Three probe and three baseline measurements were taken for science teaching and WP5 was 0% successful for both of the skills.

During three training sessions, WP5 reached 100% success at all the measurements both for spelling and semantics.

In the maintenance, WP5 kept being successful with 90% in spelling and 100% in semantics at all the measurements.

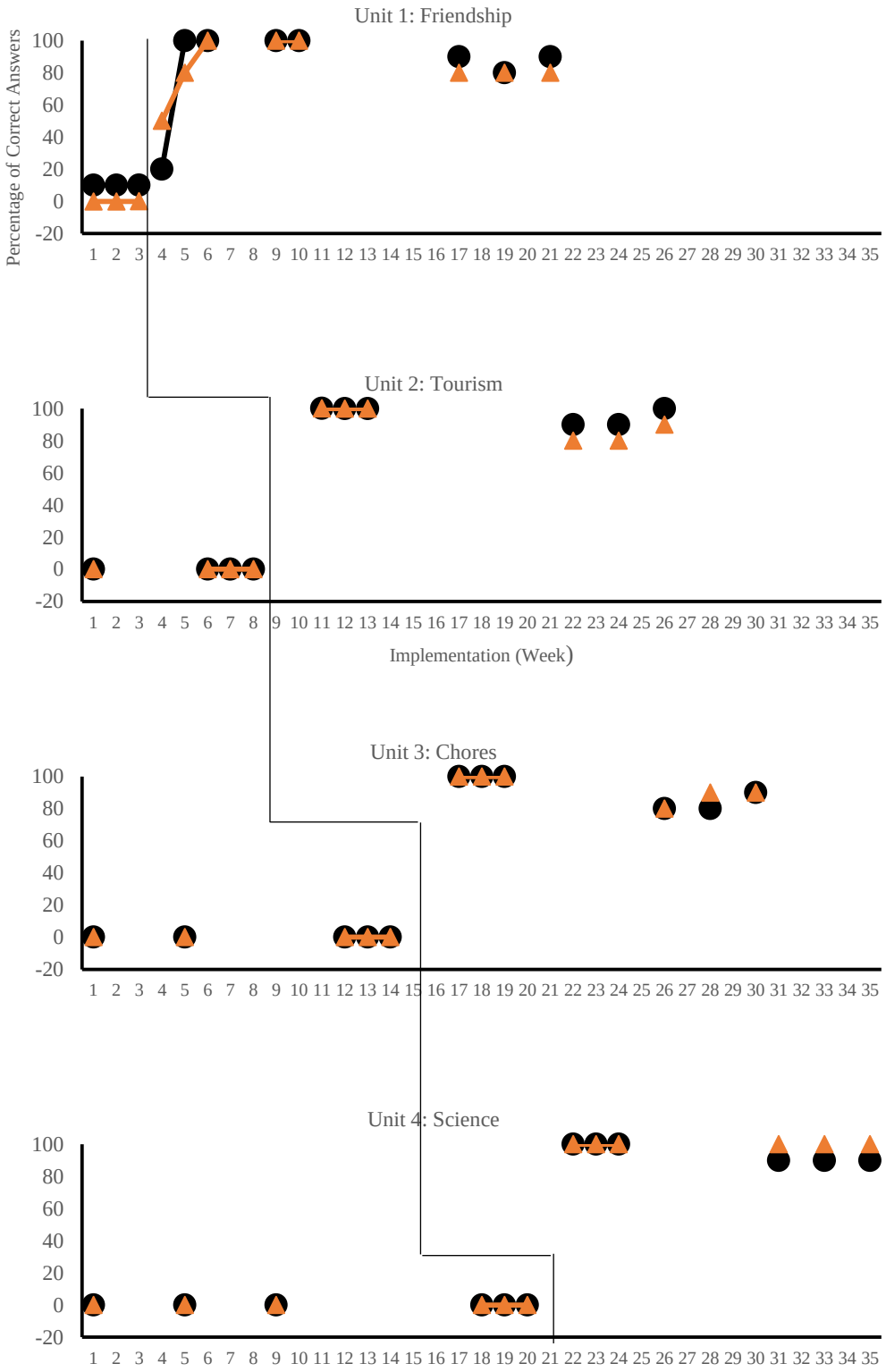

Figure 4.8 Achievement Percentages of WP5

4.4.1.6 Results of WP6 for Each Behavior

Visual graph results of WP6 for each behavior is provided in the figure 4.9.

Friendship: Three baseline measurements were taken for WP6 during friendship unit. WP6 was 0% successful both for spelling and semantics.

During the training of this behavior, four measurements were taken for this student. After the first training, WP6 was 90% successful in spelling and 70% in semantics. In the second training, WP6 got 60% in spelling and 80% in semantics. During the next two training sessions, WP6 reached 100% success for both of the skills.

During maintenance, WP6 got 80%, 90%, 80% success in spelling and 100%, 90%, 80% in semantics respectively.

Tourism: During baseline phase in tourism unit one probe and three baseline measurements were taken and WP6 got 0% in spelling and semantics.

During the training, four measurements were taken for WP6. After the first training, WP6 got 70% in spelling and 80% in semantics. For the next three training sessions, WP6 reached 100% success in spelling. In terms of semantics, WP6 got 80%, 100% and 100% respectively.

During maintenance phase, WP6 kept being successful 100% in spelling. In terms of semantics first two maintenance success were 100% and for the last measurement WP6 got 80%.

Chores: During two probe and three baseline measurements, WP6 was 0% successful.

During four training measurements, WP6 reached 100% success in spelling. For semantics, WP6 got 70%, 90%, 100%, and 100% respectively.

During maintenance, WP6 was able to keep being successful. For spelling, WP6 got 100%, 80% 100% and for semantics WP6 got 100% for all the measurements.

Science: During three probe and three baseline measurements, WP6 was 0% successful for both of the skills.

During three training sessions, WP6 got 80%, 100% 100% for spelling and 50%, 100% and 100% for semantics.

During maintenance, WP6 kept being successful in spelling with 90%, 80%, 100%. For semantics, first measurement was 70% which was below the achievement criterion. For the next two measurements, WP6 got 80% success.

