SMART TOYS IN TEACHING OF SOCIAL STUDIES CONCEPTS TO CHILDREN WITH INTELLECTUAL DISABILITY

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ABSTRACT

SMART TOYS IN TEACHING OF SOCIAL STUDIES CONCEPTS TO CHILDREN WITH INTELLECTUAL DISABILITY

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In Turkey and all around the world, technology-supported learning environments for children with intellectual disability (ID) have not yet reached to a desired point and there are limited studies that investigate the effectiveness of advanced technologies in teaching social studies concepts to children with ID. For this purpose, the current study aims to investigate the effectiveness of smart toys in teaching social studies concepts to children with ID. The mentioned smart toys/technology enhanced learning environments were developed in the scope of this study. A multi-method research design was used to determine whether this study has a positive effect on teaching social studies concepts to children with ID. In addition, children' motivation were analyzed together with the usability of (effective, efficient and satisfactory) the technology from teachers' point of view. Six individuals with IDs and four special education teachers formed the participants of the study. To be eligible for participation, individuals were expected to meet some requirements such as the ability to follow simple verbal instructions. Semi structured interviews were conducted with special education teachers to understand their opinions about the smart toy. Four kinds of data were collected, namely effectiveness, reliability, social validity, and usability. According to the results of the analysis of effectiveness data, smart toys have a positive effect in teaching social studies concepts to children with ID. Also, interview results revealed that, smart toys increased student motivation, and that smart toy technology developed in this study was effective, efficient, and satisfactory.

Keywords: Smart Toys, Special Education, Play, Individuals with Intellectual disability, Single-Subject Design

ÖZ

ZİHİNSEL ENGELLİ ÇOCUKLARA HAYAT BİLGİSİ KAVRAMLARININ ÖĞRETİMİNDE AKILLI OYUNCAKLAR

Ekin, Cansu Çiğdem
Doktora, Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü
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Türkiye'de ve tüm dünyada, zihinsel engelli çocuklar için teknoloji ile zenginleştirilmiş öğrenme ortamları henüz istenilen noktaya ulaşmamıştır. Zihinsel engelli çocuklara hayat bilgisi kavramlarının öğretilmesinde ileri teknolojilerin etkinliğini araştıran sınırlı sayıda çalışma bulunmaktadır. Bu nedenle, bu çalışma, zihinsel engelli öğrencilere hayat bilgisi kavramlarını öğretmede akıllı oyuncakların etkinliğini araştırmayı amaçlamaktadır. Bahsedilen akıllı oyuncaklar / teknoloji zenginleştirilmiş öğrenme ortamları bu çalışma kapsamında geliştirilmiştir. Bu çalışmanın zihinsel engelli çocuklara hayat bilgisi kavramlarının öğretilmesinde olumlu bir etkisinin olup olmadığını belirlemek için çoklu yöntem araştırma tasarımı kullanılmıştır. Ayrıca, öğrenci motivasyonu ve akıllı oyuncak teknolojisinin kullanılabirliği (etkililik, verimlilik ve memnuniyet) öğretmen görüşleri incelenerek analiz edilmiştir. Araştırmanın çalışma grubu zihinsel engelli altı kişi ve dört özel eğitim öğretmeninden oluşmuştur. Katılımcı olabilmek için bireylerin basit sözel yönergeleri takip edebilme gibi bazı önkoşul becerileri sağlamaları beklenmiştir. Özel eğitim öğretmenlerinin akıllı oyuncak hakkındaki görüşlerini anlamak için yarı yapılandırılmış mülakat tekniği kullanılmıştır. Etkililik, güvenilirlik, sosyal geçerlilik ve kullanılabirlik olmak üzere dört çeşit veri toplanmıştır. Etkililik verisinin analiz sonuçlarına göre, akıllı oyuncaklar hayat bilgisi kavramlarını zihinsel engelli çocuklara öğretmek konusunda pozitif bir etkiye sahiptir. Ayrıca, mülakat sonuçları akıllı oyuncakların öğrencinin motivasyonunu artırdığını ortaya çıkarmıştır. Çalışmada kullanılabilirlik sonuçları ise akıllı oyuncak teknolojisinin etkili, verimli ve tatmin edici olduğunu göstermiştir.

Anahtar Kelimeler: Akıllı Oyuncaklar, Özel Eğitim, Oyun, Zihinsel Engelli Bireyler, Tek-Denekli Tasarım

To My Parents

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TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

ICT	Information and Communication Technology
IT	Instructional Technology
ICT	Information and Communication Technology
ID	Intellectual Disability
RFID	Radio Frequency Identification
TÜBİTAK	The Scientific and Technological Research Council of Turkey
OZTEK	Investigation of the Teaching Process of Basic Essential and Cognitive Concepts to Special Education Students and Its Effectiveness Using Technology Enhanced Learning Environments
METU	Middle East Technical University
TIA	Toy Industry Association
BFF	Baseline and Follow-up Sessions Data Collection Form
IF	Intervention Sessions Data Collection Form

CHAPTER 1

INTRODUCTION

This chapter presents the background, and the statement of the problem, the purpose of the study, its significance, and the research questions of the study.

1.1 Background of the Problem

Impact of technology used in education of individuals having IDs has been identified in several studies. As Davies, Stock, and Wehmeyer (2004) emphasized, large number of individuals with IDs can benefit from technology very effectively by means of educational development, personal development and increased productivity. Ryndak and his colleagues (2008), draw attention to the positive developments about technology integration to curriculums of special education of United States of America to create less restrictive environment in education of disabled individuals. Similarly, literature provides evidence about some technologies that support and facilitate learning of children with disabilities (Adam & Tatnall, 2017; Alper & Raharinirina, 2006; Hasselbring & Glaser, 2000; Williams, 2005).

Play has a significant role in mental and social development of children. (Ariel, 2002; Lindon, 2001; Vygotsky, 1967) and toys are indispensable play tools. The literature provides evidence about toys' positive contribution to the social, physical, language, and cognitive development of children (Bradley, 1985; Nuzzolo-Gomez et al, 2002; Sridhar, Nanayakkara & Huber, 2017; Toth, 2006). Smart toys are a technological form of physical toys and have a great potential for individuals who are in need of special education to improve their cognitive and social skills (Kara, 2015; Yeni, 2015).

Although literature pays attention to the positive effects of using technology in education of individuals with IDs, there are a limited number of studies as to integrating new educational technologies or technology enhanced learning environments into special education settings. Similarly, Wehmeyer (2006) emphasized the necessity of educational technology use and individualized educational programs for those individuals. However, in Turkey, there is also a lack of technological materials prepared for special education. This is one of the problems that this study focuses on. Therefore, this study aims to design and develop a new technology based smart toy and examine the effectiveness of it for special education.

Usability of technology is also so critical that it affects the quality attributes of the developed system such as learnability, satisfaction, efficiency, and memorability. Designing technology that is accessible and more usable to individuals with disabilities can eliminate barriers that faced by them. Although literature provided a great number of studies related with use of technology to support individuals with all kinds of disabilities, there has been still a lack of research regarding usability of the technologies developed for intellectual disability compared with the other groups of disabled people. (Harrysson, 2003; Rocha et al. 2017; Williams et al., 2006). Most of the usability studies dealt with for visual disabilities (Mirchandani, 2003; Williams et al., 2006). Therefore, this study analyses usability of the developed technology enhanced learning material, which is a smart toy for children with ID.

1.2 Statement of the Problem

Despite the fact that, the experts have increased the number of special education services for individuals with IDs in recent years, they couldn't have achieved to make the offering effective training services and the use of innovative instructional materials reach to the intended rate yet (Altinay et al., 2016; Williams, 2005). For this reason, quality of the present state of education offered to disabled children is questionable. There are a limited number of studies that investigate effectiveness of technology enhanced learning environment including smart toys on teaching social studies concepts to children with ID. Therefore, there is a need to determine the effectiveness of using technology enhanced learning environments on teaching mentioned concepts and motivation of children with ID.

The second problem is related to the lack of usable and well-designed technology enhanced instructional material for children with ID (Altinay et al., 2016; Carey et al., 2005; Williams, 2005). Literature has several smart toy projects, but a limited number of them are educational and developmental (Kara et al., 2013; Kara, 2015; Lampe&Hinske, 2007). While technology-enhanced education has successful results in literature for special individuals, the number of developed technology enhanced instructional materials for them are limited.

The third problem is about teachers' views towards the educational use of smart toys. Especially in Turkey, there is no study related with the educational use of smart toys in special education. This research also aims to understand the views of special education teachers in Turkey towards the educational use of smart toys.

1.3 Purpose of the Study

The main purpose of this study is produce key design principles about how to best integrate smart toys into special education settings. The other important goal of this study is to investigate the effectiveness of smart toys on teaching social studies concepts and to determine if there is a positive impact on motivation of children with ID. In the study, an educational smart toy system aiming to teach social studies concepts to individuals with IDs was developed and used. Finally, usability issues of the smart toy are examined in terms of effectiveness, efficiency, and satisfaction from special education teachers' point of view.

1.4 Significance of the Study

In terms of child development, toys have great importance in supporting learning, cognitive development, enhancing their imagination, and affecting their behaviors (Butterworth, 2014; Kara et al., 2014a; Kara et al., 2014b). With the development of technology, computer mediated or interactive toys called ‘smart toys’ increased their popularity (TIA, 2015). These technological toys integrate the physical and virtual worlds by providing support to multimedia content. Smart toys have more advantages compare to traditional toys by enriching play activity providing with a more creative and interactive environment (Kara et al., 2014b). In addition to these advantages, smart toys can be used for educational purpose. However, the number of educational interactive smart toys developed for special education field is limited (Patrizia et al., 2009; Prazak et al., 2004). For this reason, a smart toy system was developed in the scope of this research.

Developing different instructional technologies that are usable for individuals in special education provides opportunities for them to improve their skills. However, there has been a lack of empirical data about the usability of smart toys as an instructional tool (Altinay, 2016; Plowma & Luckin, 2004). Examining the effectiveness of a smart toy will give valuable information about whether they are helpful or not for individuals in special education.

According to Malone and Lepper (1987), in designing instructional learning environments, toys have substantial potential to increase intrinsic motivation that challenge learners to use skills which they would not otherwise have wanted to use. Hence, smart toys can be beneficial in motivating children to reach specific goals. Especially, new technologies motivate children to join in learning activities (Marsh et al., 2005). Electronic toys increase motivation more than traditional toys by providing feedback and reinforcement systems (Hsieh, 2008). According to Kara (2015), “Designing plush toys according to the characteristics of child may enhance the motivation of both children and teachers to play with the smart toy" (pg.220). The findings of this research are important in terms of developing a smart toy with high usability and potential to motivate children.

In addition, technology enhanced learning environments may affect teachers' motivation in a positive way and decrease their workload, especially for teaching activities that need multiple repetitions (Yeni, 2015). Therefore, there is an apparent need for this study that aims to decrease teachers' workloads in teaching social studies concepts.

Teachers' intentions towards technology will affect their education perspective. Even if smart toys have successful empirical results for education, if the teachers do not find the developed technology useful and usable, it would be hard to utilize it in special educational setting. Therefore, it is very important to learn more such individuals' perspectives regarding smart toy technology examined in the research.

Smart toys provide an interactive learning environment in which children develop social, cognitive, and behavioral abilities (Cagiltay et al., 2014). These toys can be effective for smart toy based learning environments as cognitive tools (Kara, 2015). Therefore, this study aims to develop a new kind of smart toy that can be used in smart toy based learning environments. Educators, schools, or any educational institutions who want to use smart toys in their learning activities can benefit from the results of this research.

1.5 Research Questions

This study aims to find answers to the following research questions:

1. What are the design principles of a smart toy application for children with ID?

2. Do the smart toys have a positive impact on teaching social studies concepts to children with ID?
3. What are the teachers' opinions on the impact of smart toys on the motivation of children with ID?
4. How usable (effective, efficient and satisfactory) is the smart toys technology?

1.6 Definitions of Terms

ID (Intellectual Disability)

According to Hammill (1987), ID is described as "is a term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities"(p.1).

Child with ID:

The term "children with specific ID" refers children who have a significant disorder in the acquisition and use of language, spoken or written and have imperfect ability to listen, think, speak, or mathematical abilities" (Hammill et al., 1987).

Smart Toy

"Smart toys include tangible objects alongside electronic components that facilitate two-way child-smart toy interaction to carry out a purposeful task" (Cagiltay, Kara, & Aydin, 2014, p. 703).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter summarizes, analyzes, and synthesizes the relevant literature regarding the research questions articulated in chapter one. Firstly, definition of intellectual disability (ID) is presented. It tries synthesizing and summarizing the issues about the educational technology use for children with ID in international scope and technology use in education of children with ID in Turkey. Then, it examines smart toys as a learning technology and usability issues.

2.2 Intellectual Disability

The American Association on Intellectual and Developmental Disabilities (AAIDD) (2016) defines intellectual disability as "a disability characterized by significant limitations both in intellectual functioning and in adaptive behavior, which covers many everyday social and practical skills and originates before age eighteen." Intellectual functioning is the intellectual capacity of reasoning, learning, and problem solving. For the term 'Intellectual Disability', The World Health Organization (WHO) uses other terms such as developmental disability, mental retardation, and mental handicap.

ID has also sub-categories, differentiated by specific ranges of intelligent quotient (IQ) scores. These sub-categories include mild (IQ 50-69), moderate (IQ 35-49), severe (IQ 20-34), and profound (IQ <20) (American Psychiatric Association, 2000).

On the other hand, while fourth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-4), which is the most widely used manual by clinicians and researchers in mental disorders classification, emphasized IQ scores, these scores are not included in DSM-5. Instead of it, assessment is done based on the individual's complete clinical presentation for diagnosis (American Psychiatric Association, 2013).

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), there are three criteria for the diagnosis of intellectual disability (American Psychiatric Association, 2013). These are disorders in intellectual functions, disorders in adaptive functioning and onset of intellectual and adaptive disorders during the developmental period (before age 18). Disorders in intellectual functions cover significant limitations in practical understanding, reasoning, problem solving, and learning from experience, academic learning, abstract thinking, and judgment (AAIDD, 2010). Practical understanding is measured clinical and individualized assessment. Standardized intelligence testing is also used. Disorders in adaptive functioning cover significant limitation in conceptual (i.e. money, time, self-direction, language, and literacy), social (i.e. self-esteem, ability to obey and laws) and practical skills (i.e. personal care, professional skills, travel and money use) (AAIDD, 2010). Without support, the adaptive disorder limits daily life activities such as social participation, communication, and independent living. Standardized intelligence testing is also used to determine limitation.

2.3 Educational Technology Use for Individuals with IDs

The literature provides various educational technology examples for problems related with mental disability, academic, social skills and adaptation issues that occurs often in individuals with IDs. Computer and technology-supported education have successful results in literature in means of development of academic, social skills which often occurring as a problem also in individuals with IDs (Wehmeyer, 1998).

The technological instruments used in educational settings increase the hand-eye coordination, attention duration, and slow learners perceptions (Sahin & Cimen, 2011). In the study of Mechling, Gast, and Langone (2002), the student's ability with moderate ID to read shopping aisle signs and to locate goods in an unfamiliar store was improved via computer based video program. In another study, computer-based multimedia instruction was successful in teaching to use credit card in automatic payment machine (Mechling, Gast & Barthold, 2003b)

In the study of Sharma and her colleagues (2016), the main aim of the research was to find out the efficacy of computer-assisted instructions on the academic achievement of the intellectually disabled children. They used educational assessment checklist for children with ID to measure academic achievement of 28 children with ID. Computer assisted instruction resulted as effective on academic skills for children whereas regular classroom teaching instructions are less effective than computer assisted instruction. Similarly, Sugasawara and Yamamoto (2007) have worked on instruction of word reading and construction for individuals with IDs via computer-based program. As a result of this study, computer-based instruction affected positively the reading skills of participating children. Shelton (2016) examined effect of a treatment package consisting of computer-assisted instruction using multiple video exemplars to teach safety skills to children with ID. She evaluated knowledge acquisition and the generalization of knowledge (e.g., the school parking lot). The results showed that training was effective in knowledge acquisition and improving skills.

Some studies in the literature are about technology for the acquisition of life-skills. Renbald (1999) used advanced technologies to aid in the development of social networks of persons with learning disabilities. Rivera and his colleques (2016) examined the effects of a computer-based video intervention on teaching literacy skills to a student with ID, using Apple iBooks. Results showed that the participant can generalize image vocabulary, sight words, and vocabulary definitions through the multimedia video instruction.

In the last few years, some studies in the literature are related with advantages of AR applications and positive effects on children with special educational needs. Chang and his colleagues (2013) designed ARCoach, a marker-based AR system for vocational job skill training for individuals having cognitive disabilities. The AR system identified incorrect task and helped users make corrections by providing picture cues. The findings of the study show that participants increased success rate in the assigned tasks and maintained their skills. Similarly, the AR game developed by Lin and his colleagues (2016) developed a free interactive mobile augmented reality (AR) application. The purpose of the research was to facilitate the learning of geometry. The results show that the AR display technology improved ability to complete puzzle game tasks and enhance learning motivation of children more than traditional paper-based methods. In another study, Cifuentes and her colleagues (2016) evaluate the use of AR technology in a classroom environment. Researchers assessed its helps special-needs children to improve their performance, motivation, and other aspects of the learning process. The results show an increase in the overall academic performance.

Research reports, which are summarized above, give us important clues about education of children with ID with the use of technology and computer science and give examples related with how to be improved their academic, social skills. The use of technology in special education will gain more importance in coming years.

2.4 Educational Technology Use for Individuals with IDs in Turkey

When the studies in Turkey are compared with the studies completed abroad, national studies stay quite limited and new for individuals with IDs. Most of existing the studies is related with visual impairments. While international literature provides important clues about how effective technology and computer use are in the education of children with ID, the number of studies in national literature can be accepted as the greatest sign of such gap in our country about this issue. Some studies are presented below.

Cakmak and Cakmak (2015) analyzed teaching to people with ID the shopping skill with the iPad. Researchers developed an animation to teach independent shopping skill for iPad. Results show that shopping skill based on animation practice provided through iPad was effective.

In a TUBITAK project, which this study is also part of this project, OZTEK (2015), investigated effectiveness of learning environments that are enhanced by new technologies such as smart toys and bodily movement interactive games designed for children who have ID. OZTEK help the parents and special education teachers in terms of to provide an effective learning environment for children having ID.

Yeni (2015) examined the effectiveness of educational tablet pc applicatıons to teach daily living skills to children with ID. As a result of the study, tablet application was found effective tool to teach a daily living skill to individuals with IDs. In addition, the newly learned skill was maintained one, three and four weeks after the training and individuals could generalize the skill to different tools.

In another study, Reis and his colleagues (2010) examined effectiveness IT based exercises in mathematics teaching of children with cerebral palsy and intellectual disability. Findings show that the participants became more interested, happy, willingly to continue on working, and able to easily absorb the material through multimedia exercises.

Cimen and Sahin (2011) used a tool named "Interactive Attention Board" (IAB) for individuals with IDs and autism to improve hand-eye coordination, reaction time to stimulants and total concentration time of disabled individuals. The results showed that using IAB system provides improvements in eye coordination and attention duration of the individuals.

In conclusion, studies in literature show that people with ID benefit from computer based technologies in their education, daily life, community, and work. While designing materials for them, it should be designed to meet their needs. In special education in Turkey, there is still a gap finding appropriate learning materials, which covers subjects for disabled children due to the lack of material diversity (Dogan, 2015). New technologies may fill this gap in terms of to provide alternative ways for disabled children.

2.5 Smart Toys as a Learning Technology

Play is important in child development in terms of development of self-confidence, collaboration, expression of emotion, and taking initiative (Ariel, 2002; Lindon, 2001; Piaget, 1962; Vygotsky, 1967) and toys are indispensable play tools. They can foster children’s social, physical, language, and cognitive development. In literature, there are many experimental studies related with toys' positive contribution to the social and cognitive development of child (Bradley, 1985; Nuzzolo-Gomez et all, 2002; Toth, 2006). On the other hand, in the 2010 report UNESCO ITE (Information Technologies in Education), the significant effect of ICT tools is mentioned on communication and collaboration, creativity, such as socio-dramatic play which are the key areas of learning. Smart toys are examples of Information and Communication Technologies (ICT) for children. According to toy trends report announced by experts at the U.S. Toy Industry Association (TIA) (2015), creative toys that including innovative “smart” playthings called smart toys are among the top toy trends of 2015. In this context, information and communication technology (ICT) has a great potential to support toy based learning in playing activity (Cagiltay et al., 2014). In the most general sense, smart toys, are defined as technologically enhanced form of physical toys in a way that allow mutual interaction and encourage purposeful tasks (Cagiltay et al., 2014). the other feature that categorizes smart toys is its interaction ability. While some smart toys can interact with computers, some are self-contained (Cagiltay et al., 2014).Additionally, while classic electronic or digital toys have properties that just increase the attractiveness of toys, smart toys offer an environment in an enhanced reality (Cagiltay et al., 2013).

The play activity has a different cognitive level in children with ID who is slower than normal peers in social and cognitive development. Smilansky (1968) defines cognitive level of play activity in three stages: functional, constructive, and dramatic. A majority of children with ID play toys in lower cognitive level than normal peers (Hsieh, 2008). This difference causes also different playing activity in child with ID. It is mostly observed that these children play with toys inappropriate way. Children with ID generally show aimless behavior like throwing, rotating and holding when she gets toy into the hands. These poor gaming skills are seen in many children with ID because of a lack of social skills and creativity (Kim et al., 2003). Therefore, toy preference for instructional purpose has importance for children with ID who have insufficient playing skills. With the rapid development of technology, technology-based toys are among most preferred and widespread in the toy industry. Technology supported toys also may have a positive effect on child with ID who have insufficient playing skills. Hsieh (2008) reports toys enhanced with electronic equipment increase motivation by providing the feedback and reinforcement system in child having ID. He found adapted electronic toys increased percentage of correct responses of children having ID more than traditional toys.

2.6 Usability

According to statistical data of Turkish Statistical Institute (2002), number of disabled person in Turkey is 12.29 % of total population. In the world, 15% of total world population has some forms of disability according to the report of World Health Organization (2011). They face many barriers that normal individuals do not have while accessing and using a technology or a product. Therefore, it is important that new technology has to be designed considering limitation and needs of individuals, so that as many people as possible can use it. In this sense, usability study of designed system or technology has critical importance to produce well, specially designed usable materials for people with disabilities. Therefore, as the success and the rate of usability studies increased, number of disabled person that are independent, productive, participating education will also increase.

A well-known definition of usability stated by International Organization for standardization is that "usability is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO 9241-11, 1998).

Usability has five quality components; *learnability*, *efficiency*, *memorability*, *errors* and *satisfaction* (Nielsen, 1993). *Learnability* refers to easiness of the system to learn. *Efficiency* is defined as "once the user has learned the system, a high level of productivity is possible" (Nielsen, 1993, p. 26). M*emorability* shows easiness of the system to remember. According to Nielsen (1993), errors can be fixed few and easily repairable. S*atisfaction* measures the user's perception of ease of use of the system (Nielsen, 1993). Usability testing, on the other hand, refers to evaluating the system by testing it with representative users. Usability testing includes representative users of the system as testers to evaluate specific tasks determined before the testing (Nielsen, 1993).

2.6.1 Usability Evaluation Methods

Usability evaluation provides information about how people use a system, product, or anything and what their problems are with the interface being tested. There are several usability evaluation methods generally based on two categories: usability testing and usability inspection methods (Holzinger, 2005). Usability testing is commonly known as user based testing that the user of system is observed while using the system or product by the usability practioner. It includes methods such as think aloud, user testing, questionnaire, performance measurements and survey. Unlike usability testing methods, usability inspection methods are based on evaluators (experts or designer) that inspect the interface and find usability problems on a design (Nielsen, 1994). This category includes methods such as heuristics, cognitive walkthrough, and pluralistic walkthrough. In this research, heuristic evaluation and performance measures are used and presented below.

2.6.1.1 Heuristic Evaluation

Heuristic evaluation is an expert based usability method and originally proposed by Nielsen and Molich (1990). It is conducted by analyzing interface and trying to come up with an decision about interface's good and bad attributes according to the certain rules and guidelines. Danino (2001) states that if five experts as evaluators might find 81-90% of usability problems where the software is developed. According to the other expert based evaluation methods, heuristic evaluation takes a short time and applied easily with very few resources (Danino, 2001).

2.6.1.2 Performance Measurement

Bevan and Macleod (1994) defines that " performance measurement method gives reliable measures of the effectiveness and efficiency of system use, by evaluating the extent to which specific task goals are achieved, and the times taken to achieve task goals". Performance measures data can be collected while user performing the task. Nielsen (1993) defines eighteen typical quantifiable usability measurements. Some of them are the task completion time, number of user errors, ratio between successful interactions and errors, frequency of use of the manuals and number of commands or other features that were never used.

2.7 Usability in Special Education

According to the ICT Consultation report (2013), the use of computer technology has proven to be effective in teaching disabled children, but the needs and abilities of individuals may pose problems in using these technologies (Serra & Muzio, 2002). Parallel to this finding, rapidly changing technology, different types of users, applications and varying needs of individuals increased popularity of usability (Leventhal & Barnes, 2007). In the literature, many usability studies are related with use of ICT such as web site, assistive technologies for low vision. There is a lack of usability studies of technology enhanced learning materials, which have a potential to improve cognitive and social skills of individuals with disabilities except visually impaired people (Williams et al., 2006). As Harrysson (2003) pointed out, accessibility guidelines "almost entirely … support people with low vision, while [those] for people with cognitive limitations are almost non-existent" (p. 2).

In literature, most of studies are related with web site usability for individuals with IDs. William and Hennig (2014) analyzed in which content arrangement (horizontal or vertical) individuals with IDs access to content quickly. They analyzed usability of interface design using performance measurement method. While the participants were trying to find content or menu items, the researchers watched them and measured the completion time of the task. The results showed that there was no significant difference in the completion time in both arrangements. The content should not fall below the viewing level and it is important not to require scrolling for easy access. Similarly, Williams (2013) tested web sites including only images and audio. The purpose was to determine how information could be optimally presented while accessing information for individuals with learning disabilities. Usability of web site was measured heuristically. In the study, participants were observed while they engage in 'free exploration' of the system and undertake a series of set tasks. In terviewa were done with participants about their experiences. Results suggested that menu position and text size were the most significant factors and images have only limited value to help understanding or make easier faster access to information. In another web site usability research, Harrysson, Svensk, and Johansson (2004) conducted a study using heuristic method. In the study, researchers examined computer use by people with cognitive disabilities. They observed seven users while they navigated between different web sites. The results show that users were good at navigating while using forward/back buttons without difficulty and they recognized hyperlinks easily. However, when text input was required, users were forced to type in the address of a website or a search term. Results showed that the users were adept at navigating. Forward/back buttons were used by users without difficulty, and recognized hyperlinks. However, where text input was required, the participants wrote the address of the website with difficulty or a search term.

Some of the studies are related with usability of virtual learning environments. Rose et al (2002) conducted an investigation into the usability and usefulness of to train people with learning disabilities in a virtual environment. They used performance measurement method. In the study, there were thirty children with ID that squentionally assigned active and passive experimental group. While active participants explored a virtual bungalow searching a toy, passive participants watched the exploration of passive participants and searched the toy. Then all participants performed a test measuring their knowledge of virtual environment. Results indicated that participants were capable of using a virtual environment and motivated to use this training method. It was found that active exploration of a virtual environment enhanced their memory. In a similar study, Brown and his colleagues (1999) developed a virtual city with streets, stores, and settlements for the training of various life skills for disabled people. They used a test-retest experimental design method to compare user performance. Expert assessment was used to evaluate usability and appropriateness of the learning scenarios in VLE. Results show that VLEs present an accessible motivating and interesting learning environments for the users with special needs.

2.8 Usability Literature for Individuals with Disabilities in Turkey

Usability literature for disabled person is also very limited and new in Turkey. It is mainly related with web site usability for visually impaired people as parallel to international literature. Some examples presented below.

In study of Menzi-Cetin and her colleagues (2015), they evaluated the usability of a university website by five visually impaired children by using thinking aloud method. In this research, participants were interviewed and then asked to think aloud while navigating their university's web pages. Results show that participants had difficulty when they found exam dates on the academic calendar, and access time to the course schedule web page increased more than before. Authors suggested the need for rearrangement of the hyperlink sequences with tabs and more information about visuals, a search engine on each page and, a text version for all pages. In a similar study, Akgul and Vatansever (2016) evaluated the accessibility of twenty-five e-Government websites in Turkey with disabled people. Evaluation was made using the Web Content Accessibility Guidelines (WCAG) and automated testing tools. They found that absence of text equivalents for non-text elements, and the failure of the static equivalents for dynamic content will be updated when the dynamic content changes.

Yeni (2015) investigated the effectiveness of educational tablet applications to teach a daily living skill-using vacuum cleaner to individuals with IDs. Usability of tablet applications is examined also with seven individuals with IDs and five special education teachers. She used heuristic and performance measurement methods in usability testing. While users were performing tasks, the researcher observed them and calculated the task completion time with percentage of the correct behavior rate. The researcher found that tablet application is an effective tool to teach a daily living skill to individuals with IDs and the newly learned skill can be generalized to different tools.

In study of Karal, Kokoç and Ayyıldız (2010), they examined usability of an educational computer game used for children with mentally disabled. It helps to improve the psychomotor skills of mentioned children. A web camera was used as user-computer interaction tool in the game. There were four participants in the research. Two of them were educatable mentally disabled children, one was a teacher, and the other was a physiotherapist. The researchers took part in the playing sessions as observers. Expert based evaluation-heuristic methods were used to determine the usability of the game. Data sources included observation, diaries, and a semi-structured interview. The results showed that the design and interaction characteristics of the game meet children who need special education.

2.9 Summary

Although literature generally emphasis the importance and benefit of ICT for disabled individuals, there is a significant lack of technology enhanced learning tool for individuals with intellectual disability. Number of different learning technology studies is limited in both national and international literature. On the other hand, current studies generally examine effectiveness of the technological learning tools instead of how to best implement that to special education environment. There is a need to research the most proper way to integrate these technologies into learning environment for intellectual disability. Smart toy, which is developed in scope of this research, is expected to fill this gap.

Additionally, literature in usability mostly covers studies related with use of ICT such as web site, virtual learning environment, and assistive technologies. In addition, many of these studies are for visually impairments. Therefore, there is also a gap in the literature as empirical data about usability of smart toys for intellectual disability. This study analyzed smart toy technology in means of design to effectively integrate this technology into special education environment. In addition, special education teachers have big importance for individuals and parents in this field. Teachers' intentions to technology will affect use the use of it and its spread as an educational tool. In the literature, there are many successful empirical results for disabled individuals, but if a teacher does not find technological tool as usable, it would be hard to utilize them. With this study, special education teachers' views about smart toys are examined. It is aimed to fill the gap as to giving detailed implementation and usability analysis of smart toy in special education settings.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The purpose of this study is to investigate the effectiveness of smart toys on teaching social studies concepts and to determine if they have a positive impact on motivation of children with ID determine. Moreover, it was also aimed to analyze how usable (effective, efficient and satisfactory) the smart toys technology.

This chapter includes the research methodology of the study. To this end, the design of the study, participants, data collection procedures and analysis, data sources, and trustworthiness issues such as reliability, and limitations of the study are discussed in this part.

3.2 Design of the Study

In this study, a ***multi method research design*** was used (Figure 3.1) It is an eclectic approach that combines both qualitative and quantitative approaches (Creswell, 2009). While ***Design-based Research model*** was administered in qualitative part of the study, multiple baseline design across subjects, which is a single subject research design, was used in quantitative part to investigate effectiveness of smart toys on teaching social studies concepts to children with ID.

The independent variable of the study is the technology enhanced learning environment that includes smart toys; whereas the dependent variables are specified as the change in correct response rate for related social studies concept.

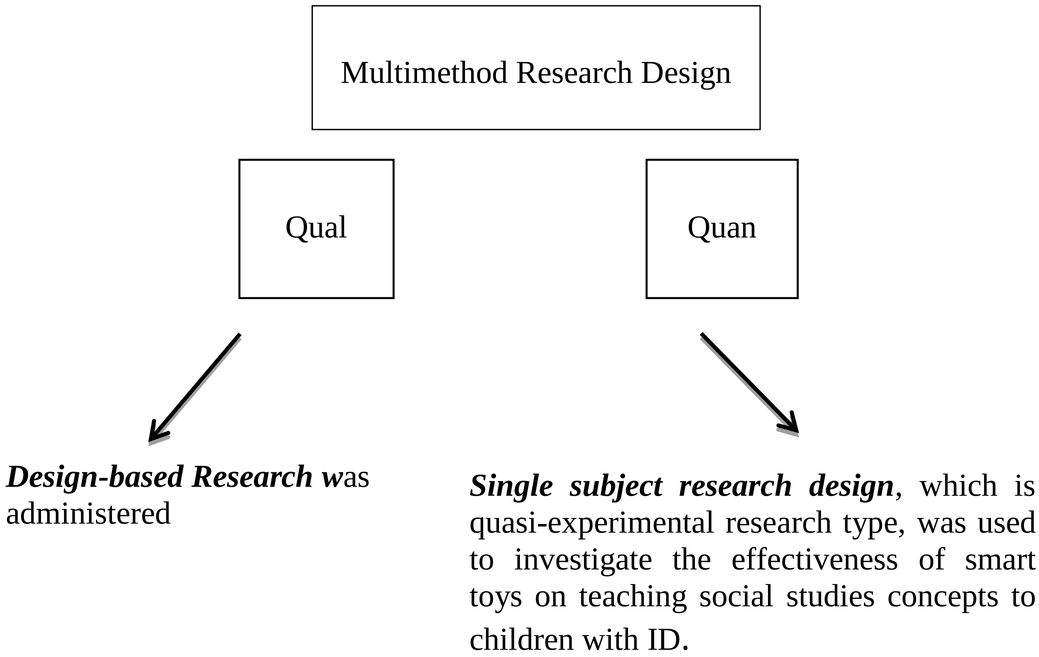

Figure 3.1 Multimethod Research Design

In qualitative part of the study, Design-based Research model was administered (Figure 3.2).