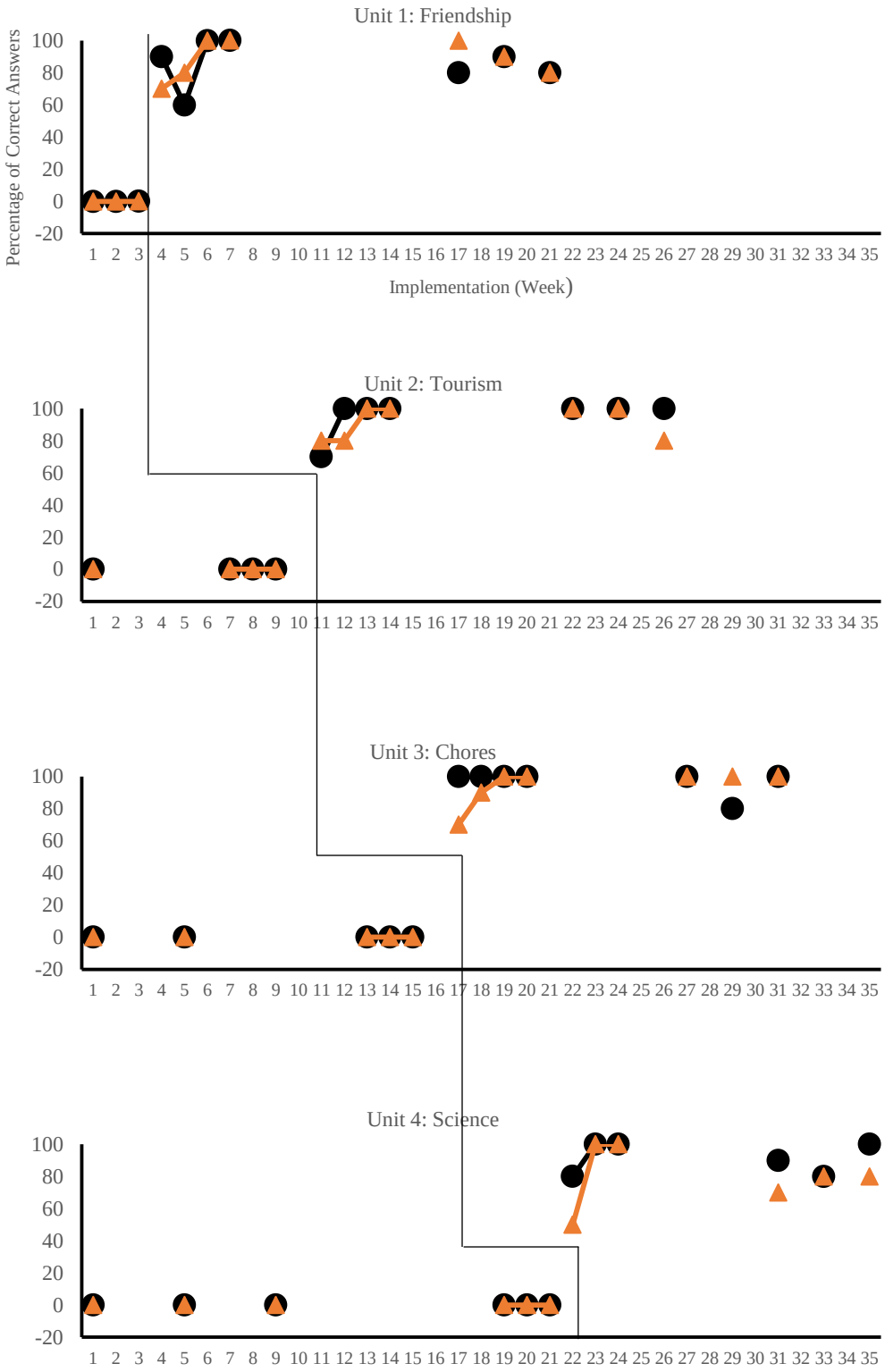

Figure 4.9 Achievement Percentages of WP6

4.4.1.6 Generalization Data Results

Generalization data for six participants were gathered at the same time for all of the vocabulary taught by using MS Word program. Students were required to listen to the teacher and then write the spelling and semantics of the word. Following figures 4.10 and 4.11 represent the generalization data results. Generalization data shows that students were able to use their knowledge in a different context, which required them to be successful when the words are given random and mixed.

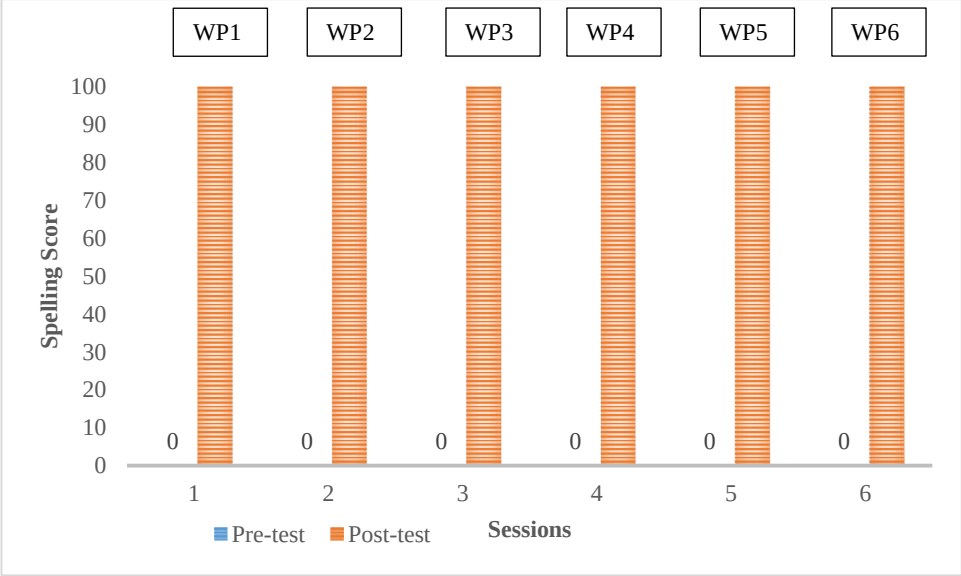

Figure 4.10 Percentage of correct spelling responses during generalization

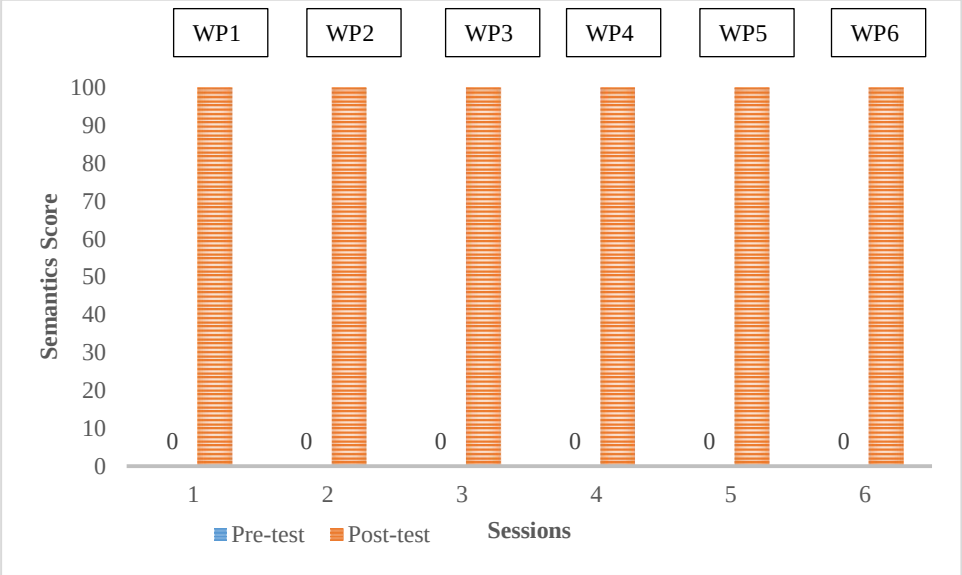

Figure 4.11 Percentage of correct semantics responses of during generalization

CHAPTER 5

DISCUSSION AND CONCLUSIONS

In this chapter, the discussion and interpretation of the results, implications of findings and suggestions for future research are presented. Findings have been interpreted in the light of previous studies and a review of the literature.

In the first section, the first and second research questions of the study are discussed based on students' and experts' experiences and also families' opinions. The third research question is then discussed, including information about the contribution of the study to the achievement of the target group.

In the second section, the fourth research question and the design principles of the program are discussed as a guide for future research. This section summarizes all the design principles that emerged through the iterative cycles.

Finally, the implications of findings and suggestions for future research are presented.

5.1 Affordances and Challenges of Web-based Drill Program

The first section considers the affordances and challenges of the study based on students', experts' and researchers' experiences and also families' opinions. All of the findings presented in this part have been discussed in combination with the participants' answers. The research questions discussed in this part are:

1. How do participants (VI students and experts) describe their experiences toward the web-based drill program?

2. What are the families' opinions about students' experiences with web-based drill program?

5.1.1 Affordances

A considerable amount of research emphasizes the affordances of assistive technologies in the education of VI learners (Douglas et al., 2009; Koenig & Ashcroft, 1983; LaGrow, 1981; Lowenfeld, 1973; Michael & McDermott, 2003; Morrow, 1999; Sousa, 2013; Tobin et al., 1997). The main affordance of assistive technologies for VI learners have been identified in the literature as facilitator role in learning progress, better educational performance and individualized instruction. Affordances of this current study support the previous research in assistive technologies for VI learners. This study combines the developed assistive technology with an adequate teaching strategy and assessment plans. When considered as a whole, the study had an additional major affordance as presentation of content. After analyzing all the findings, affordances and challenges are covered in detail.

Facilitator Role in Learning Progress

The major affordance of the study was the way in which it facilitates the learning progress of VI students with features that cannot be integrated in the face-to-face classroom environment. It has been discussed that facilitating learning progress was a feature of the program that reduces the handicapping effect of VI. One of the primary challenges that VI learners face is access to information, which increases the demand on assistive technologies (Douglas et al., 2009; Lowenfeld, 1973; Michael & McDermott, 2003; Sousa, 2013; Tobin et al., 1997). In parallel to this argument, all participants of the current study mentioned the facilitator role of the program as a major affordance since it allowed students to practically access information, to track their own progress and provides them with the opportunity for individualized instruction.