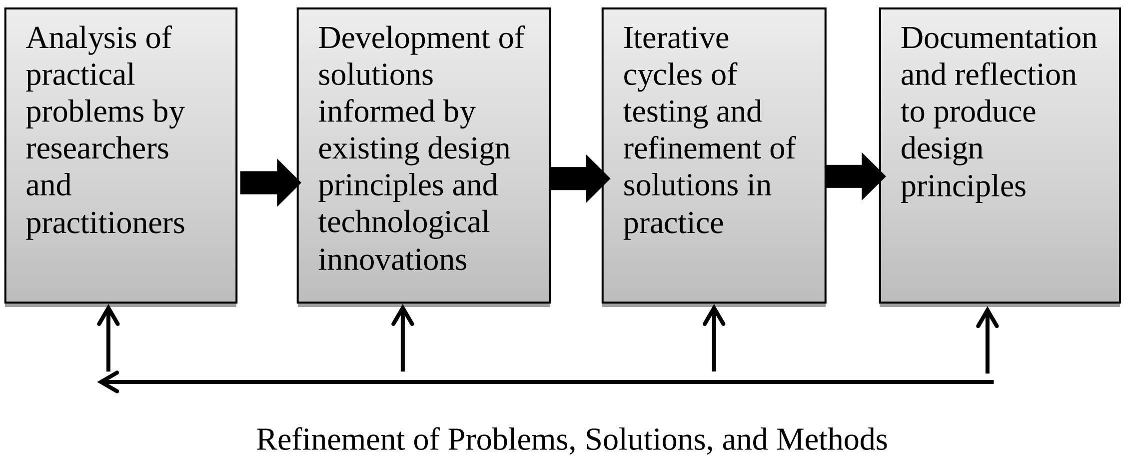

Figure 3.2 Design Based Research Model (Reeves et al., 2004, p. 60)

In the current study, Reeves et al.'s (2004) design-based research model was applied. The last version of the model of this study is shown in Figure 3.3. There were four phases in this study.

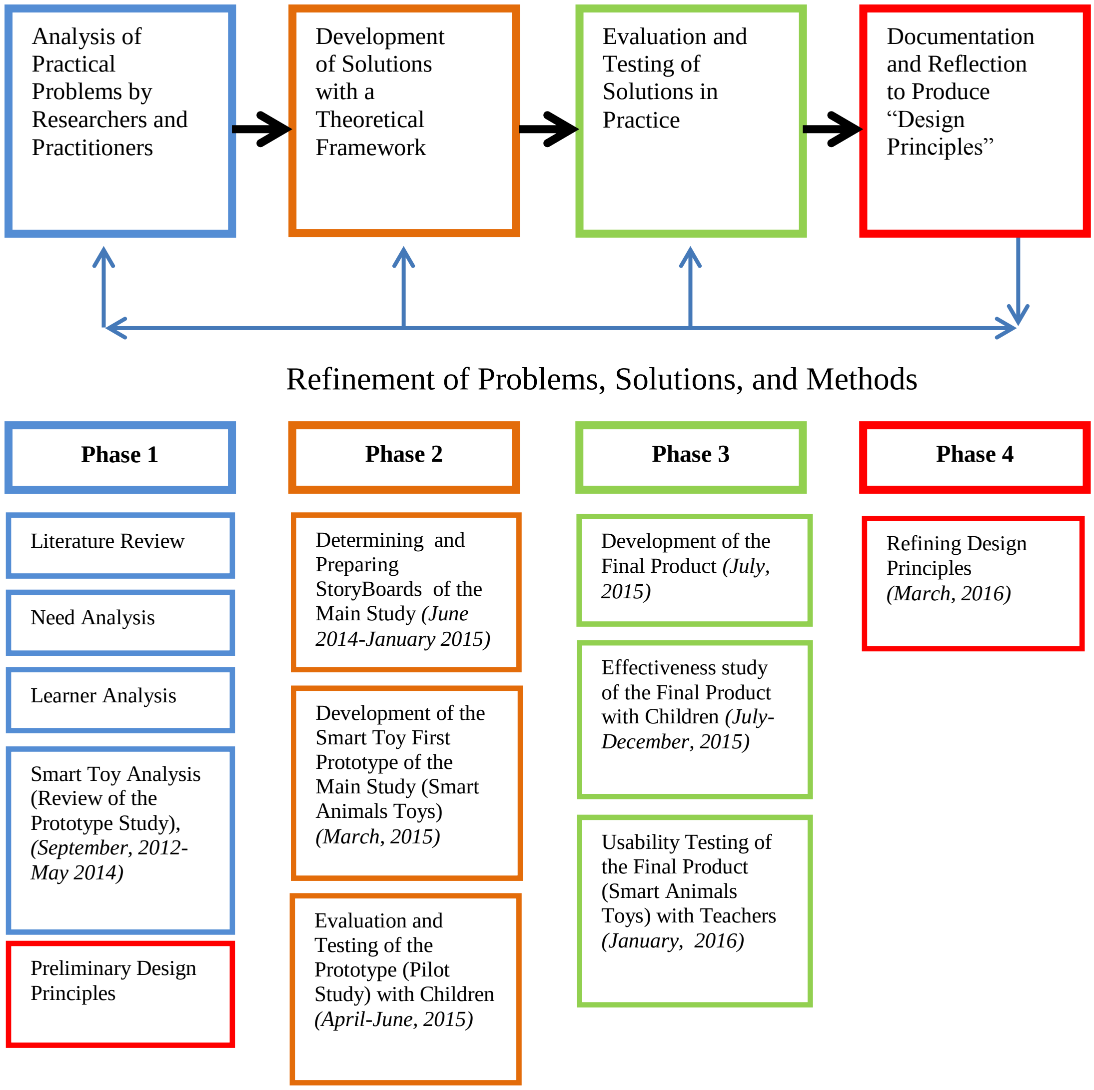

Figure 3.3 The study based on Reeves' Design Based Research Model (Reeves et al., 2004)

In the first phase, literature, need, learner, and smart toys analysis were made by taking advice of special education subject-matter experts. In this phase, it was aimed to identify the design principles of smart toys for child with ID. For this purpose, the kind of obstacles that special education specialist might encounter while trying to design and implement smart toy based learning were taken into account. Preliminarily design principles were determined according to the detailed literature review, consulting the field experts' ideas and various analyses conducted. Smart toy analysis and design phase lasted about 20 months, between September 2012 and May 2014. In this step, the researcher presented the prototype of the smart toy to the special education teachers, academicians so that they could concretize the smart toy concept. Also, special education children and teachers tested prototype study on Land and Marine animals. In total, nine meetings were conducted in 20 months and twelve special education teachers were interviewed in these meetings to have an idea concerning their views about a smart toy, which was developed in the main study. Details of time schedule of meetings of prototype study are given in the Table 4.2.1. During the whole process, as a rule of Design-based research, analysis activity continued to the end iteratively between each phase.

In the second phase, storyboards of the first prototype of the main study (Smart Animals Toys) were determined and prepared. It was prepared by taking into account outcomes gathered in the first phase and lasted about 8 months, between June 2014 and January 2015. During the preparation of the storyboards, opinions of the academicians and special education teachers were taken again. Meetings, 4 in total, were arranged with one special education teacher and two academicians. Design was made according to the curriculum of special education school (First Level) due to the importance, validity, and practicality of special education curriculum for all special education settings. Design of the first prototype of smart toys of the main study (Smart Animals Toys) took 3 months and finished in March 2015. In this phase, evaluation and testing processes of designed prototype (pilot study) were performed. Pilot study was conducted with three children with ID. Before the pilot study, a meeting was conducted with teachers and information was given about the research by the researcher. Details of the pilot study are given in part 3.12.

In the third phase, final version of the smart toy was developed by making some changes in pilot application according to the views of special education experts and teachers taking into account in the second phase from pilot study in June 2015. The changes that were made in pilot application are given in Table 4.3.

In this phase, usability testing of final version was conducted with teachers and children. Usability testing with children took 6 months. It started in June 2015 and finished in December 2015. In effectiveness study, single subject research design, which is quasi-experimental research type, was used to investigate the effectiveness of smart toys on student's social skills. In measurement of effectiveness data, multiple baseline design across subjects was implemented with 3 phases (baseline, intervention, and follow-up). While the first phase is the baseline that shows performance of student before the treatment (teaching with smart toy), intervention which is the second phase shows learning performance of child after the treatment (Fraenkel & Wallen, 2005, p.308). Third phase (follow-up) was included to ensure that the effects of the smart toys on teaching social studies concepts are maintained.

The number and type of the problem behaviors of the participants; observation of participants behaviors related to teaching material and teaching process were also determined during teaching and assessment process. Teaching environments were eliminated from stimuli (visual and auditory noise sources) that can lower participants' attention level and duration.

Performance level of each participant for each identified concepts (social studies concepts) were determined by criterion- referenced tests in baseline. The number of given right answers of each participant to each identified concept were recorded to participant file. We used criterion referenced test because of we have to focus on participant's individual learning progress in special education. In criterion-referenced assessment, participants are scored based on how well they know a standard or set of standards (Fraenkel & Wallen, 2005, p.136). In this type of assessment, a participant is only compared to himself or herself, it does not matter how other children perform. After teaching process performed with smart toys, posttest was applied and same criteria referenced tests was used again. During each quantitative study, participant's behavior was recorded with camera.

In usability testing with teachers, interviews were done with four special education teachers who joined the main study one to one or watching session from video camera recorder. It lasted in January 2016. They were expected to evaluate pre and post intervention sessions and response the interview questions so as to get their opinions.

3.3 Rationale for the Single Subject Design

Since there are not enough children available to make the use of group design practical, single subject design was performed to make it possible intensive data collection on very few individuals. Single subject designs are commonly used method to examine the changes in behavior an individual after a treatment or intervention (Fraenkel & Wallen, 2005, p.302). In this study, multiple baseline design across subjects, which is a single subject design, was used.

3.4 Multiple Baseline Design

Multiple baseline design is used to evaluate the effectiveness of teaching or behavior program intervention in multiple states (Horner & Baer, 1978; Murphy& Bryan, 1980). Multiple baseline patterns can be used for three different cases given below:

(1) Multiple Baseline Design Across Behaviors: Study of the effectiveness of a method on multiple target behavior of same subjects or groups in the same setting.
(2) Multiple Baseline Design Across Subjects: Study of the effectiveness of a method on one target behavior of multiple subjects in the same setting.

(3) Multiple Baseline Design Across Settings: Study of the effectiveness of a method on a target behavior of one subjects in the multiple setting.

When applying multiple baseline design, baseline data need to be collected simultaneously on multiple cases (behavior, subject, and setting). There may be difficulties in the baseline data collection process for the cases due to continuous or throughout the day observation need. In addition, the extended baseline measurement or take a long time of research can lead to frustration in the subjects and or practitioners (Murphy & Bryan, 1980). In such cases, multiple probe design is recommended which eliminates long baseline data collection and threatens the internal and external validity (Tawney & Gast, 1984).

3.5 Analysis of Data in Multiple Baseline Design

Data in multiple baseline design, as well as other single subject designs are analyzed graphically (Fraenkel & Wallen, 2005, p.306; Kırcaali İftar & Tekin, 1997). Line graph is used to make graphical analysis. While vertical axis of the graph shows the quantitative value of the dependent variable, horizontal axis show quantitative value of the application (days, hours, weeks, or observation sessions). Lines drawn vertical to the horizontal axis shows the phases (baseline phase, treatment phase, such as follow-up phase) and is used to separate from each other. (Fraenkel & Wallen, 2005, p.306; Kırcaali İftar & Tekin, 1997).

3.6 Participants of the Study

The participants of the pilot and main study are homogeneous sample group including six elementary school children with ID who possess the capabilities of a certain developmental stage to be able to carry out certain specified tasks defined in participant selection criteria. Participant selection criteria are given below. One participant child was from SUSMD and other two participant children were from SSERC in Ankara. The mentioned school and center have been preferred by the researcher because of the large number of children and the proximity of the their locations. Before the study, a meeting was made with teachers and information given to them about the study by the researcher. Each child was tested in a one to one session whether he/she knows animals in the research. There were ten animals, which were included in the research. Each animal was asked four times in four different animals. The child was selected as subject if she does not give three correct answers in four responses. Only six children participated research regularly and suitable for the selection criteria listed above.

In the pilot and main study, there were three children for each of them. "The Parent Permission Form" (Appendix A) was signed by parents. During the study, the participants' real names are not used; predetermined code names are used. Their code names are M-SA, M-TK, M-BO, P-MS, P-AS and P-ES. P-MS, P-AS and P-ES participated in the pilot study; M-SA, M-TK and M-BO participated in the main study.

M-SA is 11 years old male having ID. His disability rate is 50% and intelligence quotient (IQ) level was 55. He was attending SSERC twice a week for one year. He attended the study in summer semester. His mother and father's occupations are cleaner. His parent's educational status is primary education and income rate is middle. He has two brothers/sisters.

M-TK is 16 years old male having ID. His disability rate is 50% and intelligence quotient (IQ) level is 50. He was attending SSERC twice a week for two years. He attended the study in summer semester. His mother is a housewife. His parent's educational status is primary education and income rate is middle. He has two brothers/sisters.

M-BO is 16 years old male having ID. His disability rate is 50% and intelligence quotient (IQ) level is 55. He was attending SUSMD three days in a week for three years. During the study, he was attending Special Education and Rehabilitation Center twice a week. His mother is housewife and father is truck driver. His parent's educational status is primary education and income rate is middle. He has two brothers/sisters.

Table 3.1 Demographic Information about Participants

Code	Gender	Age	Type of Disability	Disability Rate	Additional Diognosis Problem	Occupation of Mother	Educational Status of Mother	Occupation of Father	Educational Status of Father
M-SA	Male	11	Intellectual Disability	Moderate	No	Cleaner	Primary Education	Cleaner	Primary Education
M-TK	Male	16	Intellectual Disability	Moderate	No	Housewife	Primary Education	Unemployed	Primary Education
M-BO	Male	16	Intellectual Disability	Moderate	Yes/ Scoliosis	Housewife	Primary Education	Truck Driver	Primary Education
P-MS	Male	11	Intellectual Disability	Moderate	No	Housewife	Primary Education	Cleaner	Primary Education
P-AS	Male	9	Intellectual Disability	Severe	Yes /Hearing Loss	Housewife	Primary Education	Turner	High School
P-ES	Male	11	Intellectual Disability	Severe	No	Housewife	Primary Education	Repairman	Primary Education

Researcher

The researcher has a BS degree in Electronic and Communication Engineering, MS degree in Computer Engineering, and PhD candidate in Computer Education and Instructional Technology with experience as an instructor in a university. She teaches "Computer Programming" at the undergraduate level. In addition, she conducts research on the teaching of cognitive concepts and skills with smart toys to people with intellectual disability. Teachers in public schools did not attend the experimental part of this study because he /she teaches more than one child at the same time. For this reason, all phases belonging to the children in the pilot study in the public school were carried out by the researcher. However, consultations were held with the teachers throughout all phases.

Teachers

Four special education teachers participated the research and conducted intervention and follow-up sessions. All teachers have experience as an instructor over five years in a Special Education and Rehabilitation center that provides education to children from autism to intellectual disability in Ankara. Three of teachers have worked at SSERC, one teacher was from SUSMD.

Observer

Interobserver reliability and procedural fidelity data were determined by two special education teachers in the study. They have bachelor degree in education of individuals with intellectual disability. Two observers were informed by the researcher about the study and teaching with the smart toy before of the experimental study.

3.7 Participant Selection Criteria

Children must have met the following requirements: (1) attend school regularly, (2) have sufficient visual level, (3) have IQ level over 55 determined in their written report by Counseling and Research Center, (4) have sufficient receptive language level (touch, show, tell and look etc.) that will perform basic instructions and (5) The child mustn't know animals included in the research.

3.8 Utilized Materials

Environment (Settings)

In the study, all sessions were implemented in an individual training room at two school in Ankara. The school names were used as code name. The code name of first school was SSERC and code name of second school was SUSMD. There were one table, two chairs and several closed teaching materials cabinet out of research materials and equipment in individual training room. In the application home, there were one table, several chairs, one seat and research materials and equipment. One camera was placed in both rooms to keep data records. Camera was positioned to see the child reactions and items that were placed on the table. All sessions were carried out between 9:30 to 16:00 on weekdays as one to one sessions for each child.

Equipment and Materials

The listed tools and equipment, which were used throughout the research (see Figure 3.11):

For Teaching of Social Studies Concepts:

- Samsung Intel Atom 1.66 GHz, 10.2 inch PC
- Flash Animation

- 10 different figures hard plastic animal toys /Smart Animals Toy (inserted RFID tags)
- 1 Reader device
- Cable

Smart animals toy used a radio-frequency identification (RFID) system. A special RFID tag was placed under or inside the hard plastic animal depend on their size (see Figure 3.11). RFID tags are imperceptible to the child. In this system, an RFID reader connected to the computer recognizes the toy via the tags (see Figure 3.12). to In design of computer animations, Adobe Flash CS6 was used. The computer application was triggered by the transmitted tag data.

Depending on the toys placed on the RFID reader, the related animal's animation appears on computer screen. The learning activity with smart toy includes four phases, which are beginning, instruction, reinforcement, and measurement-evaluation phases. In the beginning phase, the child is expected to register with the help of her teacher via login screen in flash animation with predefined login name and then choose a play character (Can or Cici) to continue the animation. After play character was chosen, "Learning Animals" screen welcomes children. After this phase, animal to be taught was chosen with the help of teacher and second phase, instruction phase starts. In this phase, the child is expected to watch instructional animation on the screen and put correct toys on the surface of the RFID reader according to voice instructions. If an incorrect item is placed on the reader's surface, instructional animation is repeated until right toy is put on the reader's surface. In the third, reinforcement phase, related animal is asked respectively from one, two, and three choices. If an incorrect animal is placed on the reader's surface, instructional animation is repeated and then return to the unsuccessful level. In the last, success rate of child is tested by asking correct animal four times in measurement and assessment phase. During the measurement, all answers are recorded and score is shown at the end of application. Screen captures of last version of smart toy application are presented in Figure 3.13.