Practicality. The first aspect of facilitating learning progress is practicality of the environment. In terms of the program, its practicality relates to its effectiveness in

meeting target students' wishes and needs. As pointed out by Nieveen (1999), the practicality of an instructional tool is related to its effectiveness. Similarly, Jitendra et al. (2004) highlighted this issue and indicated that practicality is the critical issue in vocabulary instruction through computer-aided environments. According to this study's findings, the practicality features of the program ensure students have adequate practice opportunity and time efficiency. Especially, those students who missed out on content from face-to-face classroom instruction and were unable to meet with their teacher emphasized that during the study they felt equal to the other students since the practicality feature of the program enabled them to access content in a time efficient manner. Repetition was also attributed as a strong point of the study since undertaking adequate practice through different activities contributes greatly in terms of improving students' word knowledge. This item corroborates the arguments of Pokrivčáková et al. (2015) who stated that continuous and developing repetition of presented matters must be present during the whole foreign language education of special needs' students in order to prevent failure and other issues. Furthermore, the significance of repetition in VI education has been emphasized by a number of scholars in the literature (Conroy, 2005; Stein et al., 2010).

The other issue regarding practicality was time efficiency. This study ensured that students achieved an adequate level of repetition in a timely manner. This issue is critical since it concerns one of the barriers that VI students face in their traditional education. As mentioned in the literature, due to the time related issues, VI students cannot find the opportunity to undertake practice in class, which negatively affects their learning process. Providing students with an effectively designed environment that ensures adequate and efficient repetition time is one of the ways to address such barriers. Similarly, the results of experts' interviews revealed that due to the practicality features of the program, students were able to learn content in a shorter period of time when compared to face-to-face class instruction. This also supports the arguments of Watkins and Slocum (2004) who underlined that the teaching of basic skills should be achieved in the minimum time possible.

The findings revealed that this study ensures practicality which is a criterion for high quality interventions. This implies that the intervention meets the wishes and needs of VI students. Thus, this factor has crucial implications in terms of the design and development process of assistive technologies, as practicality is the way to ensure that this technology contributes to the target setting with an effective intervention.

Tacking Progress. The other affordance mentioned by the students regarding facilitating learning progress of the intervention was providing ways to track their own progress, thus they were able to figure out their own level and encourage themselves to study more. As Newton and Dell (2011) pointed out, tracking assignments or grades is one of the ways to help disabled learners become organized which is very hard without an assistive technology. In his study, Marzano (2009) examined the effects of students' tracking their own progress and found that it is associated with a 32 percentile gain in students' achievement. Likewise, ten students in this study mentioned this issue, indicating that they were able to realize their own performance and thereby direct themselves to study more. The features of the program that provide opportunities to track students' progress were auditory feedback, scores and the user information section.

The auditory feedback provided by the program was highlighted by the students as an affordance since it ensures students are made aware of their performance. Students mentioned that the program gives auditory feedback about their correct and incorrect answers. Considering VI students' individual needs, it was seen that auditory feedback was a prerequisite in their learning process. Being aware of their own performance and being informed about correct and incorrect answers is only possible for VI students through auditory feedback. This issue was also highlighted by the experts who strongly emphasized that auditory feedback is critical in VI education. They indicated that the program implemented auditory feedback effectively by including positive and negative feedback in different sections. Also, the program provides effective auditory feedback by informing students about the number of their correct answers in the "I am practicing" section, by giving positive and negative sound effects. The significance of auditory feedback was also highlighted by Stein et al. (2010) who indicated that

auditory feedback may be an alternative solution to teach spelling to VI students. In another study, McGookin, Brewster, and Jiang (2005) found that auditory feedback was useful in improving dragging performance of VI students with severe impairments.

Students were also satisfied with the scores being provided by the program. By following their scores they were able to understand how they were progressing. If they gained high scores they were motivated since they felt they had adequately learnt the content, whereas if they gained low scores they were again motivated to study more. Scores provided in different sections kept them alerted during the study. Furthermore, trying to reach a certain score in order to pass a level in the "I am playing a game" section was effective in helping them understand their level.

The other issue students mentioned was the user information section, which includes information about the most mistaken words and the scores gained in the sections. This section provides general information about student performance.

In summary, these issues imply that the strategy of tracking one's own progress is a good benefit for students. The design and structure of any assistive technology should implement auditory feedback effectively in order to better direct students with cues about their performance.

Individualized Instruction. As an affordance, individualized instruction was repeatedly mentioned by both students and experts as they believed it to have many advantages in VI education. This finding corroborates the arguments of another study that VI learners often need individualized instruction because in the regular class they cannot master the required skills since the content cannot be provided in a meaningful manner ("Learning about Blindness", 2000). In line with that, students in this study expressed experiencing difficulties in the traditional classroom while following content during group instruction due to diversity in intellectual strengths of the class. In contrast, students stated that they benefitted from this study since they were able to study at their own pace and in their own way. According to this study's findings, the reason behind this was students having been provided with the opportunity for self-paced

learning which was closely related to their being successful. They thought that they learned better in this way and improved their spelling. As discussed by Stainback and Stainback (1992), when students are not treated as individuals it is not possible for them to be successful. Similarly, Pugach and Warger (1996) pointed out that if the unique learning needs of students are not recognized, they cannot reach their potential.

In conclusion, it can be said that in order to educate VI learners the top priority issue is to facilitate their learning progress with available assistive technologies. In essence, assistive technologies for VI learners are equivalent to pencil and paper for sighted students (Sousa, 2013). Changing how VI learners are provided with instruction can be achieved through properly designed assistive technologies.

Presentation of Content

Presentation of content was the second major affordance of the study, and which was identified by all the participants. Even students who have a low level of success in their face-to-face class environments and who had prejudices against learning English benefitted from the study with increased motivation due to the content structure.

As previously discussed, the sequenced and structured content was effective in terms of the students' enjoyment and motivation. As indicated in Grundtvig Learning Partnership (2008-2010), personal motivation is one of the ways for VI learners to fill gaps in their language education. Thus, providing educational environments with an appropriate content presentation that motivates these students is crucial to increasing their competence in foreign languages. The students emphasized that during the study they were motivated to learn the words due to the features they were provided with. According to the study's findings, providing VI students with an increasing challenge, scenario-based game, accessible content and direct instruction were the critical issues in content presentation.

Challenging Content. As previously mentioned, the content of the study provided similar activities in different contexts with different challenges. Firstly, in the study there was a great deal of enjoyment had by the students due to the challenging content,

with different types of activities presented in the sections. One of the students indicated that due to the limited use of current educational materials and intense course content, they do not gain adequate enjoyment from face-to-face classes. However, in this study the same student indicated that an enjoyable time was had with the activities.

The challenging factors presented during the study were trying to write ten times in the "I am practicing" section; competing with time in the "I am trying my speed" and "I am playing a game" sections; and also trying to accomplish tasks in a game by gaining enough points were challenges which motivated the students. As a result, VI students had the chance to have fun, enjoy the content and engage more in the activities. The critical issue in providing challenging content is an accessible format. Otherwise instead of challenging the VI students, it creates a challenge to their learning progress.

Experts mainly focused on the similar activities set in different contexts. They indicated doing similar activities with different challenges has advantages for students as tackling challenging content in an accessible format enables students to be highly motivated. For example, they were competing against the clock, or trying to save a ship, or they were trying to gain enough points. These activities represented an effective and structured presentation of the content. The significance of effective content presentation for VI students was emphasized by Aziz, Abdul Mutalib, Sarif, and Jaafar (2013). They indicated that assistive technologies are needed due to a lack of effective content creation. Quality content should be created that focuses on VI students' needs, individual characteristics and learning styles. To that end, this study can be attributed as effective since it provided content presented based on the students' wishes and needs. This study also came up with the idea that providing challenging content in an accessible environment provides ways for VI students to better enjoy the content.

Scenario-based Game. Another strong point regarding the content presentation was the scenario-based game with voice discrimination. As expected, six of the students underlined this issue; that accomplishing a scenario-based task was a good motivator

for them. Mechanical content provide students with a scenario to make the program more attractive and enjoyable. Providing VI students with accessible games is a difficult task to accomplish. For this reason, as emphasized by Araluc (2002), VI children cannot enjoy most of the games, unlike sighted children, because of their handicap. The critical issue is that basic level games without visual clues can be designed only by integrating stories. Furthermore, the involvement of VI children in games can only be achieved by providing voice discrimination and localization of sound.

Accessible Content. In special education, accessible content is the most important aspect. Whatever is designed and developed, it would be worthless if inaccessible to the intended user(s). This affordance of the program was highlighted by the experts since they were able to check whether or not the program follows the accessibility criteria. The design process was completed by following the four principles of web accessibility which are perceivable, operable, understandable, and robust. As the experts emphasized, providing accessible content is a key directive and that this study was good at meeting this criterion. The other important point emphasized by the experts was trying to teach content in a face-to-face classroom environment with inaccessible course materials, and with the same amount of time as schools that teach sighted students. Prevalence of visual content in language books hampers the learning progress, and VI students cannot equally enjoy them as much their sighted counterparts. As a result their motivation cannot be maintained. As Araluc (2002) highlighted, VI students cannot enjoy language classrooms as if they are sighted because VI students cannot access the same attractive materials. For this reason providing an accessible web environment is key to VI education, and which also addresses time-related barriers. Additionally, considering the experiences of students and researchers' observations, the students faced no accessibility problems while using the program.