For Collection of Interobserver and Procedural Fidelity Data

- Samsung Digital Camera

For Keeping Children Performance Records

- Data Collection Forms for Baseline , Intervention and Maintenance Phases
- Pencil, Notebook

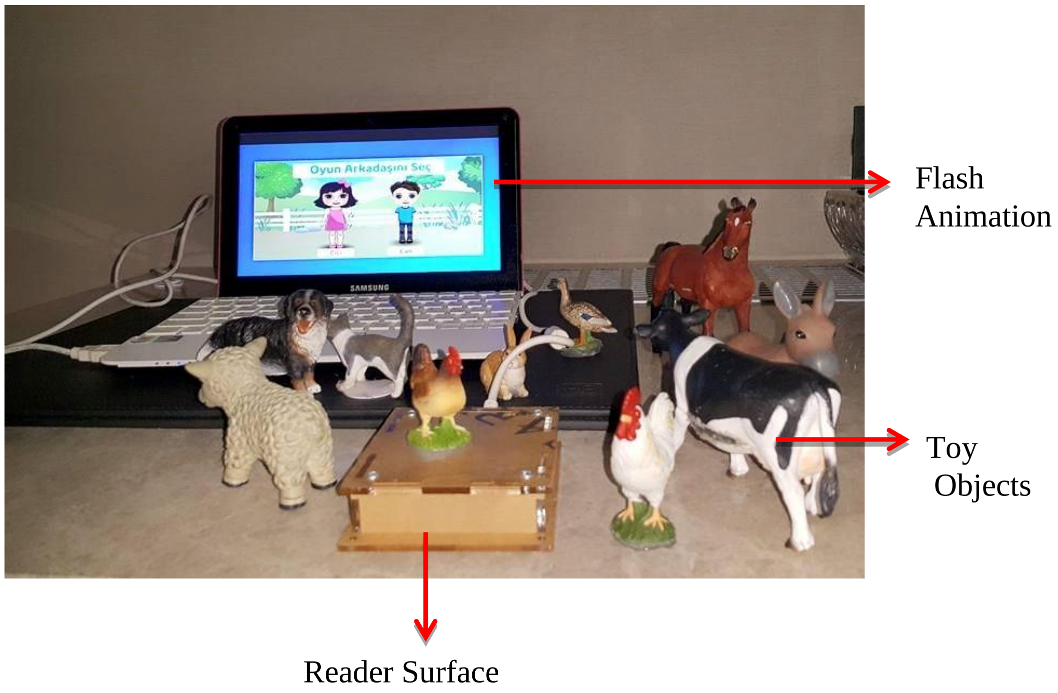

Figure 3.11 Main Components of Smart Animal Toys

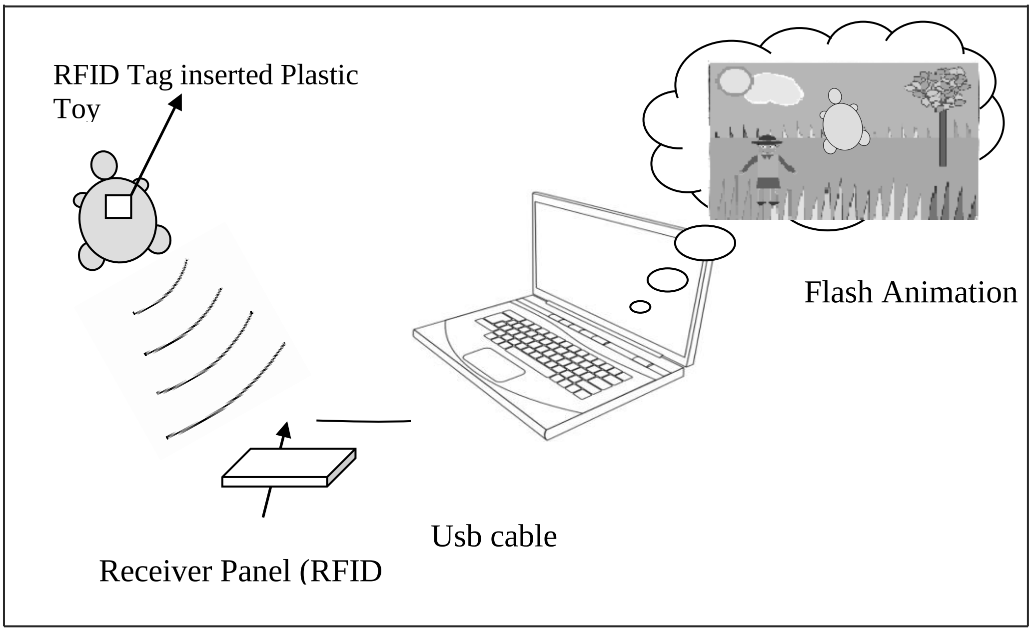

Figure 3.12 Mechanisms of Smart Animals

1.User Login and Register Screen

2. New User Register Screen

3.Successful New User Register Screen

4. Play Character Choosing Screen

5.Play Character Welcome Screen

6. "Learning Animals" Selection Screen

7.Teaching Screen (Cow)

8.Measurement Screen with One Choice

Figure 3.13 Screen Captures Last Version of Smart Animal Toy Application

3.9 Experimental Conditions

In the study, there were three phases performed in different time schedules:

1. **Baseline Phase (at least 3 sessions for each child)**

This phase shows performance of each child before the treatment. It was implemented at least in three repeated sessions for each child. Baseline data were collected with Baseline Data Collection Tool named “Baseline and Follow-Up Sessions Data Collection Form” (see Appendix C). During the application, the child sit opposite to researcher or teacher and the the concept to be taught was asked four times in four different concepts (Figure 3.14). Child was expected to answer for 4-5 seconds; the instruction was repeated if child did not answer the question. If the child still did not respond, or incorrect response was considered as the wrong response. For the child's right, wrong, and unresponsive answers were marked to “Baseline and Follow-Up Sessions Data Collection Form “(see Appendix C).

Figure 3.14 Baseline Session

2. **Intervention Phase (Teaching the concept- At least 3 sessions for each child)**

In this phase, smart animal toy application are used for teaching related social studies concepts to children with ID. Teacher controlled the application and helped the child during intervention session (Figure 3.15). The intervention session for each subject is continued until the three consecutive sessions meet the success criteria. The correct answers of individuals are reinforced with audial and visual feedback by the smart toy application, incorrect answers are ignored and the training part is displayed again automatically and child is asked to answer again. It is repeated until child completes all steps correctly (see Figure 3.16). After each intervention session, intervention data were collected with

“Intervention Sessions Data Collection Form” (see Appendix D) that shows learning performance of child after the treatment. It consisted of totally at least three repeated sessions for each child.

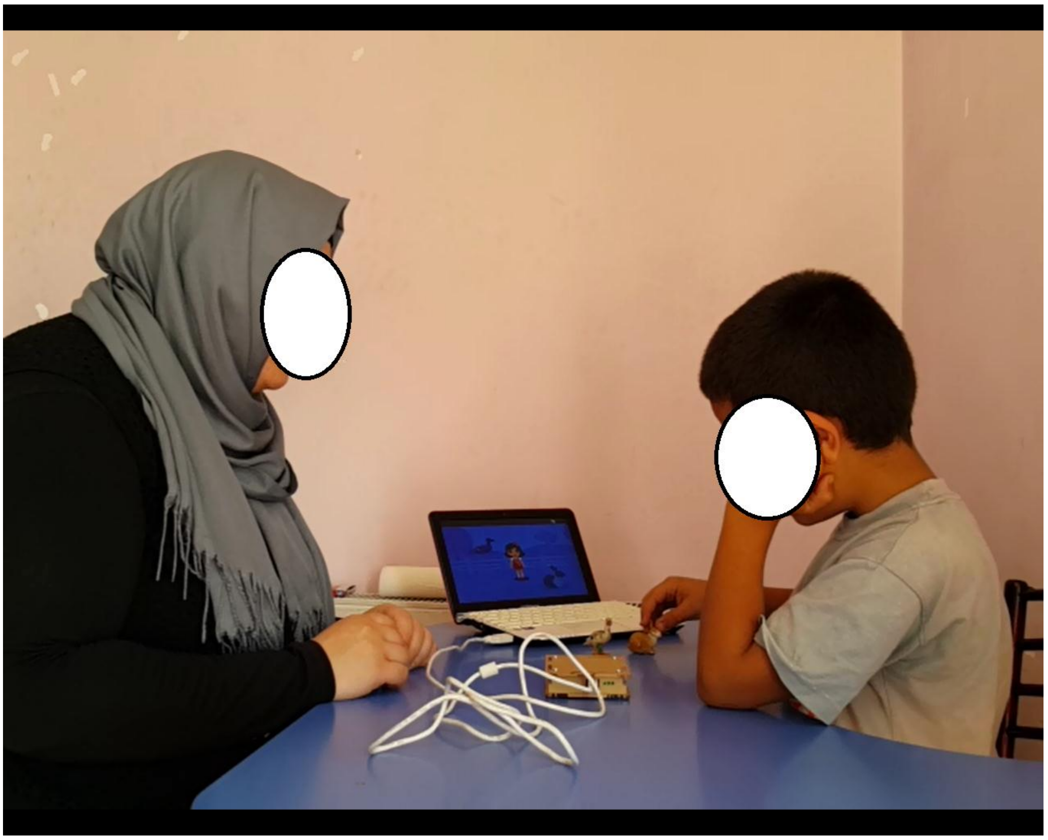

Figure 3.15 Intervention Session

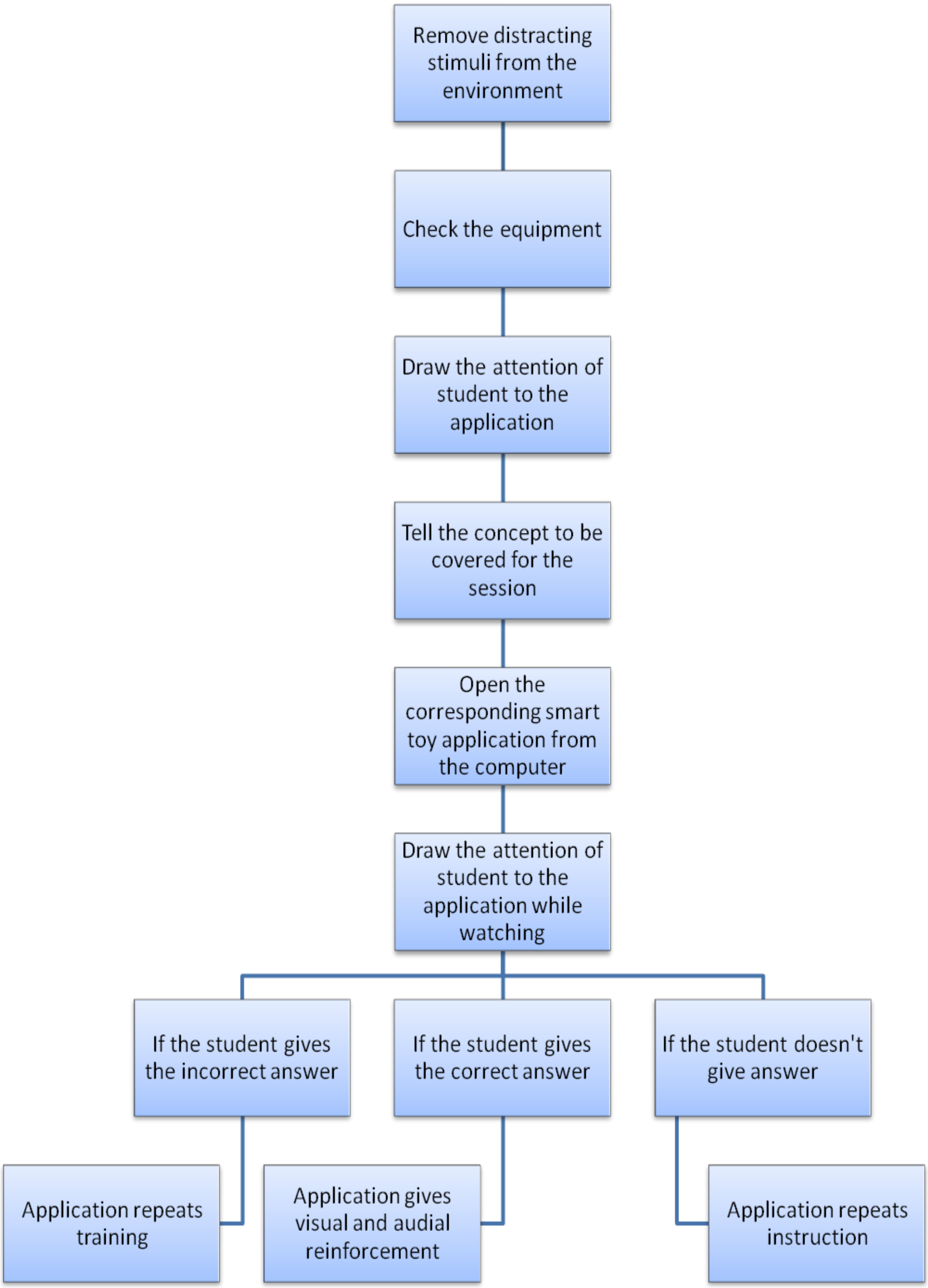

Figure 3.16 Flowchart of the Intervention Session

3. Follow-up Phase (At least 1 session for each child)

To determine whether the teaching of social studies concepts that was performed with smart animal toys persist for a certain time in children with ID (expected to be positive) or not, continuous data were collected at least 7 days after the training. During the sesion, the child sit opposite to researcher or teacher and the the concept to be taught was asked four times (Figure 3.17). Only one session was applied for three children. Follow-up data were collected with "Baseline and Follow-Up Sessions Data Collection Form" (see Appendix C)

Figure 3.17 Follow-up Session

Table 3.2 Overview of Research Questions, Data Sources, Data Collection Instruments, Data Analysis Techniques, and Validity Issues

Research Questions	Data Sources	Data Collection Instrument	Data Analysis Techniques
1. What are the design principles of a smart toy application for children with ID?	12 Special Education Teacher and 2 Academicians	Semi-structured interviews	Content Analysis
2. Do the smart toys have a positive impact on teaching social studies concepts to children with ID?	3 elementary school children with ID	Criterion referenced performance tests, Observations	Graphical Analysis Descriptive analysis
3. What are the teachers' opinions on the impact of smart toys on the motivation of children with ID?	4 Special Education Teachers	Semi-structured interviews	Content Analysis
4. How usable (effective, efficient and satisfactory) is the smart toys technology?	4 Special Education Teachers	Semi-structured Interviews, Observations	Content Analysis-Descriptive analysis

3.10 Data Collection Procedure and Instruments

In this research, semi-structured interviews, video records of training sessions and observations were the main data collection sources of the study. Four kinds of data were collected with these instruments: effectiveness data (1), reliability data (2), social validity data, (3) and usability data (4). Details of each data collection procedure are given in the following Table 3.3.

Table 3.3 Data Collection Procedure, Instruments, and Roles of Practitioners

Process	Data Collection Tools	Data Type	Practitioner
Before the implementation	• The Parent Permission Form *(Appendix A)*		Parents
	• The Demographic Information Form *(Appendix B)*	Descriptive Data	Special Education Teachers
During the implementation	• Baseline and Follow-up Sessions Data Collection Form *(Appendix C)* • Intervention Sessions Data Collection Form *(Appendix D)*	Effectiveness and Usability Data	Researcher, Special Education Teachers
	• Video Recording	Interobserver Reliability and Usability Data	Special Education Teachers, Observer
After the implementation	• Observer Notification Sheet *(Appendix F)*	Interobserver Reliability	Observer
	• Baseline and Follow-up Sessions Procedural Fidelity Checklist (Appendix H) • Reliability Checklist *(Appendix G)* • Intervention Sessions Procedural Fidelity Checklist *(Appendix H)*	Procedural fidelity data	
	• Interview Protocol for the Special Education Teachers for Social Validity *(Appendix J)* • Interview Protocol for the Special Education *(Appendix E)*	Social Validity Data Usability Data	Special Education Teachers

3.10.1 Collection of Effectiveness Data

In the research, change in the dependent variable (target skill) was recorded by Baseline, Intervention, and Follow-up Sessions Data Collection Form" (Appendix D). Child's behavior was classified in two types: (1) Child gives correct response in acceptable rate. (2) Child gives incorrect response. Depend on child correct or incorrect response,"+" or "-"sign was put to form in every step of the skill then percentage of the correct behavior rate are calculated depend on the number of these sign on the data collection form. A correct response was defined as choosing a correct animal within four different animals after the presentation of question. Each question was repeated four times for taught animal concepts. An incorrect response refers to choosing an incorrect option and has 0 point. A correct response has 1 point. So, the total maximum possible points was 4 points for each session. The program also automatically scored the children' responses for intervention and follow-up sessions. After calculation, result data were visualized in a table at measurement screen.

3.10.2 Collection of the Reliability Data

In this research, three kinds of reliability data were collected. (1) Inter-observer reliability, (2) Inter-coder reliability and (3) procedural fidelity. The typical recommendation for the reliability data collection range from at least 20% - 50% of each session (Gast & Ledford, 2014). In this research, reliability data were collected randomly chosen 20% of all sessions.

3.10.2.1 Collection of Inter-observer Reliability and Observer Training

Inter-observer reliability was used to examine the agreement between observers. It is the degree to which two independent observers watching the same events agree on what they observe. The researcher was the primary observer and rated all sessions for all participants. The secondary observer was a special education teacher who was not involved in the experimental procedures, she also rated all sessions. The secondary observer was trained at the start of the study relating to intervention and data gathering process. The training information was given relating by using "Observer Notification Sheet" (Appendix F). She was independently coded the observations. The steps used to collect reliability data as follows: (1) All sessions were recorded by video camera; (2) Secondary observer was informed by "Observer Notification Sheet"; (3) All sessions were watched and rated by the observers. (4) Finally, Inter-observer reliability was calculated by using the "agreements/ (agreements + disagreement) x 100" formula which is used for analysis of the reliability data between the observers (Tawney & Gast, 1984).

3.10.2.2 Collection of Inter-coder Reliability for Interviews and Result

Content analysis is defined as systematization of text analysis that examines "underlying meanings and ideas are revealed through analyzing patterns in elements of the text, such as words or phrases" (Yang, 2008, p. 689.). Intercoder reliability is at the heart of this method and prevents the mistakes while transcribing instruments (Creswell, 2009). It is "the extent to which the different judges tend to assign exactly the same rating to each object" (Tinsley & Weiss, 2000, p. 98). To determine inter coder reliability in this study; two researchers coded the same interview data independently and the codings compared for agreements. The researcher was the primary coder and transcriber and coded all interviews. The secondary coder was a foreign language teacher. Her master thesis was related with qualitative data analysis. She has also experience in qualitative coding as intercoders because of her thesis study. Inter-coder reliability was determined by using the standard formula (Miles & Huberman, 1994, p. 64): Reliability = Number of Agreements / (Total Agreements + Total Disagreements).

Miles and Huberman (1994) suggest that inter-coder reliability in qualitative data analysis should be at least or exceed 90% and it is accepted as good reliability. In this study, Miles and Huberman (1994)'s inter-coder reliability score was the basis on evaluation.

Intercoder reliability was measured for interview data in this study. The reliability checking was performed for interviews conducted with four special education teachers to answer the research question one, three and four. Before starting the coding, information was given to the intercoder by researcher related with the aim of the study and research questions. After only one question of interview was coded together, rules were determined related with main theme and sub-themes. All interview transcripts were coded independently and finished in nearly 2 days. After finishing the coding, themes and subthemes were compared and reliability coefficients were calculated according to Miles and Huberman's (1994) formula considering the number of agreements having similar meanings and number of disagreements. Intercoder reliability data was found 0.91, which was reliable quite.

3.10.2.3 Collection of Procedural Fidelity Data

Ledford and Gast (2014) defines procedural fidelity as the degree to which a research plan was implemented as intended. In this research, procedural fidelity data was collected by using "Baseline and Follow-up Session Procedural Fidelity Checklist" (Appendix G) and "Intervention Session Procedural Fidelity Checklist" (Appendix H). For two children, treatment was done by special education teacher. For other one child, it was done by researcher not studies in special education field. According to Tekin-Iftar (2012), if treatment was carried out by the person who was not from the special education field, procedural fidelity data is collected at least 30% of sessions which were selected randomly (pg.111). For that reason, procedural fidelity data was collected from 30% of each different type of sessions in this research. Procedural fidelity data were calculated by using the formula: observed practitioner behavior/planned practitioner behavior X 100 (Ledford & Gast, 2014; Tawney & Gast, 1984). Procedural fidelity data were collected on researchers' behaviors of (a) getting the attention of the learner, (b) presenting target stimuli, (c) waiting for the learner to respond, (d) presenting stimuli after behavior, (e) waiting for intervals between sessions and (f) ending the session. These behaviors were examined during baseline, intervention, and follow-up sessions.

3.10.3 Collection of the Social Validity Data

Social validity is the measure of appropriateness of the goals, findings and methods an intervention program (Tekin & Kircaali-İftar, 2006; Wolf, 1978). In this study, a social validity form was developed consisting of six questions according to the Wolf's (1978) three levels of social validity. While four questions were related with social significance of research's aim and social appropriateness of the methods in the research, other two of them were about social importance of the effects. Social validity questionnaire was administrated to special education teachers of participants at the end of implementation. Interviews were done using form named "Interview Protocol for The Special Education Teachers for Social Validity" (Appendix J). Four special education teachers who joined the main study one to one or watching session from videos were chosen for interview. They were expected to evaluate pre and post intervention sessions and response the interview questions so as to get their opinions.

3.10.4 Collection of the Usability Data

In order to determine the usability issues of smart toy applications, two different methods, "expert approach-heuristic evaluation" and "experimental approach-user test" methods were used together. User testing method was used together with experts' view because of properties of special education field. People with ID can not reflect their thoughts and in the each test can behave differently than before. Therefore, when field experts use "heuristic evaluation" method to identify usability issues, user tests' data may be helpful to them.

In collection of usability data, interviews and observational data were used. Interviews were done using a form named "Interview Protocol for The Special

Education Teachers (Usability Data)" (Appendix E). For interviews, four special education teachers were selected who joined the main study one to one or watching experimental sessions from video camera recorder. They were expected to evaluate pre and post intervention sessions and response the interview questions so as to get their opinions. In usability testing, users are included as testers to fulfill specific tasks identified prior to the testing (Nielsen, 1993). In this study, playing with the smart toy from starting to end was defined as the main task and this task was performed with children having ID.

Observational data was collected with two forms named *Baseline and Follow-up Sessions Data Collection Form* (BFF) (see Appendix C) *and Intervention Sessions Data Collection Form* (IF) (see Appendix C). IF was only used to conduct the smart toy usability testing in the pilot and main study because of the intervention sessions were the sessions that the smart toy was used. IF had five columns, namely task (target behavior), performed, not performed and, no response. Task refers to action that the child needs to perform in each screen. During the usability test, a video camera was used to observe and record the children.

3.11 Smart Toy Prototype

Smart toy study started first as a prototype including some sea and land animals in. Its video is accessible from the web site http://www.oztek.metu.edu.tr (OZTEK, 2015). Its development process took approximately 6 months. At first, the study was limited with autistic children with moderate intellectual disability. For that reason, developmental characteristics of children with autism have been taken into account in the design of the prototype. Sounds, visuals, and animations have been developed considering views of field experts.

In design process, instructional materials were examined in two special education schools that used in the educational process of autistic children (OISEC and CSEABTC) and interviews have done with field teachers in the mentioned schools. As a result of the examination, the concepts related with land and sea animals were choosen to teach using smart toy applications. In addition, the mentioned concepts were also appropriate in creating teaching scenerios with smart toy architecture. Smart toy technology, which enables real and virtual environment to combine, has potential to increase the effectiveness of learning activity compared to the classical methods. Protoype design was carried out by receiving feedback from special education experts on how to design visual parts and other details (sounds, animations, etc.). At the end of this stage, first smart toy prototype has been developed as instructional material for austistic child with ID (see Figure 3.18). As seen in the Figure 3.18, first application included eight animals. Screen captures of prototype smart toy application are presented in the Figure 3.19 and 3.20

The prototype of the smart toy set consists of three different prototype applications. The first prototype application consists of computer animation, plastic marine, and land animal toys. This prototype application was designed to facilitate the teaching of land and marine animals (which are defined in a set of FarmTech smart toys) related with where they live and what their names are. In this application, the child with ID chooses a land or marine animal character and puts this animal character to reader surface in order to interact it with computer (Figure 3.18). Depending on plastic toy contacted with reader surface, an animation appears on the computer screen. Animation includes visual content and verbal information about related animal name and its voice in the natural environment. In this activity, it is possible to repeat and pause the each playing upon the child or the teacher's demands.

The second application of the prototype consists of land and marine visuals as well as computer animations. The trained concepts in the first application are measured in this second application and all animals appear respectively on the screen. Depending on voice instructions in the animation, for example "Where does the cow live?" the child is expected to put the right environment card (sea or land) on the reader surface. If he/she does so correctly, the animation moves on the second question by giving a 'Congratulations' response and continues until all the questions are answered correctly. If the child does so incorrectly, the application waits until he/she puts the correct card on the reader surface by giving a "Try Again" feedback.

“Find Correct Animal” application is the third application of prototype smart toy. In this activity, the child is expected to place the right plastic animal on the reader surface after audio instruction such as “Find the Turtle and Put the Surface.” If he/she does so correctly, animation continues giving a “Try Again” feedback until he/she matches with correct animal.

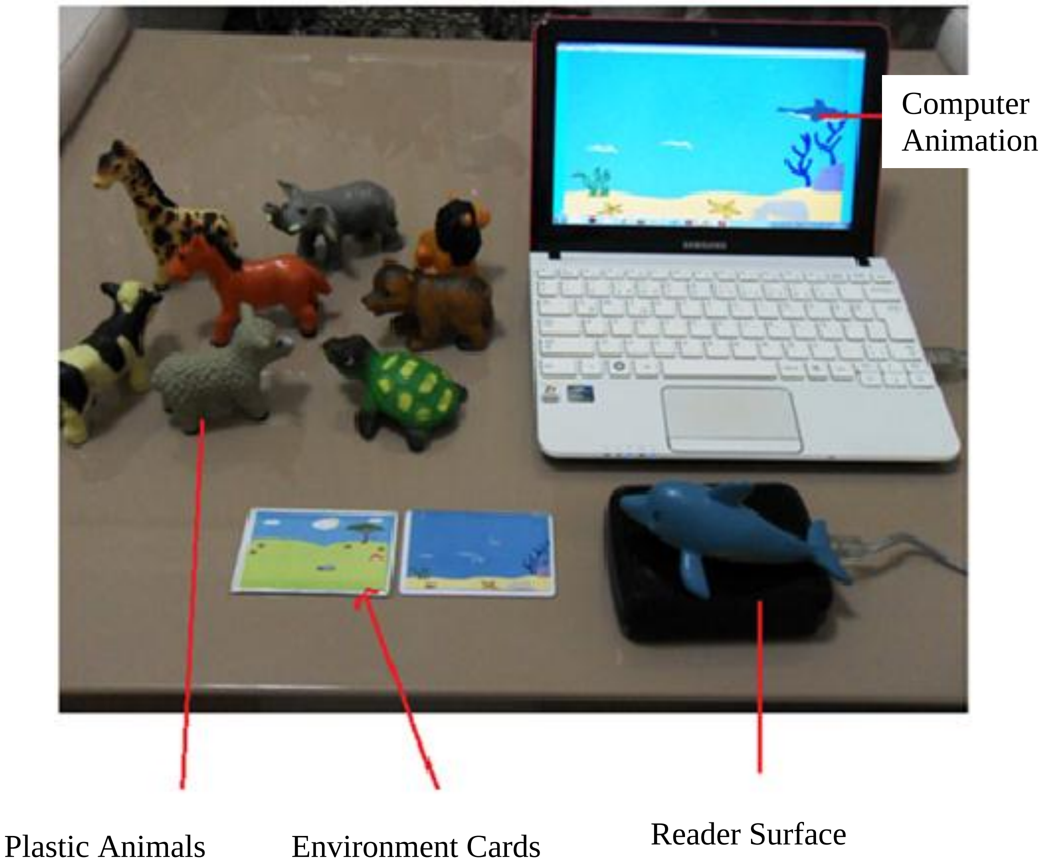

Figure 3.18 First Smart Toy Prototypes

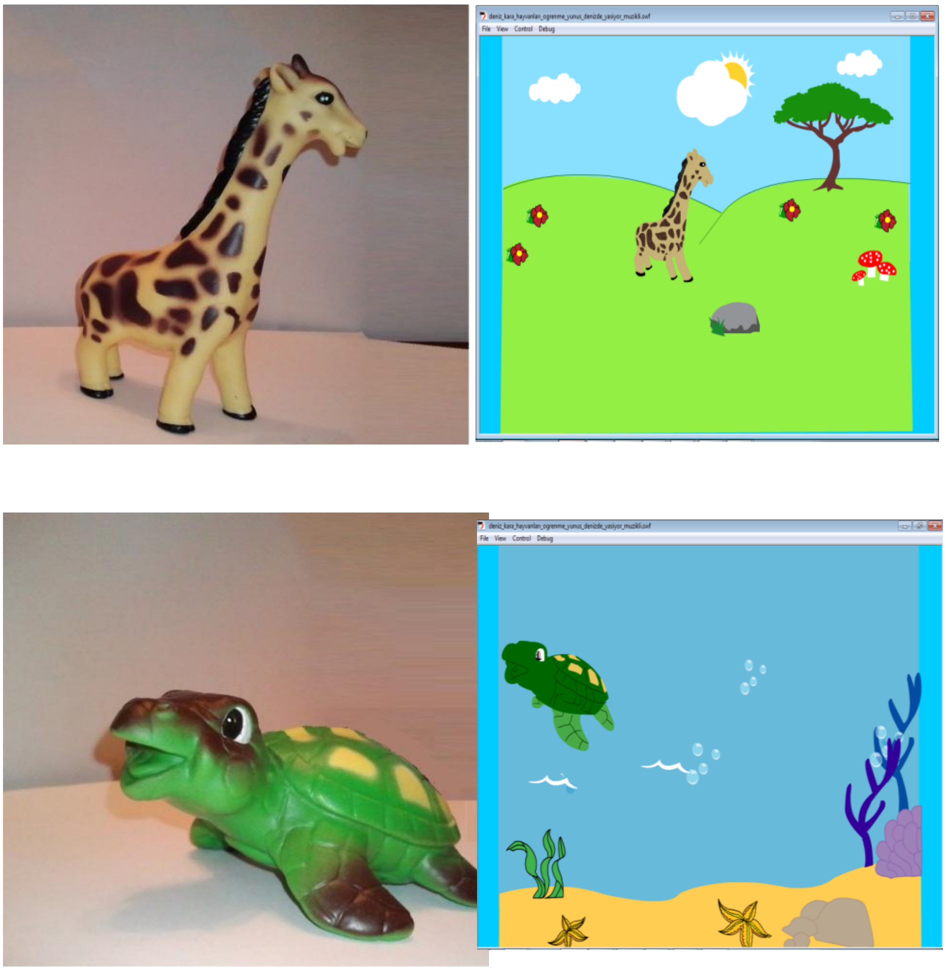

Figure 3.19 Screen Captures of Sea and Land Animals Prototype Smart Toy Application

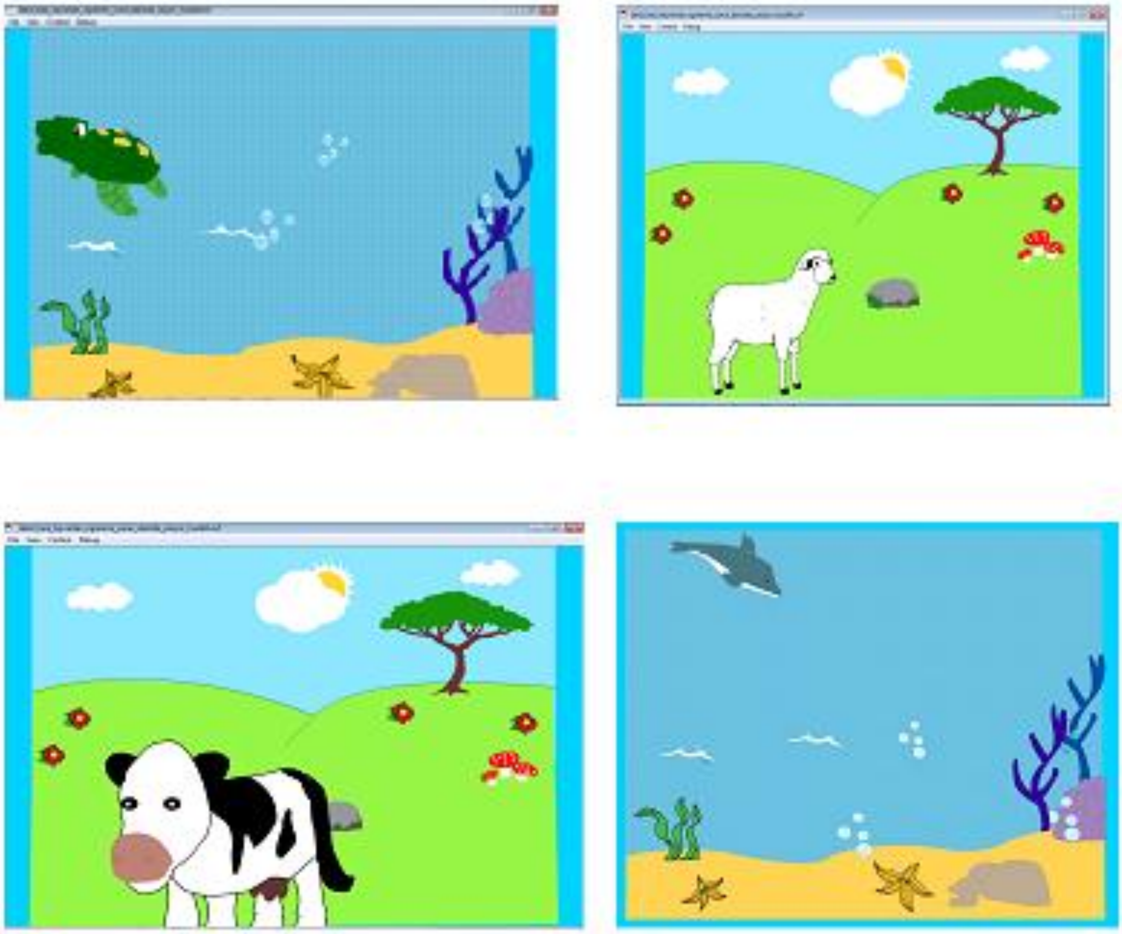

Figure 3.20 Plastic Smart Animals and Their Screen Captures of Computer 3.12 Pilot Study

After the development of prototype smart toy, according to the observations and suggestions of special education teachers and experts, this study was redesigned to be used by special education children with intellectual disability in the scope of a TUBITAK project named OZTEK. During research, first prototype was shown to special education teachers and academicians. In total, eleven meetings have been done with them. Related web sites and projects were examined. All screens, animals, animations, and sound effects were changed in the pilot study.