The findings revealed that the design of the program was successful and the content accessible. The importance of web accessibility cannot be ignored and its role for the disabled has been discussed in the literature (Harper & Yelisada, 2008). Additionally,

web accessibility is not only helpful in providing VI students with an open content, but also helps save time in the educational process.

Teaching Strategy. Regarding the presentation of content, teaching strategy was also one of the affordances of the study underlined by the experts. They believed that the content structure was effective since it represents the integration of Rosenshine's explicit teaching model effectively and enables students to undertake adequate repetition.

As Huebner (1986) pointed out, VI learners need DI of skills that others learn incidentally. Focusing on this issue, this study implemented the principles of DI into the sections of the web-based drill program. This study adapted Rosenshine's explicit teaching model to a computer-based environment by using the affordances of technology for providing feedback, presentation, and guided practice (Magliaro et al., 2005). As suggested by Pressley and McCormick (1995), the content was presented in a sequenced and structured manner. Furthermore, based on the goal of direct vocabulary instruction, students were introduced to as many new words as possible (Anderson & Nagy, 1992).

In addition to the results of expert interviews, vocabulary tests also supported the effectiveness of DI on VI students since six of the students who took part in the whole study showed substantial progress. This is in line with the literature, with many studies have shown the effectiveness of DI in special education with participants having different types of impairment (Corn & Koenig, 2002; Fallon et al., 2004; Flores & Ganz, 2007; MacCuspie, 2002; Swanson, 1999; Texas school for the blind and VI outreach programs, 2010).

Therefore, the findings showed that the study was motivating for all students including the ones that define themselves as low ability based on their grades. Furthermore, the findings provide evidence to conclude that individualized instruction can be effective to motivate VI students and to increase their success by providing the opportunity to study at their own pace. Furthermore, enjoyment is an essential support for learning which is also effective to motivate VI students and increase their involvement in

activities. Based on the findings, it was concluded that effective teaching of spelling and semantics can be achieved with the implementation of DI into web-based learning environments for VI students. The other conclusion is that VI students can learn tasks more rapidly if well-planned educational procedures are presented to them. Furthermore, repetition of similar activities in different contexts and enabling students to undertake adequate practice are effective ways of teaching basic skills to VI students.

Better Educational Performance

Better educational performance was the third affordance of the study underlined by the students, experts, and families. All of the participants agreed upon the contribution of the study in terms of better educational performance. Findings revealed that students were able to improve their vocabulary knowledge and computer literacy.

Students stated that they were able to improve their vocabulary knowledge and their computer literacy at the same time. Achievement of the students can be associated with the appropriate intervention implemented during the study. By properly designing the program, providing students with accessible content and with an appropriated teaching strategy, it is possible to stimulate success. This result implies that VI students can be successful by reaching their potential when provided with adequate intervention. As mentioned in the literature, VI individuals are able to achieve a similar level of intellectual and educational success as the sighted (Cattaneo & Vecchi, 2011; Pring, 2008) when they receive appropriate intervention (Milian & Ferrell, 1998). The first aspect of achievement was improvement in vocabulary knowledge, as students emphasized that various sections of the program required them to undertake practice which at the end increased their achievement. A similar study was conducted by Hub et al. (2005) with VI learners by integrating assistive technology into foreign language education, and according to the results students were successful in learning the object names. The second aspect of the achievement was an improvement in the students' computer literacy. Students indicated that they were able to improve themselves in

keyboard techniques, especially in faster keyboard usage, and learning the shortcuts that were necessary for the practical usage of screen readers.

The experts also found the study to be appropriate particularly in increasing the achievement of the students. This allowed them to consider to use the program in support of their face-to-face classes. Experts mentioned that this success being due to the opportunities provided to students to learn in an easier and faster way. This can be related to the contribution of assistive technologies to the educational performance of VI students. In line with the previous studies, it can be concluded that appropriate assistive technologies enable VI students to complete required tasks efficiently, and as a result increase students' achievement (Koenig & Ashcroft, 1983; LaGrow, 1981). The experts also emphasized that students were also successful in remembering words after the study was completed. They indicated that in the future, face-to-face class students would be able to remember the words immediately and perform well in exams. This finding corroborates the studies conducted in neuroscience which found that VI learners have superior memory functions when compared with the sighted (Amedi et al., 2003; Cattaneo & Vecchi, 2011; Hull & Mason, 1995; Pring, 2008; Raz et al., 2005, 2007; Raz et al., 2007; Röder et al., 2001), and that as a result of this advantage VI learners have better retention (Pring, 2008).

Better educational performance was also underlined by families and they indicated that their children were successful in their national exam (known as TEOG). They believed that this was related to the advantages of borne from the current study. This achievement was also associated with the retention success of the students.

5.1.2 Challenges

Challenges, as expected, are an inevitable part of any educational intervention conducted with technology. Related to this issue, a literature review showed possible challenges that may occur while using the assistive technologies in VI education (Shimomura et al., 2010; Smith, Kelly, & Kapperman, 2011; Wong & Cohen, 2015). The challenges reported in the literature are technical issues, lack of expertise, limited technology and accessibility. Technical issues faced in this study were in line with the

literature. However, regarding the lack of expertise, limited technology and accessibility there were not problems faced during the study. As mentioned in the affordances, in terms of accessibility the study was effective. The challenges of the study were mostly related to the challenges of the technological capacity of the school, rather than the features of the web-based drill program. In addition to the technical issues, another challenge was about students' low level of knowledge.

Technical Issues

Implementing technology in education brings about various issues upon which researchers should focus. In this study, technical issues emerged as a major challenge in delivering the content. Internet connection problems, screen reader problems and problems experienced by students' logging-in or logging-out were mentioned mostly by students and observers. Experts did not observe the implementation of the study and were therefore unaware of any technical problems; however, they indicated that the lack of a mobile application could be a challenge.

Due to the structure of the school where the study was implemented, problems were experienced related to the Internet connection. When there was a problem with the Internet it was impossible to implement the study which resulted in delays. Some sections were postponed because of the problems. In web-based environments the Internet is the most critical issue which can prevent content from being reached. In addition to the Internet problems, there were technical problems also with some of the computers. This affected students' motivation at some points and sometimes they had to wait for the problems to be fixed. A similar computer related problem was seen in the study of Shimomura et al. (2010) and one of the students was unable to participate in the experiment due to problems with the Braille display.

The other technical problem related to the screen readers. Due to the technical limits of some computers there were problems related to screen readers which adversely affects the flow of the lesson. When the problems occurred with the screen readers students were unable to reach the content and as a result they were distracted. Similar to the Internet problems, screen reader problems are also critical since it is the means

for VI students to access the content through technology. However, this problem was not faced often and did not prevent the study from being conducted.

At the beginning of the study some of the students experienced difficulties with logging-in and logging-out; however, this problem did not last and the problem was resolved.

Whatever the problem, technical issues are critical and can change the whole process of the study. As Orsini-Jones, Courtney, and Dickinson (2005a) underlined, that effective language learning can only be implemented if all stakeholders such as academics, technical support and students collaborate during the instruction.

Low Level of Knowledge

A low level of knowledge was another challenging aspect of the study which at some points affected the flow of the implementation.

The first dimension of low-level knowledge was related to the 7th graders who were unfamiliar with the English alphabet. During the first implementation they were demotivated because the sections of the program were presented using the English alphabet. In order to solve this problem, the "I am learning the alphabet" section was added to the program and students were required to practice learning the letters. Thus, this problem was resolved with the addition of another section that also aids future users who require additional support with the English alphabet.

The other dimension in this part was about the students' low-level computer literacy. This problem affected five of the students and two of them had difficulties using the Q keyboard (with top row letters starting QWERTY etc.) since they were familiar with F keyboard (or Turkish keyboard – with top row letters starting FGĞIOD etc.). The other problem related to keyboard usage was faced by five students who could not use the keyboard fast enough. This mostly caused problems in the sections with time-based activities. However, after a while and with enough practice they were able to use the

keyboard at an adequate speed. Thus, in time the challenge turned was into an advantage.