Pilot study was conducted with three children with ID in SUSMD. Before the pilot study, a meeting was conducted with teachers and the researcher gave information about research. According to the recommendations of special education teachers, fifteen children were selected.

At the start of study, each child was tested whether he/she knows the animals or not. Ten animals were asked one by one four times among four different animals. The child was selected as subject if she/he does not give three correct answers in four responses. While five children among fifteen knew all animals, three children did not listen instructions and show suitable not behavior. Other three of them did not come school regularly. Only three children participated regularly and were suitable to the participation selection criteria. "The Parent Permission Form" (Appendix A) was signed by parents. Predetermined code names were used. The code names of children participate to pilot study were P-MS, P-AS and P-ES.

All sessions carried out by the researcher herself since the teachers of the classes had to attend to other children. Thirty-five sessions were performed in total with three participants. Firstly, baseline data were collected at least three sessions before the intervention, and after reaching the stable response, baseline sessions were ended. In baseline sessions, a stable response refers to a behavior demonstrated by a participant unable to recognize an animal after three consecutive sessions. Then intervention session was performed and stable response condition was checked. If the stable response was given, intervention session would be ended. If stable response was not given, intervention session would continue. In the intervention sessions, stable response refers to a behavior demonstrated by a participant in at least three consecutive sessions implying that he/she can recognize the picture and, thus, learned the target skill. Finally, follow-up sessions were performed.

CHAPTER 4

RESULTS

4.1 Introduction

In this chapter, the results of the research are presented. The research questions were analyzed in accordance with the related phases of the design based research (see Figure 3.3). While the research question 1 was mainly investigated in phase 1 and 4, research question 2 was investigated in phase 3. The research questions 3 and 4 were investigated in the phase 2 and 3. The results of the research questions are presented under the following headings: (1) Effectiveness data, (2) Reliability data, and (3) Interview data (Usability and Social Validity) (shown in Table 4.1).

Table 4.1 Types of Result Data Related with Research Questions

Research Questions	**Data Type**	**Phase**
Research Question 1: What are the design principles of a smart toy application for children with ID?	Interview Data	Phase 1, Phase 4
Research Question 2: Do the smart toys have a positive impact on teaching social studies concepts to children with ID?	Effectiveness and Reliability Data	Phase 3
Research Question 3: What are the teachers' opinions on the impact of smart toys on the motivation of children with ID?	Interview and Reliability Data	Phase 2, Phase 3
Research Question 4: How usable (effective, efficient and satisfactory) is the smart toys technology?	Interview , Effectiveness and Reliability Data	Phase 2, Phase 3

4.2 Phase 1 (Research Question 1)

4.2.1 Preliminary Design Principles

Preliminary Design Principles of New Developed Smart Toy

After prototype smart toy was developed, it was shown to 12 special education teachers and two academicians in total 11 meetings. In addition, previous studies were examined focusing on characteristics and design of computer games for individuals with IDs in the literature. The list of institutions and field experts held meetings in prototype study was given below table. Code names were used as name of institution. According to the observation notes and suggestions of academicians, special education teachers and experts in nine meetings, based on review of prototype smart toy, preliminary design principles of main smart toy application were determined as defined below.

Table 4.2.1 The List of Institutions and Field Experts Held Meetings in Prototype Study

Name of Institution	Date	Meetings
OISEC	June 25, July 11 and October 9, 2012	3 meetings with 1 special education teacher and working with 2 children
CSEABTC	13 and 20 March, 2013	2 meetings with 2 special education teachers, working with 2 children
BSERC	October 31, 2014	1 meeting with 1 special education teacher
SUSMD	January 21 and March 9, 2014	2 meetings with 6 special education teachers
AASMD	April 9, 2014	1 meeting with 2 special education teachers
MU and GU	November 3 and 11, 2014	2 meetings with 2 academician

According to the interview results obtained by two academicians from MU and GU (see Table 4.2.1), the expectations in the design of new smart toy applications are as follows.

- The concepts to be taught should be included in the special education curriculum;
- A virtual play character (Narrator) should also be added;
- A virtual play character should be changeable (boy or girl) depending on the child's preference;
- The final scene in the application should include what the child has accomplished throughout the smart toy play;
- Feedbacks should be given to each child regarding their success or failure in the play;
- The educational content should be adapted to the children with ID;
- An appropriate game concept should be introduced to attract the children's attention and maintain their motivation high;
- The visual design, animations, and sound effects should be simple and considering the children's mental capacity and specific conditions.

According to the interview results obtained by six special education teachers in SUSMD, as well as one teacher in BSERC (see Table 4.2.1), both located in Ankara, the expectations in the design of new smart toy applications are as listed in the following.

- While teaching an animal, number of choices should be two for each animal (one correct and one incorrect) in the reinforcement screens of learning applications;
- The application should include only farm or marine animals and they should be separately;

- Occupations, trucks or fruits and vegetables can be used as alternatives in concept teaching; and
- In the application, the feedback should not be included in the assessment screens.

There were also interviews held by two special education teachers at AASMD and OISEC (see Table 4.2.1), with the following results:

- The application should include very few concepts in one frame such as sound, name, or living environments only, and there should exist a separate learning application for each concept;
- The developed application should be a design that highlists all the related attributes of the concept being taught;
- Toy play should allow the children to interact with their intended educational contents and purposes;
- Smart toys should be designed in a way that is both safe for child and fragile or prone to damages easily;
- Higher level animals such as bears and elephants (non-domestic animals) not encountered in daily life are not needed to be learnt by children at an early stage, can be later be included to increase the level of application for other children having severe mental disorders. Farm animals such as chickens, cows, and sheep or animals encountered mostly in daily life such as cats, dogs are primarly preferred for teaching;
- Smart toy play should be guided and monitored by teacher to increase effectiveness; and
- In the learning applications, the picture of the relevant concept should be appear on the screen and, then, the child should be able to reinforce the concept by matching its picture with the right smart toy, assessment should start only afterward.

The following opinions are shared by the teachers at SUSMD and AASMD (see Table 4.2.1)

- The learning applications should not be complex and include all animals in one animation;
- In design of the learning applications, the audio instructions should be simple, clear, and short;
- The applications should have different difficulty levels to make them usable by children with different cognitive levels;
- In the assessment screen, the same question should be asked four times and in the same way;
- The number of options on the assessment screens should be four at most;
- The first prototype should only be used only as a reinforcement if it does not include a separate application; and
- In the application, there should be a selection screen that allows the teacher to choose which concept to teach and in which order.

In addition, interviews held at CSEABTC in Ankara (see Table 4.2.1) yielded the following results from the teachers' perspectives.

- In the assessment and learning applications, if the child does not place the smart toy on the reader surface within 4-5 seconds after the audio instruction, the instruction should be repeated until he/she does so; and
- In the learning applications, if the child places the wrong smart toy on the reader surface, the related question should be repeated by giving a visual hint.

4.3 Phase 2 and 3 (Research Question 2, 3, and 4)

4.3.1 Effectiveness Data (Effectiveness Study of the Pilot and Main Study with Children)

The effectiveness data were analyzed separately for pilot and main study. Details of pilot study are given below. Effectiveness data of the main study of the research related with teaching social studies concepts to children with ID by using smart toy are illustrated in the Figure 4.4. It shows progress of participants from baseline to follow-up sessions. Each data point represents an observation session. Data point appears on a participant's graph for each observation session she attended; if there is no data point, this refers the participant did not attend the session. The phase lines distinguish the baseline phase from the intervention phase with the smart toys, and then the intervention phase from follow-up phase. While the horizontal axis represents the number of baseline sessions (baseline, intervention, follow-up); the vertical axis of the graphic represents the percentage of the participants' correct responses during baseline sessions. The results are analyzed in three stages for each participant: (1) baseline sessions, (2) intervention session and, (3) follow-up sessions. In the research, since participant children attend to school in different days and continue in different school, same sessions' data of children had to be collected in parallel not started at different times. Also, some selected participant did not attend study regularly and in the middle of study. Therefore, some participants had to be replaced by different participants.

4.3.1.1 Effectiveness Data of the Pilot Study

Observations during the Pilot Study

All sessions were performed by the researcher for three children. The percentage of the child P-AS's correct responses throughout baseline, intervention, and follow-up phases are displayed in Figure 4.1. P-AS completed the six baseline sessions before teaching the concept (chicken) by using smart toys. He received no information regarding his performance. According to baseline data, the mean score of P-AS in giving right responses for related animal character (chicken) is 29%. While he performed 0% in the first session, he performed 50% and 25% in the last three sessions.

Out of the second and third intervention sessions (50% and 75%), participant P-AS performed 100% correct response in all four sessions during the intervention as shown in the Figure 4.1. The intervention sessions were ended when the three consecutive sessions gave the desired extent (100%). He performed 100% in the first and 75% in the second at the follow-up sessions. Two measurements were taken as follow-up session data.

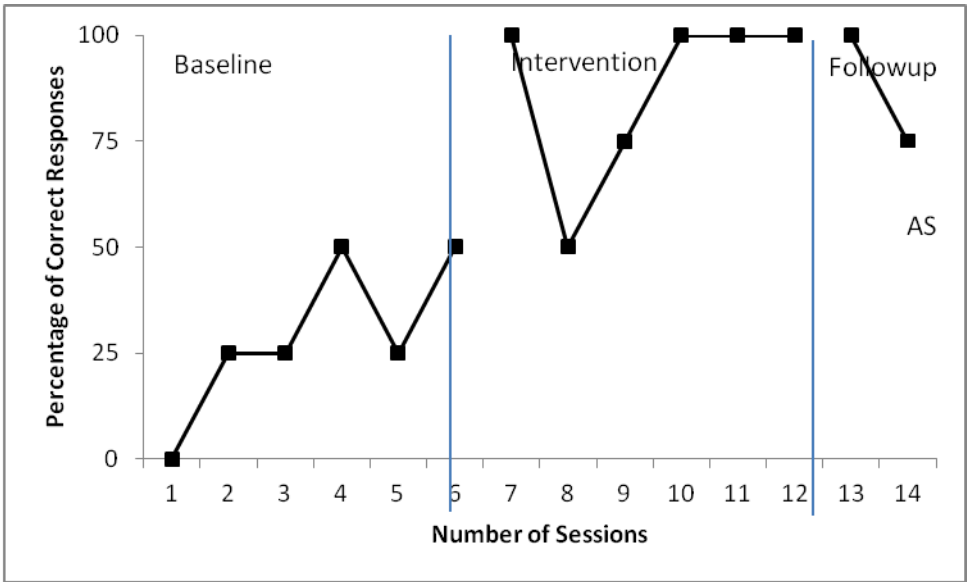

Figure 4.1 Percentages of Correct Responses of Participant P-AS

The child P-ES's percentage of correct responses throughout baseline, intervention, and follow-up phases are shown in Figure 4.2. P-ES completed six baseline sessions before teaching the concept (sheep) by using smart toys. He received no information regarding his performance. According to baseline data, the mean score of P-ES in giving right responses for related animal character (sheep) is 12.5%. While he performed 0% in first the two and fourth session, he performed 25% in the last two and third session.

Participant P-ES performed 100% correct response in three sessions during intervention as shown in the Figure 4.2. The desired extent (100%) was reached at least three consecutive sessions, so intervention sessions were ended. He performed 100% in all follow-up sessions. Two measurements were taken as follow-up session data.

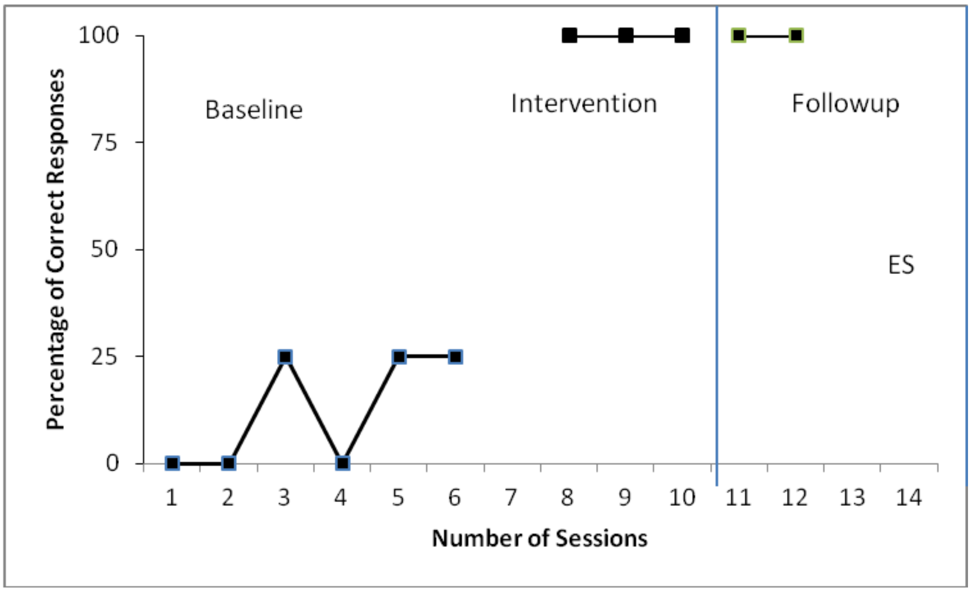

Figure 4.2 Percentages of Correct Responses of Participant P-ES

The percentage of the child P-YS's correct responses throughout baseline, intervention, and follow-up phases are shown in the Figure 4.3. P-YS completed the four baseline sessions before teaching the concept by using smart toys. He received no information regarding his performance. According to baseline data, the mean score of P-YS in giving right responses for related animal character (rabbit) is 12.5%. While he performed 0% in the first, second, and fourth session, he performed 25% in the last two and third session.

Participant P-YS performed 100% correct response in only two sessions during intervention as shown in the Figure 4.3. He performed 100% in the follow-up session. One measurement was taken as follow-up session data.

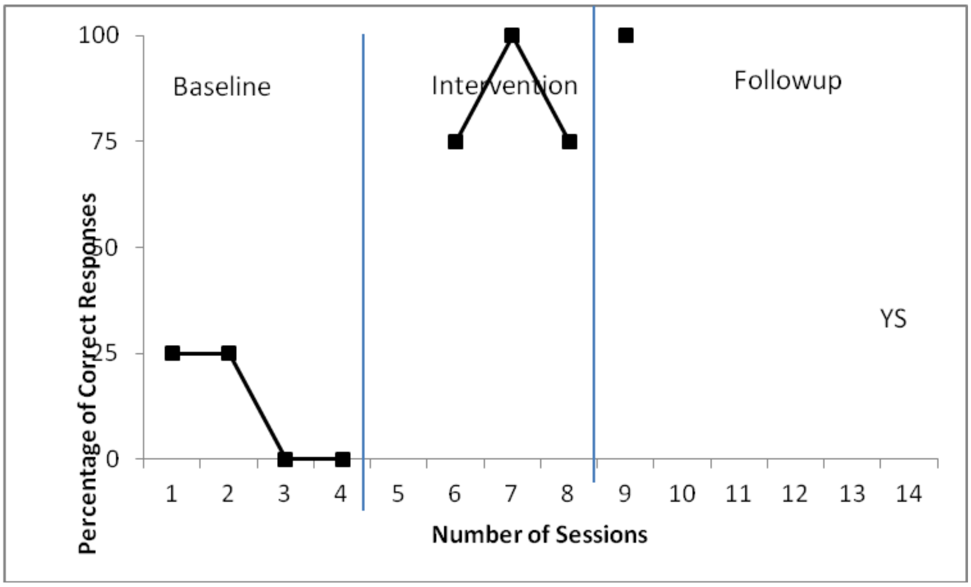

Figure 4.3 Percentages of Correct Responses of Participant P-YS

After the pilot study, based on discussions with experts, it was decided that all sound recordings be made once again, this time in a professional studio. Also, in the pilot study, there were forward buttons, which move the application to next screen, and teachers had to press with help of a touchscreen or mouse. This diverted both the child's attention and minimized the integrity of the applications. These problems will prevent children advance notice activity on-screen card was tried to be overcome by the design. These problems were overcome by the designing a RFID card. All forward buttons were changed in a way that can be operated with this card.

In addition, in the old version, the correct animal always appeared in the upper left corner, giving a hint to participants to guess the correct animal. For that reason, in each reinforcement, measurement and evaluation screen, order of animals was designed to change randomly.