To summarize, there is no question that assistive technology environments may have challenges. However, the overall findings of the study have important implications in the use of those technologies for VI education.

5.2 Contribution of the Program to VI Students' Spelling and Semantics

The third research question was "What is the contribution of web based drill program on VI students' spelling and semantics knowledge in English vocabulary?" This question was investigated through vocabulary and retention tests, with the purpose of understanding the students' achievement in spelling and vocabulary semantics.

After many years of receiving little academic attention, the literature now demonstrates the importance of vocabulary knowledge (Allen, 1983; Laufer, 1986; Nation, 1990; Stein et al., 2010). With similar focus, this study investigated the effect of a web-based drill program on VI students' spelling and semantics vocabulary knowledge.

The potential promise of a designed and developed web-based drill program for VI for increasing student achievement outcomes in the spelling and semantics of English words was examined through repeated measurements of six student participants in a single-subject research. Their achievement process was analyzed by comparing baseline, training and maintenance measurements.

For student WP1, when the baseline condition was compared to the training condition it was seen that WP1 met the success criterion and was able to maintain 100% success after completion of the intervention for all four behaviors (friendship, tourism, chores, and science). Comparison of WP2's baseline and training condition revealed that WP2 was successful with all of the behaviors and was able to maintain his success to at least 80% during maintenance. Similar to WP2, WP3 also increased success rate after the intervention according to the baseline condition and was also at least 80% successful in the maintenance phase. One critical score was the third maintenance section of

semantics which was 70% for WP3. The scores for WP4 were not as stable as WP1, WP2 and WP3; however, WP4 was successful at the training phase and continued his success to at least 80% in maintenance. Comparison of WP5's baseline and training condition revealed that WP5 was successful with all behaviors and was able to keep his success to at least 80% during maintenance. WP6 was also successful during training sessions when compared to his baseline condition. He was able to reach at least 80% success for both skills, and mostly continued his success during maintenance. Likewise, WP3 had problems with one of the maintenance tests. For science behavior, the first maintenance data for semantics was 70%.

Thus, the baseline data for all six students were stable before the intervention. All of the students showed immediate increases in spelling and semantics achievement following the introduction of the intervention. Training changes for all students were seen in the desired direction. Despite two students had changing results in training and maintenance, it did not cause them to be unsuccessful. Still their behavioral change was in the desired direction. The desired change of the behaviors during training was replicated with an additional phase named maintenance, and still the positive change in all behaviors was maintained by all of the students.

The visual analysis of the students' single-subject data allowed a conclusion to be drawn that all six students showed substantial progress with the vocabulary test based on the 80% success criterion. In the literature, there have been many studies and projects in the computer-assisted vocabulary learning (CAVL) field conducted for the vocabulary improvement of VI learners (Hub et al. 2005; Jayakody et al., 2016; Stein et al., 2010; Stein et al., 2011); however, those studies were limited to the investigation of the design process. Different from those studies, this current study investigated the achievement process of students in addition to investigating the design process of the designed program. Despite not providing evidence-based practice, Hub et al. (2005) indicated that students were able to learn the object names during the study.

In conclusion, both qualitative and quantitative data of the study showed a long-term benefit of the study in enhancing vocabulary knowledge. However, these promising

results of the program relate to its proper design and development process considering the target groups' specific needs.

5.3 Design Principles of the Web-based Drill Program

The research question discussed in this part is "What are the participants' experiences pertaining to the design principles of web-based drill program for the VI? During the implementation of the study, the qualitative data were used to address the modifications and improvements of the web-based drill program. As previously mentioned, one pilot and three cycles were implemented until a final, adequate program was realized. Qualitative data analysis of experts and students revealed that the designed program was accurate, appropriate and accessible, especially in underlining the design considerations. This process allowed the researcher to focus on the design principles that could contribute to future studies.

According to the experiences of the whole process, collaborative effort between the researcher, teachers and students should start from the very beginning of the study. The use of design-based research was highly effective for the design and development of the program. The flexible iterative design ensured designing the most accurate program.

These principles will hopefully guide the design and development of similar instructional programs targeting VI learners. The iterative nature of the study allowed the application of changes to the intervention and helped to derive the instructional principles. Based on the participants' interviews and observations forms, the following principles were revealed for designing an effective instructional program. Figure 5.1 represents the construction of the design principles:

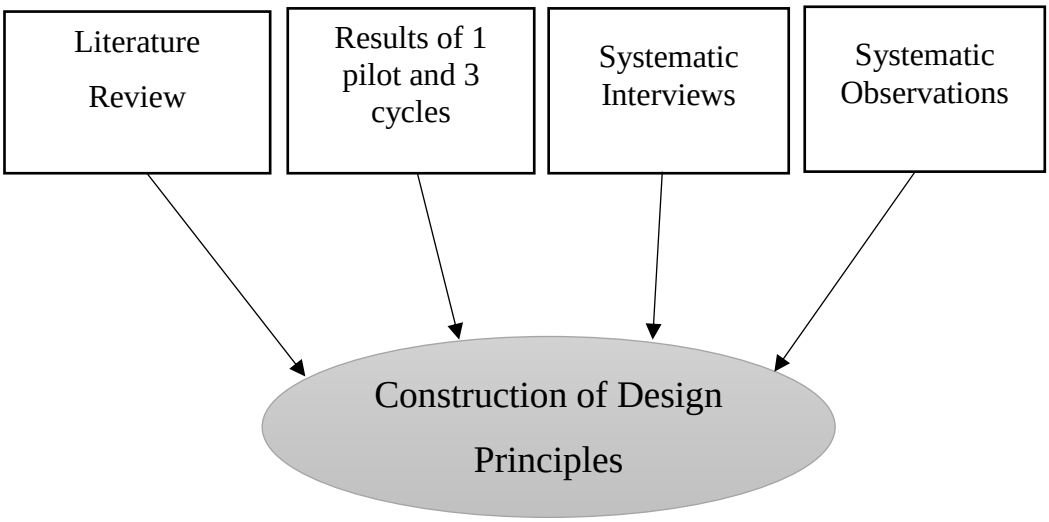

Figure 5.1 Construction of Design Principles for the Current Study

The design principles were presented under content-related principles, instructional design principles, auditory feedback principles and accessibility principles headings.

Content-Related Principles

- Providing accessible content should be the main purpose of the instructional program.
- Content should be attractively presented considering the characteristics and individual needs of VI learners.
- Content should include different levels of difficulty and challenge students in order to maintain their attention.
- Content should be presented with activities that overlap with the learners' and should not cause cognitive overload.
- Content should be presented with clear and understandable instructions considering the characteristics of VI learners in order to prevent confusion and enable them to be successful.

- Activities should have a competitive nature that triggers the motivation of VI learners.
- Considering the individual differences between students, content should provide preferable features in order not to lose learners' attention.
- Scenario-based games and content are good motivators for VI students; therefore, scenario-based tasks should be incorporated into the instructional process.
- Basic level simple games without visual clues can only be designed by integrating stories.
- Considering the barriers that VI students face in their traditional education, instructional program design should provide features that enable VI learners to study in a time efficient manner.
- Providing content with similar activities in different contexts may result in increased success.
- Integrating direct instruction in web-based learning environments for teaching VI students may be an efficient teaching strategy.
- Providing VI students with scores during all sections is a key factor in improving their motivation and gaining attention.
- The program should have features that allow VI learners to follow their own performance in order to figure out how they are progressing in learning the relative skills.
- The capacity of content features to motivate students and focus their attention with repetitiveness, practicality, increasing challenge, auditory input and feedback may positively affect the acquisition and maintenance of skills.
- Any intervention to teach skills to VI learners should include activities of varying level of structure.
- Content should include frequent assessment activities in order for VI students to self-evaluate.
- Personalized description of components may increase VI learners' sense of belonging.

- VI learners should be provided with a practical environment that enables them to practice with the content in order to compensate for their lack of vision.
- VI learners should be able to experience repetition in a variety of ways.

Instructional Design Principles

- Instructional design targeting VI learners should provide users with individualized instruction and a flexible environment.
- An instructional design should allow VI learners to access non-visual elements through a simple interface.
- Instructional design should provide opportunities to VI learners for self-paced learning.
- Instructional design should give users control over pacing and instruction.

Auditory Feedback Principles

- Auditory feedback plays a major role in the education of VI learners. The system design and structure should be based on auditory feedback and guidance.
- Auditory feedback should be given based on the users' correct and incorrect answers.
- Encouraging auditory feedback should inform students about their answers.
- Distinguishing auditory sounds can be effective in informing students about their performance and also motivate them.
- Despite screen readers, instructional programs should also provide auditory input for the critical parts.