As another change, animals were changed in a way that would appear randomly on each reinforcement, measurement, and evaluation screen. In old version, the animal quartets used to be same in each measurement screen. Also, in the old version, there was no play character on the screen and only a voice would instruct the participant. In the main version (modified version), there is a play character featuring a boy or a girl. Play character appears on screen during his/her speech.

4.3.1.2 Effectiveness Data of the Main Study

4.3.1.2.1 Effectiveness Data of the First Participant M-SA

The first child M-SA's percentage of correct responses throughout baseline, intervention, and follow-up phases are shown in the Figure 4.4. M-SA completed the five baseline sessions before teaching the concepts (animals) by using smart toys. He received no information regarding his performance. According to the baseline data, the mean score of M-SA in giving right responses for related toy animal character (duck) is 15%. While he performed 0% in the first and second sessions, he performed 25 % in the last three sessions.

Out of the second intervention session (75%), participant M-SA performed 100% correct response in all four sessions during intervention as shown in the Figure 4.4. The intervention sessions were ended when the three consecutive sessions gave the desired extent (100%). He performed 100% at the follow-up session. Only one measurement was taken as follow-up session data.

4.3.1.2.2 Effectiveness Data of the First Participants M-TK

The second child M-TK's percentage of correct responses throughout baseline, intervention, and follow-up phases are shown in Figure 4.4. M-TK completed the six baseline sessions before teaching the concepts (animals) by using smart toys. He received no information regarding his performance. According to the baseline data, the mean score of M-TK in giving right responses for related toy animal character (rabbit) is 8.3%. While he performed 0% in the four sessions, he performed 25 % in the last and first sessions.

M-TK performed 100% correct response in all five sessions during intervention as shown in the Figure 4.4. The desired extent (100%) was reached at least three consecutive sessions, so intervention sessions were terminated. He performed 100%

at the follow-up session. Only one measurement was taken as follow-up session data.

4.3.1.2.3 Effectiveness Data of the First Participants M-BO

The third child M-BO's percentage of correct responses throughout baseline, intervention, and follow-up phases are shown in the Figure 4.4. M-BO completed the seven baseline sessions before teaching the concepts (animals) by using smart toys. He received no information regarding his performance. According to baseline data, the mean score of M-BO in giving right responses for related animal character (dog) is 10.7%. While he performed 0% in the first, fifth, sixth and seventh sessions, he performed 25 % in the second, third and fourth sessions.

M-BO performed 100% correct response in all four sessions out of first session (75%) during intervention as shown in Figure 4.4. The intervention sessions were ended when the at least three consecutive sessions gave the desired extent (100%). He performed 100% at the follow-up session. Only one measurement was taken as follow-up session data.

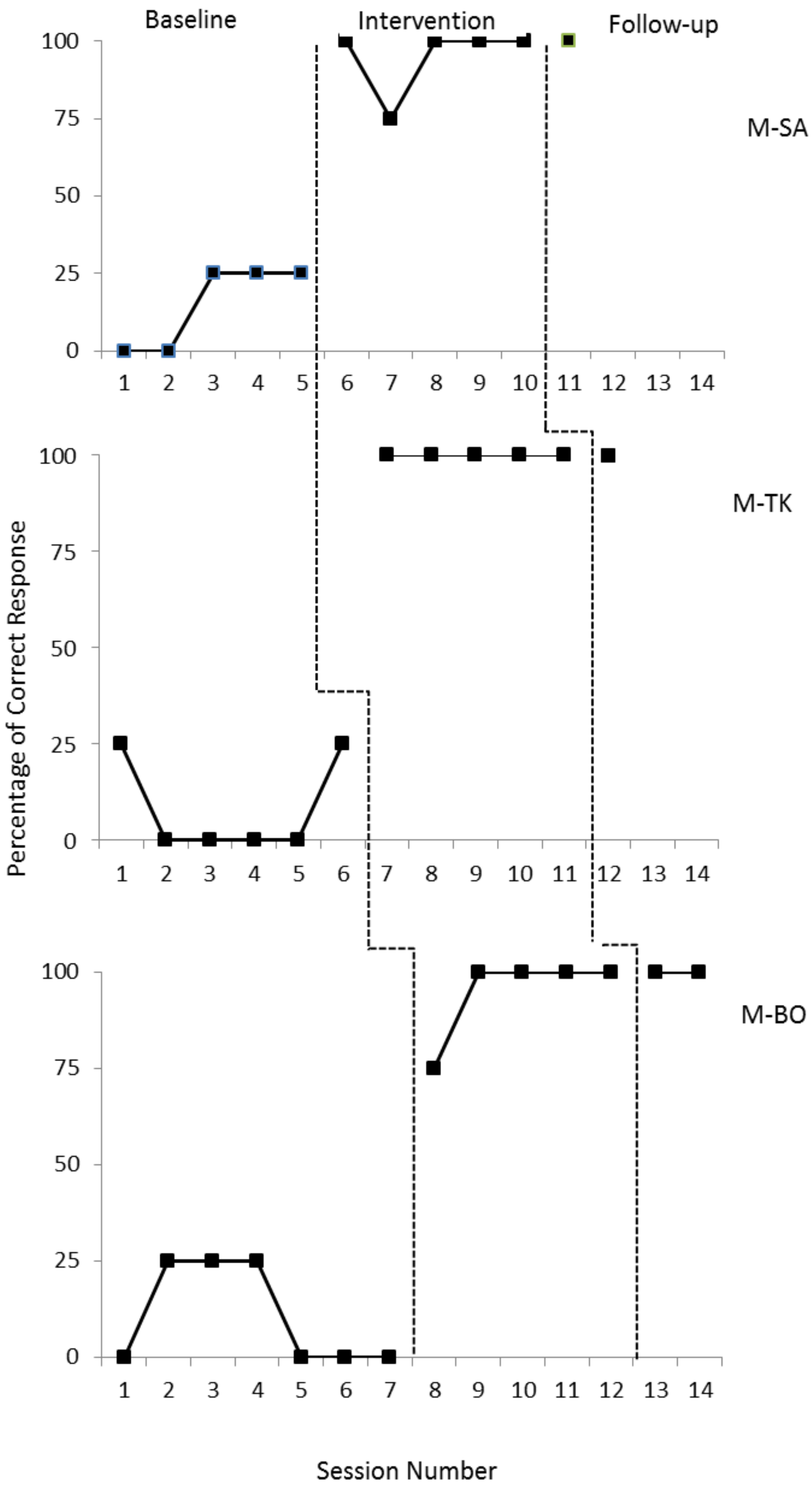

Figure 4.4 Percentages of Correct Responses of Three Participants for the Baseline, Intervention, and Follow-up Sessions

4.3.2 Reliability Data

In the study, three different reliability data were collected: (1) Inter-observer Reliability Data, (2) Procedural Fidelity Data and, (3) Inter-coder Reliability Data.

4.3.2.1 Inter-observer Reliability Data

In order to calculate inter-observer reliability, the agreement on the same content was checked between observers. While primary observer was the researcher, the second observer was independent from the research. For assessing inter-observer reliability, all sessions were watched by the second observer after data collection procedure was explained by using "Observer Notification Sheet" (Appendix F). Then baseline and follow-up sessions' data were coded to Appendix C, intervention sessions' data for each child were coded to Appendix D.

In this part, "agreements/ (agreements + disagreement) x 100" formula was used for analysis of the reliability data between the observers (Tawney & Gast, 1984). The results were as follows: the mean inter-observer agreement was 100% across all children during the three sessions (100% for the baseline session, 100% for the intervention session, and 100% for the follow-up session).

4.3.2.2 Procedural Fidelity Data

Purpose of procedural fidelity is to examine how the planned implementation is applied correctly by practitioner (Tekin-Iftar, 2012). Procedural fidelity data were collected for baseline, intervention, and follow-up sessions as show in the Table 4.2.2. In this study, procedural fidelity data were collected from at least 30% of each different type of sessions, which were selected randomly and coded according to the related session to "Procedural Fidelity Checklist" (Appendix G and Appendix H). Procedural fidelity data were calculated by using the formula: observed practitioner behavior/planned practitioner behavior X 100 (Ledford & Gast, 2014; Tawney & Gast, 1984).

Table 4.2.2 Procedural Fidelity Data for Baseline, Intervention, and Follow-up Sessions

	Baseline Sessions	**Intervention Sessions**	**Follow-up Sessions**
Total Session Number	18	15	4
Evaluated Session Number (calculated at least as % 33 of total of sessions)	6	7	3
Procedural Fidelity Data	88	100	92

Procedural Fidelity Data for Baseline Sessions

In the study, 18 baseline sessions' data were collected. Five sessions belong to the first participant (M-SA), 6 sessions belong to the second participant (M-TK), and 7 sessions belong to the third participant (M-BO). Six sessions were selected randomly in total for procedural fidelity calculation (30% of total baseline sessions). Procedural fidelity data show that practitioner applied the baseline sessions with 88% accuracy level.

Procedural Fidelity Data for Intervention Sessions

Fourteen intervention sessions' data were collected from three participants. Five sessions belong to the first participant (M-SA), 4 sessions belong to the second participant (M-TK), and 5 sessions belong to the third participant (M-BO). Seven sessions were selected randomly in total for procedural fidelity calculation (50% of total baseline sessions). Procedural fidelity data show that practitioner applied the intervention sessions with 100% accuracy level.

Procedural Fidelity Data for Follow-up Sessions

Follow-up sessions' data were collected from three participants. One session belongs to the first participant (M-SA), 1 session belongs to the second participant (M-TK), and 2 sessions belong to the third participant (M-BO). Three sessions were selected randomly in total for procedural fidelity calculation (75 % of total baseline sessions). The result of procedural fidelity data proves that practitioner applied the follow-up sessions with 92% accuracy level.

4.3.3 Usability Data

To answer the fourth research question, observation and interview data were collected. To collect data from the children playing with the smart toy observation method was used. An observation sheet including specific tasks related to smart toy based training was prepared (see Appendix D). The children were observed whether they fulfill these tasks or not. Details of observations were also noted as comments. For each child, usability testing was applied individually under the guidance of his/her teacher. The researcher informed the teachers about how to play with the smart toy before the sessions. Also, the smart toy was introduced to each child by the teachers before starting of each play session. The usability testing results are presented below.

Besides, the changes in the smart toy application after pilot study were considered in usability analysis. After pilot study, main (last) version of smart toy application was developed by making some changes in the pilot application according to the views of special education expert and teachers. They are given in Table 4.3.

Table 4.3 The modifications in the Smart Toy Application after the Pilot Study

Sample Screen No	Modifications
All	All recordings were made once again in a professional studio environment.
9,12,14	All forward buttons were changed in a way that can be operated with a RFID card.
16	All themed backgrounds was removed from the measurement screens.
16	Animal sounds were eliminated from the measuring and assessing screens.
11,13,14,16	The order of animals was designed to change randomly in each reinforcement, measurement, and evaluation screen. In the old version, the correct animal appeared in the upper-left corner.
11,13,14,16	The animals were designed to appear randomly in each reinforcement, measurement, and evaluation screen.
All screen	A play character was added to accompany the audio instructions.

4.3.3.1 Efficiency (Behaviors of Children)

In the Table 4.4, comparison of intervention session time between pilot study and main study – effectiveness data are shown. Time differences have been calculated as duration between choosing play character and end of intervention time. Measurement sessions that were made after in each intervention sessions have not been considered.

As seen in the Table 4.4, there is no significant difference in the mean spent time between pilot study and main study. While participants in the main study completed intervention sessions in average 03:24 minutes, before changes in application participants in pilot study completed intervention sessions in average 03:48 minutes. Maximum value of total playtime in the main study was 05:42 minutes for participant M-SA. Because, he repeated training session twice because of choosing incorrect animal. Minimum value was 02.30 minutes for M-TK. Main reason behind this result is similarity of main and pilot study. There were no changes in the number of steps in two applications in training of skill that effect application duration.

On the other hand, the amount of time spent between sessions for the intervention in the main and pilot study decreased for each participant. For example, while the first intervention session duration in the main study for participant M-TK was 04:13 minutes, it was 02:30 minutes in the last session. Likewise, while participant AS completed first intervention session in 04:44 minutes, last session duration was 03:38 minutes at pilot study.

Similarly, the same trend in time spent for intervention sessions was valid for other participants too. Therefore, efficiency result is important, after participants got used to the smart toy application, the amount of time-spent decrease. For children having limited attention time can benefit from this application.

Table 4.4 Quantitative findings as to the usability of the smart toy

Pilot Study			Main Study		
Code of Participant	Intervention Session Number	Duration (minutes)	Code of Participant	Intervention Session Number	Duration (minutes)
P-AS	1.Intervention	04:44 s	M-SA	1.Intervention	05:42 s
P-AS	2.Intervention	04:03 s	M-SA	2.Intervention	03:09 s
P-AS	3.Intervention	03:02 s	M-SA	3.Intervention	02:53 s
P-AS	4.Intervention	03:38 s	M-SA	4.Intervention	02:50 s
P-ES	1.Intervention	04:44 s	M-TK	1.Intervention	04:13 s
P-ES	2.Intervention	03:22 s	M-TK	2.Intervention	03:25 s
P-YS	1.Intervention	03:15 s	M-TK	3.Intervention	03:00 s
P-YS	2.Intervention	04:25 s	M-TK	4.Intervention	02:30 s
P-YS	3.Intervention	03:00 s	M-BO	1.Intervention	02:43 s
			M-BO	2.Intervention	03:50 s
			M-BO	3.Intervention	02:45 s
Mean		03:48 s			03:24 s

4.3.3.2 Effectiveness

All participants' general success rate for intervention and baseline sessions in the pilot and main study are presented in the Table 4.5 and Table 4.6. Although, participants are more successful in baseline sessions of pilot study (18.8%) than the main study (11.1%) as shown in the Table 4.5, general mean of pilot study (91.7%) is closer to general mean of main study (96.7%) in intervention session.

The main reason of this result is that a few minor changes were made between the pilot study and main study as improving sound quality, changing animal location, and removing some background images. In the pilot study, some participants already knew the names of some animals when they started the baseline sessions, therefore their success rate in baseline is higher than the main study.

Table 4.5 Comparison of Participants' success level in baseline session according to steps of skill between the Pilot Study and Main Study - Effectiveness data

Pilot Study			Main Study		
Code of Participant	Session Number	% Correct Responses	Code of Participant	Session Number	% Correct Responses
P-AS	1.Baseline	0	M-SA	1.Baseline	0
P-AS	2.Baseline	25	M-SA	2.Baseline	0
P-AS	3.Baseline	25	M-SA	3.Baseline	25
P-AS	4.Baseline	50	M-SA	4.Baseline	25
P-AS	5.Baseline	25	M-SA	5.Baseline	25
P-AS	6.Baseline	50	M-TK	1.Baseline	25
P-ES	1.Baseline	0	M-TK	2.Baseline	0
P-ES	2.Baseline	0	M-TK	3.Baseline	0
P-ES	3.Baseline	25	M-TK	4.Baseline	0
P-ES	4.Baseline	0	M-TK	5.Baseline	0
P-ES	5.Baseline	25	M-TK	6.Baseline	25
P-ES	6.Baseline	25	M-BO	1.Baseline	0
P-YS	1.Baseline	25	M-BO	2.Baseline	25
P-YS	2.Baseline	25	M-BO	3.Baseline	25
P-YS	3.Baseline	0	M-BO	4.Baseline	25
P-YS	4.Baseline	0	M-BO	5.Baseline	0
			M-BO	6.Baseline	0
			M-BO	7.Baseline	0
Mean		18.8			11.1

Table 4.6 Comparison of Participants' success level according to steps of skill between Pilot Study and Main Study - Effectiveness data

Pilot Study			Main Study		
Code of Participant	Session Number	% Correct Responses	Code of Participant	Session Number	% Correct Respon
P-AS	1.Intervention	100	M-SA	1.Intervention	100
P-AS	2.Intervention	50	M-SA	2.Intervention	75
P-AS	3.Intervention	75	M-SA	3.Intervention	100
P-AS	4.Intervention	100	M-SA	4.Intervention	100
P-AS	5.Intervention	100	M-SA	5.Intervention	100
P-AS	6.Intervention	100	M-TK	1.Intervention	100
P-ES	1.Intervention	100	M-TK	2.Intervention	100
P-ES	2.Intervention	100	M-TK	3.Intervention	100
P-ES	3.Intervention	100	M-TK	4.Intervention	100
P-YS	1.Intervention	100	M-TK	5.Intervention	100
P-YS	2.Intervention	75	M-BO	1.Intervention	75
P-YS	3.Intervention	100	M-BO	2.Intervention	100
			M-BO	3.Intervention	100
			M-BO	4.Intervention	100
			M-BO	5.Intervention	100
Mean		91.7			96.7

4.3.3.3 Satisfaction

4.3.3.3.1 Problems of Children Playing with the Smart Toy

According to the observation notes, a majority of children have difficulty placing the toys on the RFID surface. Since some toys cover a wider surface area or farther away from the sensor surface to be placed on the RFID, some of the children get help while placing the toy on the RFID surface. It was important to correctly place the toy onto the RFID surface; otherwise, the reader would not be able to scan the tag correctly and the virtual character of the toy did not appear on the screen as a result. This is an important point as it affects the flow and designed squence of the toy play. To solve this problem, a warning sign can be arranged to appear on the screen informing the child of the incorrect placement. According to this finding, the design of a smart toy needs to be clear and opperational for children with ID.