Accessibility Principles

In terms of accessibility, principles provided by WWW were ensured during the study and confirmed by the users' experiences. The main points to be emphasized in terms accessibility are:

- Navigation parts, menus and other components should be designed and replaced based on the VI learners' characteristics.
- Providing an accessible and usable environment is crucial.
- Navigation should be designed to allow learners, especially students with low-level computer skills, control the webpage easily and without difficulty.

5.4 Implications of the Findings

In order to address the needs of the visually impaired target group, assistive technologies offer great opportunities for practitioners and researchers.

This study focused on the design principles of web-based environments and the contribution of the study on student success. The main issue that should be emphasized in the design process of an educational program is that it is necessary to gather the ideas of all stakeholders like teachers, researchers and also the target group. In order to design and develop the most appropriate educational program, opinions and the feedback of teachers and students should be gathered throughout the process, from the analysis stage right through to evaluation. Involving users in the design process ensures the solution is fit for purpose and therefore fit for them. Several iterations for improving the design and gathering data from stakeholders brings the designers one step closer to a better designed and more appropriate program. Based on the findings of the study, the main impact of the study is that designing the most appropriate web-based drill program for VI learners with valuable educational basics may have the power to teach specific content within a practical, enjoyable and accessible platform. Additional conclusions that are drawn from the findings are:

- Web-based instructional programs can be incorporated into the education of VI learners as an assistive technology for the teaching of spelling and semantics. Schools that have computer laboratories and a reliable Internet connection can particularly benefit from this program. Since the program ensures accessibility and practicality, it would also be an effective program for teachers to save time in their class.

- VI learners who want to improve their spelling and semantics knowledge of the English language can benefit from this program since it is accessible via the Internet. The structure of the program is designed for individual use, and does not necessitate the help of anyone to assist.
- This web-based program has similar affordances to other assistive technologies. Especially in terms of facilitating learning progress, practicality of the program is of the utmost importance since it ensures that the program is capable of meeting the demands of the target group. For this purpose, the target group can benefit from the program in order to undertake the required additional practice they are unable to achieve in the traditional classroom environment.
- The tracking progress feature of the program ensures that students can determine their level of success they want to achieve. This additional awareness may increase the chance that students stick to their learning goals and encourage themselves to be more successful. The other possibility is that if students can figure out they are successful, this feature can be a good motivator for them.
- Individualized instruction, which is one of the affordances of the program, might enable students to master the required skills since the content is provided in a meaningful manner. As a result, this may increase the students' achievement and motivation, even for students with a normally low rate of success.
- Incorporating Rosenshine's explicit teaching model into assistive technologies ensures effective content presentation which, as a result, increases the students' enjoyment and competence in vocabulary and retention.
- Exposing VI learners to target vocabulary with different types of challenging and repetitive activities contributes to long-term retention.
- Engagement of students can be increased and maintained through the delivery of effective and structured content presentation that focuses on VI learners' special needs and individual characteristics.
- Ensuring students learn at their own pace is critical, especially in VI education.

- For teaching VI students spelling in English it is necessary to teach them the English alphabet effectively. If not, this might decrease student success and motivation.
- Scenario-based games in computerized environments can be incorporated in EFL education of VI learners which ensures students' have an enjoyable time whilst learning. However, the critical issue in designing scenario-based games for VI students is that basic game environments should be created with simple stories, but without the usual visual clues.
- The primary output mode of all assistive technologies for VI should be auditory, but still able to teach spelling and orthography.
- It is important to involve users in the design process to ensure that the solution is fit for their purpose.
- VI students, especially those with low-level computer literacy in terms of keyboard usage and shortcut knowledge in screen reader usage, should increase their computer literacy before using the program.

The following part summarizes the implications for practitioners.

5.4.1 Implications for Practitioners

The results and design principles defined in this study may help practitioners who aim to design and develop web-based educational platforms for VI learners. Based on the previously mentioned design principles, the following steps can be considered as a guide by practitioners:

Analysis Phase:

Purpose: Define real-world problem and the scope of the study

- Conduct a literature review
- Conduct needs analysis
- Conduct content analysis
- Conduct context analysis

Design and Development Phase:

Purpose: Develop solutions for the real-world problem

- Determine content and task structures
- Determine the technological solution, tools and materials
- Determine specific methods
- Frame guiding questions
- Determine basic strategies
- Determine research setting
- Draft a planning manuscript
- Determine preliminary principles
- Develop the initial version of the program
- Conduct discursive practices with teachers and other experts in the field

Implementation Phase

Purpose: Conduct iterative cycles until finding the most appropriate program.

- Conduct a pilot study with the initial program in order to test design intentions in terms of accessibility, feasibility, and accuracy.
    - Ensure target participants use the program
    - Learn all participants' considerations
    - Conduct discursive practices with teachers and other experts in the field
    - Explore whether or not the program can reach the ideals
    - Explore whether or not there are conflicts during implementation
    - Collect and analyze data, then analyze the results
    - Measure potential effectiveness and impact of the program
    - Develop a second version of the program
- Conduct a first implementation with the second version of the program in order to test the design intentions in terms of accessibility, feasibility, and accuracy.
    - Conduct the same steps in a pilot study
    - Make a decision whether or not to conduct more implementations

- If you decide not to conduct another cycle, develop the final version of the program.

Evaluation Phase:

Purpose: Make a reflective assessment to produce design principles

- Collect data about the final version of the program and analyze the data
- Finalize the design principles

5.5 Recommendations for Future Research

On the basis of the findings, conclusions, and implications, the following recommendations are suggested for future studies. As with any study, replication would further enhance the results.

- The main purpose of the study was to constitute the design principles of the web-based drill program. In further studies, the design principles should be tested through replications of the findings in various contexts in order to determine whether or not the same results will occur.
- This study concentrated on the teaching of vocabulary in terms of spelling and semantics. The web-based drill program developed in this study can be utilized in teaching orthography, phonology, semantics and syntax simultaneously. Trying to teach all aspects of vocabulary learning can be studied and the contribution of the program can be further examined.
- This study investigated the contribution of the program by implementing repetitive vocabulary tests. Further studies can replicate the vocabulary tests which will provide more evidence-based practice.
- Further research is needed to investigate the effect of tracking students' own progress on achievement. Experimental studies can be conducted by comparing face-to-face class and computer-based environments in terms of self-tracking progress.

- Further research can be conducted in order to investigate the usability and accessibility of the program by implementing relative tests.
- As this study mostly focused on vocabulary teaching, further studies can be conducted with different purposes. For example, grammar and sentence structure.
- Similar studies can be conducted with different age groups such as with primary or high school students.
- One limitation of this study was the Internet dependency. Hence, future studies should concentrate on developing mobile applications that supported by operating systems without Internet dependence.
- Future studies are needed in order to investigate the effect of games that can be played with two participants. VI students' motivation, attitude and achievement throughout the process can be better studied in comparative games.

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APPENDIX A

IBR APPROVAL FROM MIDDLE EAST TECHNICAL UNIVERSITY

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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12 Haziran 2015

Gönderilen : Prof.Dr. Soner Yıldırım
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 doktora öğrencisi Tuğba Kamalı Arslantaş'ın "**Görme Engelli Öğrencilerin İngilizce Dil Eğitimine Yönelik Web Uygulaması Tasarımı ve Geliştirilmesi: Doğrudan Anlatım Modeli**" isimli araştırması "İnsan Araştırmaları Komitesi" tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı

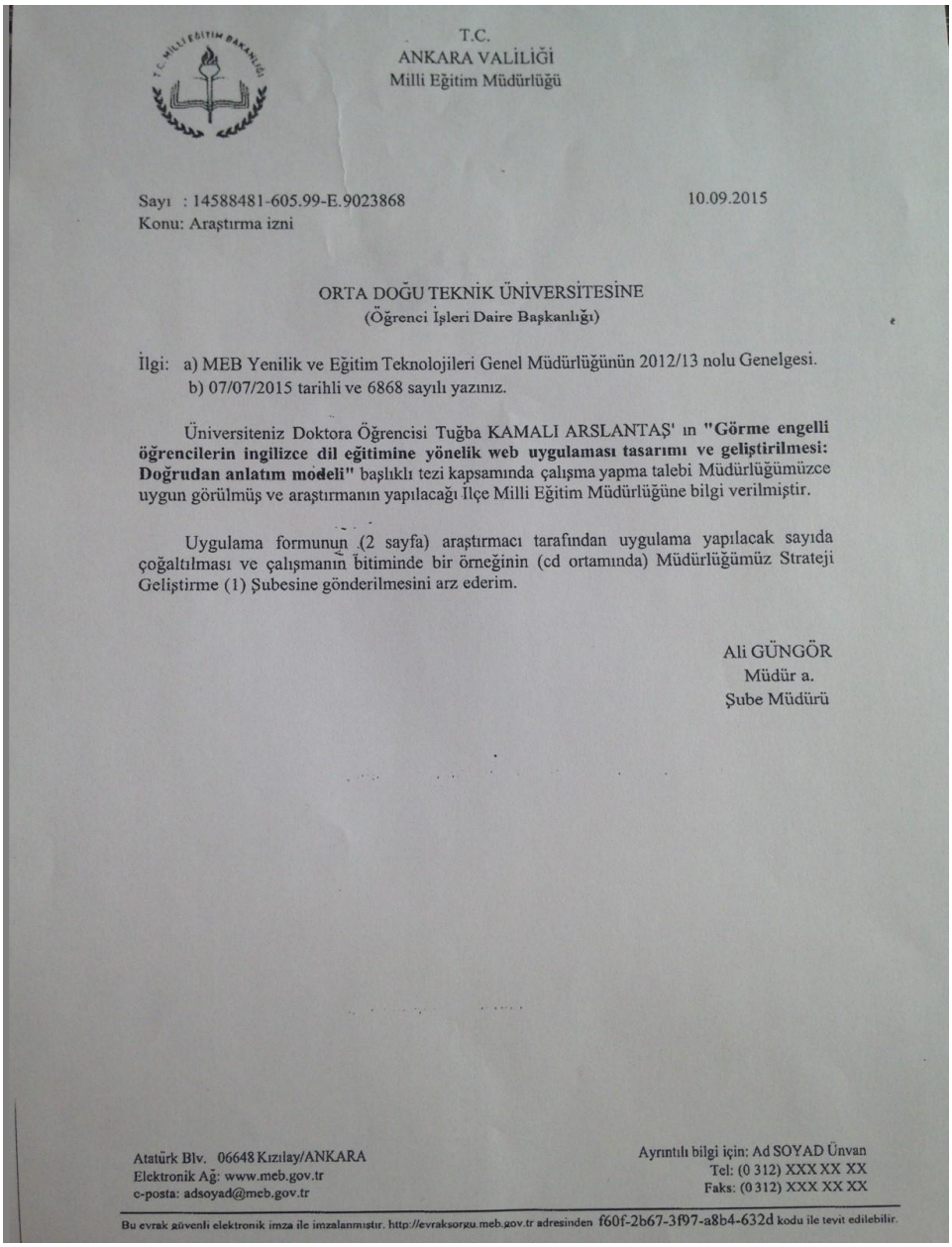
Uygundur

12/06/2015

Prof.Dr. Canan Sümer
Uygulamalı Etik Araştırma Merkezi
(UEAM) Başkan Vekili
ODTÜ 06800 ANKARA

APPENDIX B

APPROVAL FROM MINISTRY OF EDUCATION IN TURKEY



T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

Sayı : 14588481-605.99-E.9023868 10.09.2015
Konu: Araştırma izni

ORTA DOĞU TEKNİK ÜNİVERSİTESİNE
(Öğrenci İşleri Daire Başkanlığı)

İlgi: a) MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2012/13 nolu Genelgesi.
b) 07/07/2015 tarihli ve 6868 sayılı yazınız.

Üniversiteniz Doktora Öğrencisi Tuğba KAMALI ARSLANTAŞ' ın **"Görme engelli öğrencilerin ingilizce dil eğitimine yönelik web uygulaması tasarımı ve geliştirilmesi: Doğrudan anlatım modeli"** başlıklı tezi kapsamında çalışma yapma talebi Müdürlüğümüzce uygun görülmüş ve araştırmanın yapılacağı İlçe Milli Eğitim Müdürlüğüne bilgi verilmiştir.

Uygulama formunun (2 sayfa) araştırmacı tarafından uygulama yapılacak sayıda çoğaltılması ve çalışmanın bitiminde bir örneğinin (cd ortamında) Müdürlüğümüz Strateji Geliştirme (1) Şubesine gönderilmesini arz ederim.

Ali GÜNGÖR
Müdür a.
Şube Müdürü

Atatürk Blv. 06648 Kızılay/ANKARA
Elektronik Ağ: www.meb.gov.tr
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Ayrıntılı bilgi için: Ad SOYAD Ünvan
Tel: (0 312) XXX XX XX
Faks: (0 312) XXX XX XX

Bu evrak güvenli elektronik imza ile imzalanmıştır. http://evraksorgu.meb.gov.tr adresinden f60f-2b67-3f97-a8b4-632d kodu ile teyit edilebilir.

APPENDIX C

DEMOGRAPHICS QUESTIONNAIRE

DEMOGRAFİK BİLGİ FORMU

ADINIZ: .....

SOYADINIZ: .....

OKUL NUMARANIZ: ……...

1. Görme kaybınızın derecesi nedir?

2. İngilizce seviyeniz ne düzeydedir?

   a. Başlangıç
   b. Orta Düzey
   c. İleri Düzey

3. İngilizce:

   a. Çok zor bir dildir
   b. Zor bir dildir
   c. Orta zorlukta bir dildir
   d. Kolay bir dildir
   e. Çok kolay bir dildir

4. İngilizce öğrenirken en çok hangi alanda veya alanlarda problem yaşıyorsunuz?

a. Konuşma
b. Yazma
c. Okuma
d. Dinleme

5. Yaşadığınız bu problemlerin çözümü için ne tür teknolojilere ihtiyaç duyuyorsunuz?

6. İngilizce kelimeleri doğru yazmakta problem yaşıyor musunuz?

a. Evet
b. Hayır

7. Öğrendiğiniz yabancı dil kelimelerinin yaklaşık ne kadarının yazımını dogru biliyorsunuz?

8. İngilizce kelimelerin yazılışını nasıl öğreniyorsunuz? (Teknoloji yardımıyla, bireysel olarak?).

9. İngilizce kelimelerin yazımını öğreten ne tür teknolojiler önerirsiniz?

10. MEB İngilizce kitapları görme engellilere uygun mu?

a. Evet
b. Hayır

11. MEB İngilizce kitabı hakkındaki görüşlerin nelerdir?

APPENDIX D

INTERVIEW PROTOCOL FOR STUDENTS

ÖĞRENCİ GÖRÜŞME FORMU

BİRİNCİ BÖLÜM (PROGRAMIN GELİŞTİRİLMESİNE YÖNELİK SORULAR)

1. Programı kullanırken erişim sorunu yaşadın mı? Evet ise ne tür sorunlarla karşılaştın?
2. Programı kullanırken yaşadığın tecrübeleri açıklar mısın?
   a. Menüler arası geçiş sence nasıldı?
   b. Web sitesinde gezinirken zorluk çektiğin bölümler var mı?
   c. Ekran okuyucuyla beraber sistem kullanımı nasıldı?
   d. Kullanmada zorluk yaşadığın bölüm var mı? (kelime öğreniyorum, Pratik ..)
3. Her bölüm girişlerindeki açıklamalar hakkındaki görüşlerin nelerdir?
   a. Programı kolay bir şekilde kullanmanı sağladı mı?
   b. Yönlendirmeler anlaşılır mıydı?
   c. Yönlendirmeler sistemi kolay kullanmanı sağladı mı?
   d. Eksik yönlendirmeler var mı? Varsa nelerdir?
4. Programın hangi yönlerinin değiştirilmesi veya geliştirilmesi gerektiğini düşünüyorsun? Nedenleri ile birlikte açıklar mısın?
   a. Program tasarımının geliştirilmesi konusunda tavsiyelerin nelerdir?
   b. Her ünitede verilen kelime sayısı hakkında ne düşünüyorsun?
5. Programda verilen sesli geribildirimler hakkındaki görüşlerin nelerdir? (tebrikler doğru bildin...)
   a. Seslendirmelerde rahatsız edici unsur var mıydı?

b. Farklı sesler eklenmesini ister misin?
c. Geribildirimler motivasyonunu nasıl etkiledi?

6. Programdaki kelime öğreniyorum bölümüne yönelik görüşlerin nelerdir?
   a. İngilizce kelime öğrenmene yeterli katkıyı sağlıyor mu? Neden, açıklar mısın?
   b. Kelime öğreniyorum bölümünü kolaylıkla kullanabildin mi?
   c. Kelime öğreniyorum bölümünün geliştirilmesi için önerilerin nelerdir?
7. Programdaki pratik bölümüne yönelik görüşlerin nelerdir?
   a. İngilizce kelime öğrenmene ne tür katkı sağlıyor?
   b. Pratik bölümünde kelimelerin 10 kez girilmesi hakkında ne düşünüyorsun?
   c. Pratik bölümünün geliştirilmesi için önerilerin nelerdir?
8. Programdaki oyun bölümüne yönelik görüşlerin nelerdir?
   a. Oyun bölümü öğrendiğin İngilizce sözcüklerle ilgili yeterli düzeyde pratik yapmanı sağlıyor mu?
   b. Oyun bölümünün eğitsel olarak sana faydası olabileceğini düşünüyor musun?
   c. Oyunda puan ve seviyelerdeki verilen süreler hakkında ne düşünüyorsun?
   d. Oyun bölümünün geliştirilmesi için önerilerin nelerdir?

İKİNCİ BÖLÜM: SOSYAL GEÇERLİK SORULARI

9. Kulladığın program hakkındaki genel görüşlerin nelerdir?
   a. Olumlu, neden, açıklar mısın?
   b. Olumsuz, neden, açıklar mısın?
10. Programın İngilizce öğrenme konusunda ne gibi etkileri oldu?
   a. Olumlu, neden, açıklar mısın?
   b. Olumsuz, neden, açıklar mısın?
11. Programın İngilizce öğrenmeye yönelik motivasyonuna etkileri nelerdir?
12. Programı ilerleyen yıllarda kullanmayı düşünüyor musun?

APPENDIX E

INTERVIEW PROTOCOL FOR EXPERTS

ÖĞRETMEN GÖRÜŞME FORMU

1. Yabancı dil eğitiminde görme engelliler gören bireylere göre daha fazla problem yaşıyor mu?
    a. Neden, açıklar mısınız?
2. Eğer görme engellilerin dil eğitiminde problem yaşadığını düşünüyorsanız, problemleri gidermede sizce eknolojinin rolü nedir?
3. Sizce Görme Engellilerin dil eğitimine yönelik ne tür teknolojik çözümler olabilir?
4. Yabancı dil öğrenme becerilerinden (okuma, yazma, konuşma, dinleme) en çok hangisinde görme engelli öğrenciler problem yaşıyor?
5. MEB İngilizce kitapları hakkında ne düşünüyorsunuz?
6. Bu program hedef kitlenin ihtiyaç ve beklentileri doğrultusunda eğitsel olarak ne tür fayda sağlayabilir?
7. Programın geliştirilmesine yönelik önerileriniz neler olabilir?
8. Programı erişilebilirlik açısından nasıl değerlendirirsiniz? Geliştirilmesi gereken yönler sizce nelerdir?
9. Programdaki yönlendirmeler ve bölüm girişlerindeki açıklamalar hakkında ne düşünüyorsunuz? Önerileriniz nelerdir?
10. Kelime Öğreniyorum bölümü hakkında genel görüşleriniz nelerdir? Geliştirilmesi gereken yönler sizce nelerdir?

11. Pratik bölümü hakkında genel görüşleriniz nelerdir? Geliştirilmesi gereken yönler sizce nelerdir?
12. Oyun bölümü hakkında genel görüşleriniz nelerdir? Geliştirilmesi gereken yönler sizce nelerdir?
13. Sizce programa eklenmesi gereken başka bölümler var mı?
14. Yüz yüze derslerinizde yürütülen bu çalışmanın etkilerini gözlemlediniz mi? Eğer cevabınız evet ise bu gözlemleriniz nelerdir?
15. Program hakkındaki genel görüşleriniz nelerdir?
    a. Olumlu, neden, açıklar mısınız?
    b. Olumsuz, neden, açıklar mısınız?

APPENDIX F

INTERVIEW PROTOCOL FOR FAMILIES

AİLE GÖRÜŞME FORMU

1. Program hakkında neler biliyorsunuz, kısaca açıklar mısınız?
2. Program hakkındaki genel görüşleriniz/izlenimleriniz nelerdir?
    a. Olumlu, neden, açıklar mısınız?
    b. Olumsuz, neden, açıklar mısınız?
3. Çocuğunuz evde program hakkında sizinle konuşuyor mu? Evet ise nelerden bahsediyor?
4. Çocuğunuzun bu program sürecinde edindiği tecrübelere yönelik izlenimleriniz nelerdir?
    a. Çocuğunuz İngilizce öğrenmeye yönelik tutumunda değişiklik gözlemlediniz mi?
    b. Programın çocuğunuza katkısını gözlemlediniz mi?
    c. Program sürecinde çocuğunuzun nasıl vakit geçirdiğini düşünüyorsunuz?
5. Edindiğiniz tecrübe ve izlenimlere dayanarak, program ile ilgili önerileriniz nelerdir?

APPENDIX G

OBSERVATION FORM 1

Okul: **Öğrenci Sayısı:**

Gözlemci: **Tarih-Saat:**

Ders hakkında genel bir açıklama:	
Eğitsel İçerik: *(Kelime Sayısı, Kelime Seviyesi, Öğrencilere Uygunluğu…)*	
Tasarım: *(Tasarımsal Öneriler, Yaşanan Olumsuzluklar, Eksiklikler…)*	
Erişilebilirlik: *(Öğrenciler programı kullanabiliyor mu?, Erişimsel aksaklıklar var mı? Ekran okuyucuyla uyumlu çalışıyor mu?Öneriler…)*	
Geribildirim:	

(Sesli geribildirimler yeterli mi?, Eksiklikler, Öneriler…)	
Öğrenci Tecrübeleri: *(Öğrenciler odaklanabiliyor mu?, Eğleniyor mu?*	

APPENDIX H

OBSERVATION FORM 2

Date:

STEPS	**YES / NO**

1. Review relevant previous learning
2. State lesson goals
3. Teach in small steps
4. Use clear language
5. Check for student understanding
6. Avoid digressions
7. Guided practice
8. All students respond and receive feedback
9. High success rates
10. Continue practice until students are fluid
11. Give process feedback
12. Give sustaining feedback
13. Independent practice
14. Weekly and monthly review

CURRICULUM VITAE

PERSONAL INFORMATION

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EDUCATION

Degree	Institution	Year of Graduation
MS	M.E.T.U, Computer Education and Instructional Technology	2012
BS	M.E.T.U, Computer Education and Instructional Technology	2009

WORK EXPERIENCE

Year	Place	Enrollment
February– July 2017	University of Florida, USA, Educational Technology	Visiting Scholar
August 2011-	M.E.T.U, Computer Education and Instructional Technology Department	Research Assistant
2010-2011	Enocta, Ankara	Instructional Designer
2006-2008	M.E.T.U, Computer Education and Instructional Technology Department	Technical Support Assistant, Part-time

ACADEMIC STUDIES

1. Kamali, T, & Cevizci, E, & Leymun, C, & Tokel, T (2011). 3D Learning Environment for "Conscious Individuals & Livable Environment" For Elementary Students. Proceedings of 5th ICITS 2011Conference, 8-13 September 2011, Elazig, Turkey.

2. Kamali, T. (2012). The Effects of Task-Based Language Learning In Second Life on Students' Anxiety, Motivation and Self-Confidence in Speaking English: The Case of Middle East Technical University. Master Thesis.

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8. Kamali, T., Arslan, O. & Cagiltay, K. (2014). Investigating Game Player's Flow Experiences: The Case of First Time Guitar Hero Players. In J. Viteli & M. Leikomaa (Eds.), Proceedings of EdMedia 2014--World Conference on Educational Media and Technology (pp. 2617-2624). Tampere, Finland: Association for the Advancement of Computing in Education (AACE). Retrieved August 18, 2017 from https://www.learntechlib.org/p/147850/.

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13. Türkmen, G., Kamalı Arlantaş, T., Uzunosmanoğlu, S. D., & Arslan, O., (2016). Formation of Academic Research and Writing Group: A Design Based Research Approach. Paper presented at ICITS 2016, Rize, Turkey.

14. Kamali Arslantas, T., Yildirim, S., & Arslantekin, B., (2017). The Design and Implementation of a Web-Based Vocabulary Instruction for Visually Impaired Students: Direct-Instruction Approach. Paper presented at AERA 2017, Texas, USA.