Besides, the RFID reader did not sense the toy because some children placed the related toy character on the RFID surface before the audio instructions were completed. This was due to the design of the RFID program, it was written in such a way the RFID reader sensed after the audio instructions were completed. To make the detection occur, the child had to remove the toy and put it back on the RFID surface with the help of the teacher. It can be inferred from these findings that the RFID surface should be allowed to run while the audio instruction continues.

4.3.3.3.2 Positive Activities of Children Playing with the Smart Toy

According to the observations, the most of children played with the smart toy enthusiastically. Majority of them were happy and enthusiastic when they came to the next intervention session. They wanted to play with the smart toy again. Moreover, plastic toys were attractive for all children. In addition, all of them played toys without leaving the game. Voice instructions were easily understood by the children and they performed the tasks on different stages. It can be inferred from these findings and findings of research question 3 and 4, children enjoyed and motivated while playing with the smart toy.

4.3.3.3.3 Interview Data for Teachers' Views about the Smart Toy Application

To answer the third and fourth research questions, semi-structured interviews were carried out with four special education teachers (see APPENDIX E). 7 of 11 questions were related with teachers' views about the smart toy application. 4 of 11 questions were related with teachers' views about the smart toy technology. Teachers' views about the smart toy application and technology were categorized under seven main themes. These themes were:

- Effectiveness
- Usefulness
- Enjoyment
- Motivation
- Easiness
- Intention (Future Use)
- Features need to be changed

These themes are explained in detailed in the following section.

4.3.3.3.3.1 Effectiveness

All of the 4 teachers found Smart Toy application as effective and instructive. For example, one teacher stated:

> *Yes, I think that is both instructive and effective. Already, when the idea was explained at the stage to join the project, I was thinking it would be a very effective (M-BC).*

Another teacher said:

> *I find it effective. I think it can be reflected in many areas. Both instructive and effective (M-BB).*

Moreover, all teachers stressed that the presenting visual and audio content together made application more effective and instructive. For instance, a teacher explained this as follow:

> *I think it would be very effective. Because children see, animals as well as they hear the sound from the computer. These are things that we cannot find as together (BC).*

One teacher stated that presenting toys and computer together is very effective for special education. She explained this as follow:

Yes, I think smart toy application would be effective. I think it would be effective for these aspects. We normally use computer alone and 3D (physical) toys separately. I think the idea of a bringing together toys and computer is brilliant in terms of special education. Because children really like to do something with a computer and they are impressed by the visual material coming from computer (BC).

In addition, all teachers found smart toy application as effective because it has tangible content and appeal to number of senses such as tactile, visual, and audio. For instance, the views of two teachers for this finding are as follow:

Children like working with material they can touch, feel, and detect the size with their finger. To merge these two materials in terms of special education, I think it would be beneficial for children. Yes, especially in our practice a child can take the toy and put it on the stage, feel with the fingers. Already, computer is the most favorite thing for children (BC).

I think there will be more effective learning due to child uses number of senses: tactile, visual, and audio (NY).

Lastly, one teacher emphasized the application as instructive due to its interactive features. He said that:

Sometimes we have topics that we have failed to teach. It is very difficult in a certain classroom environment in a certain time because we know that we should teach by living and doing already. Let us say we are teaching a duck by using pictures, instruction does not to conclude. However, with a smart toy, child sees a duck from computer with its sound in an interactive way, feel, and also computer says it is duck. There is a good instruction by interaction; child takes a feedback whether it is a duck or not when she puts duck to reader surface (EH).

In summary, teachers' findings as to effectiveness of the smart toy were listed below:

- Visual and audio content presented together.
- Toys and computer presented together.
- Have touchable content.
- Appeal to number of senses.

In conclusion, it can be inferred that teachers found the smart toy application effective and instructive because of it appeals to number of senses and has interactive features.

4.3.3.3.3.2 Usefulness

All teachers found smart toy application as useful. When its useful aspects are asked one teacher emphasized that children learn by experience and touching. She stated:

> *Of course, we are teaching our children based on visual intelligence. They should see first. Therefore, such applications are well suited for our children. We can make instruction in this way by showing, experience. Yes, it is useful because child establishes face-to-face contact in this application, as touching. They feel the visuals also, of course, they are touching, it is not like the paper, or the book they are much more useful for them. I wish I could teach with this in all courses in all areas. There are only a few games, we can teach children by experience, smart boards are now very useful to us also but we need also these materials everywhere (actually where the concept teaching is). For example, in social cohesion for example, this child cannot take a shower (BB).*

Additionally, one teacher pointed out that application appeals to number of senses. She stated:

> *It is so beautiful because it appeal to number of senses (NY).*

On the other hand, 2 of 4 teachers stressed that the smart toy application is useful because it increases retention of memory. For instance, a teacher explained this as follow:

> *Even if child sees, she forgets after a short time. However, she faced with these types of programs and reinforced constantly, retention of memory increases and I think it is more useful for learning (EH).*

In conclusion, based on the teachers' responses, the smart toy play has number of advantages for children. Teachers' findings as to usefulness of the smart toy were listed below:

- Children learn by experience and touching.
- It appeals to number of senses.
- It increases retention of memory.

4.3.3.3.3.3 Enjoyment

All of 4 teachers stated that they and their children enjoyed when using Smart Toy application. For example, one teacher stated that:

> *I did not understand how the time passed, it was very enjoyable (BC).*

Additionally, one teacher declared that smart toy adapted children faster. She explained this as follow:

> *Yes, especially common features of both kID usually cannot adopt any application immediately. So they don't adopt any our work style quickly but they have adapted very quickly and asked them questions, they give very fast response, this is a very important thing for us (BC).*

Besides, one teacher expressed smart toy application as enjoyable because it has enjoyful feedback and reinforcement. She explained this as follow:

> *We are giving food or some things as prizes in here, but when it comes to computer and other device (smart toy) which is interaction device with computer as a material in this way, child reinforces herself already. She is doing more enjoyable seeing she did right or wrong by hearing voice from there. Its benefit is too much (EH).*

Moreover, 2 of 4 teachers pointed out that smart toy maked learning fast and easy. For example, one teacher explained this as follow:

I think, education will be easier thanks to this material. When these types of programs come, our lessons are more enjoyable and a certain time of the course remains because learning is being fast than before. Therefore, we are enjoying very much with children by doing different activities at remaining time (EH).

Lastly, 2 of 4 teachers pointed out that smart toy application saved time of teacher. They stated:

Therefore, we are enjoying very much with children by doing different activities at remaining time (EH).)

They like and we save our time by enjoying much. (NY).

In summary, based on the teachers' responses, smart toy application is enjoyable. It can be inferred teacher and their children had fun when using smart toy applications. Teachers' findings as to enjoyment of the smart toy are listed below:

- Child adopted faster
- Smart toy provided enjoyable feedback and reinforcement
- Smart toy provided fast and easy learning
- Smart toy saved time of teacher

4.3.3.3.3.4 Motivation

What are the teachers' opinions on the impact of smart toys on the motivation of children with ID?

To answer the third research question, motivation sub-theme was analyzed which is included in seven categories about teachers' views about the smart toy application.
In means of motivation, all teachers expressed smart toy application motivated their child and them. One teacher pointed out that application increased child motivation with its similar features to game. She stated this as follow:

Definitely more motivating for children, sounds like a game to them, it seems to learn by playing (BC).

In addition, one teacher emphasized that application motivated child according to the classic learning methods. She explained this as follow:

> *If we used classic learning method, we had to find as possible as cat images to provide visualizing and all of them would remain two-dimensional image. For 3D, we have to show cat by finding cat at outside. Here we can sometimes show video. With this application, we can show 3D model and able to create a mental picture of what it looks like without searching something too much. Yes, yes, more motivating (BC).*

Besides, 2 of 4 teachers mentioned the increase in child motivation by enjoyable reinforcement. For example, one teacher explained this as follow:

> *Of course, she liked very much to be applauded there when she show the animal. She was happy with it, wanted to do it again. If she does not want to do it, already she would not continue, leave. Because she liked it, she did not want to leave, and wanted to get back to applause. Therefore, it was a good reinforcement for her. Therefore, she was very motivated there because she continued. Those reinforcements are important and there were in your application (NY).*

Additionally, 2 of 4 teachers emphasized the increase in child motivation through their interest in PC. For example, one teacher stated:

> *Here, they forget one letter even we work for a year but child is much more relaxed in front of computer that we say smart technology. She sees it as enjoyable environment (EH).*

Moreover, one teacher pointed out that virtual simulation of real environment increased the child motivation. She stated:

> *Of course, classic teaching method remains simple, this is better because child feel like as if live inside of a farm or real environment (NY).*

Lastly, 2 of 4 teachers expressed that their motivation also increased by teaching fast and easily. For example, one teacher stated:

> *Yes, concept teaching is really hard to special education children. Creating image of thought concept in their mind is not a rapidly developing phase.*

> *However, we were able to accomplish it fast by this application. More importantly, we see that they remember the concept after a few applications (BC).*

In conclusion, it can be inferred that teacher and their children were very motivated when using smart toy applications. Teachers' findings as to effect of smart toy on motivation of the children were listed below

- Increase children motivation, sounds "Learn by playing."
- Increase children motivation according to the classic learning materials.
- Increase children motivation by enjoyable reinforcement.
- Increase children motivation through their interest in PC.
- Increase children motivation by virtual simulation of real environment.
- Increase teacher motivation by teaching fast.
- Increase teacher motivation by teaching easily.

4.3.3.3.3.5 Easiness

Based on the responses of all teachers, smart toy application was found easy to use. For example, one teacher stated:

> *Very easy, I did not have trouble to switch with RFID card between screens (BC).*

In addition, same teacher expressed that RFID card provided continuity in application. She stated:

> *Also, RFID card was very useful providing continuity in application. (BC).*

Also, 2 of 4 teachers found smart toy application easy adaptable after a few exercises. For example, one teacher stated:

> *It is extremely easy in terms of usage. At first, in order to move more quickly, a little training is needed (EH).*

Moreover, one teacher found smart toy application enjoyable than learning by books or cards. For example, the teacher stated:

> *Yes, I want, very easy for us, much more enjoyable to teach in this way than to teach from books or card in vain (BB).*

All teachers expressed that using smart toy technology was not complex or hard. For example, one teacher stated:

> *Extremely easy to use, even the younger generations perceive these things more easily, a retired teacher ,later generations behave a little skittish when working with computers but I think this is an application even they can learn in a practice way (BC).*

In addition, all teachers felt themselves competent when they used smart toy technology. For example, one teacher explains this as follow:

> *When one describes the use of it to a person not use computer, I think it is easy to understand (BB).*

On the other hand, in means of difficulties, 2 of 4 teachers expressed that reader surface may be made larger. For instance, one teacher explained this as follow:

> *Of course, it is so good and easy program in means of usage, it is considered very nice, especially animals are in a size that child can hold but the surface that they put the animals can be bigger a little bit because child cannot know how to put the animals on it (NY).*

In addition, as another difficulty, one teacher stated that the use of smart toys for teaching abstract objects may be difficult. She explained this as follows:

> *An excellent learning takes place in a tangible object, but I think it would be a bit difficult in the abstract object. For example, such as excitement, love, I think we forced a little to reflect on emotional expression (EH).*

In summary, it can be inferred that teachers found smart toy application as easy in terms of switching with RFID card between screens, continuity in application, being enjoyable than learning by books and cards, adapting after a few easy exercises.

However, there were also some difficulties related with size of reader surface and teaching abstract objects. Teachers' findings as to easiness and difficulties of smart toy were listed below:

- Very easy to switch with RFID card between screens.
- RFID card provides continuity in application.
- Enjoyable than learning by books and cards.
- Can be adapted after a few easy exercises.
- Reader surface may be larger.
- Use for teaching abstract objects may be difficult.

4.3.3.3.3.6 Future Use (Intention)

All of the teachers claimed that they wished to use smart toy applications in their future classes. For example, one teacher said:

> *I want to use smart toys because they are ease of use (NY).*

In addition, one teacher emphasized that child learns concepts by experience. She explained this as follow:

> *The child learns concepts by experience one to one, for instance, let us say color learning is on the screen, real colors are next to her, and when she reinforced real colors with screen and with voice reinforcement, she will be happier (NY).*

Also, one teacher expressed that smart toy application can be used in many areas. She explained this as follow:

> *You can use this in daily life skills, color, and shape teaching, anything in the way (NY).*

Moreover, one teacher stated that real animation objects can be used on screen. She explained this as follow:

Animation object can be real animal on the screen. Therefore, child can easily generalize (BB).

Lastly, one teacher said that children feel better in such a pleasant environment. She stated:

When the child watches a something, she enjoys at more than paper in her hands because she sees colorful, moving, and lively ambiance there (NY).

In summary, it can be inferred teachers want to use smart toy application in their future classes. Teachers' findings as to future use of smart toy were listed below:

- It is easy to use
- Children can learn concepts by experience
- It can be used in teaching color, object and daily life skills
- Children are more pleasant by colorful, moving and lively environment
- Real animation objects can be used

4.4 Interview Data for Social Validity

The social validity of the research was based on how included teachers responded to questionnaire (Appendix J) presented to them upon completion of the intervention. Questionnaire included six open-ended questions related with research's aim, method, and effect.

The questions related with research's aim were, "Is it important for you to learn these skills of your children?", "Do you think it is important what is taught to your children?" All four teachers gave positive responses. Responses from open-ended questions included responses such as, "It is important for me to learn these skills of children for me, and for her", "Yes, I think it is important what is taught to my children". It can be inferred from teachers' opinion that taught concepts were important to them and their children.

The questions related with research’s method were, “Do you find appropriate the method used in the teaching of these skills?”, “Do you find the appropriate the settings, teaching devices and determined procedures of the research?” All four teachers gave positive responses. Open-ended questions included responses such as,” Of course, certainly very convenient”, “Both very suitable because of familiarity with computers and technical equipment of today's children and it makes desk work more fun and more curious”, “I found them very suitable. All types of materials were organized in accordance with the objectives of the study. There is no situation that hit my eye as contradictory”, “Used material especially from the teaching method is much more effective in teaching concepts to our children.” It can be inferred from teachers’ opinion that they did not see any problems with the appropriateness of the method used in the teaching, settings, teaching devices and procedures and they liked the environment and equipment and found them convenient. This application made the class work more entertaining for children thanks to their interest in studying with the computers. The teachers wanted to diversify this application for teaching different concepts.

The other two questions related with research’s effect were, “Is the child satisfied with the created impact?” and “Do you think it is a positive contribution to the lives of your children to learn these skills?” Responses from open-ended questions included responses such as,” As I said in the beginning, I think absolutely, the child was satisfied. When children go out and for example see a dog, when the child cannot tell its name to his family, friends or to another child will not feel good”, “Children liked”, “M-TK was satisfied. These things were a great opportunity for Taha, because he loved very much these types of things. M-TK is both touching the animals in his hand against the computer and he hears voice feedback from there. M-TK's favorite things are very nice, I think he liked very much.” It can be inferred from teachers’ opinion about child’s satisfaction that the teachers were satisfied with the created impact and its benefit to their children’ lives and they stated children build a wall in terms of in social relations, adaptation, and expressing their feelings. They said that after special education teacher passed that wall, they could begin teaching. However, thanks to this application they taught very easily and amusing.

The fact that the applicaton directly responded to the correct answers given by the child enabled him/her to continue the smart toy play more happily. They think that application was a great opportunity for their children, because children liked these types of things that appealed to many senses very much.

Results from the social validity questions showed all four teachers gave positive responses with all questions. Overall, positive responses were gathered from all participants about their liking of smart toy. Based on these findings, it can be said that the social validity of the study is high.

4.5 Phase 4 (Refining Design Principles)

The finalized and refined principles emerged after completing all phases. These design principles are presented below.

- Smart toy applications should not be complex and not include all animals in one animation, there should be separate learning scenerios for each concept;
- The application should not include too much information about the concept to be taught such as its sound, name, or living environment in one frame;
- The applications should have different difficulty levels to make them usable by children with different cognitive levels;
- The reader surface should be large enough to fit the size of the toys used or toys should be enough size to fit the reader surface;
- All sound effects and narrations should be clear, same tone and, slow;
- When an animal was chosen for play, its voice and background music should be added to the different scenes to attract attention of children;
- Time intervals among assesment and reinformcement screens should be between 3 and 5 seconds as same in systems without technology to prevent loss of children’s concentration;

- Instructions should be simple and not long to keep concentration of the child;
- Screens having forward buttons should be adjusted that can be operated without clicking it;
- Feedbacks should be given immediately in each correct or incorrect move;
- Virtual visuals of the toys should match entirely with the real form to make smart toy play environment as effective and interactive; and
- Play character should be visible only when talking.

4.6 Summary of the Results

Results are presented in five titles: effectiveness, interview data (used in social validity, usability, and third research question), and reliability data. Effectiveness data shows that smart toys are effective to teach social studies concepts to children with ID. While mean value of correct response rate of three participants were 10.1% in baseline session, all participant learned concepts 100% after intervention session. Five intervention sessions were applied for each participant. While second participant (M-TK) learned related animal concept in first intervention, first (M-SA) and third (M-BO) participant learned the concept after second intervention. Therefore, it can be inferred that smart toys have a positive impact on teaching social studies concepts to children with ID.

According to the interview data used for third research question, teachers stated that smart toys are definitely more motivating for children via lots of its feature. The features of smart toy application increasing child motivation expressed by teachers as follows: (1) having similar features with game, (2) more motivating according to the classic learning methods, (3) having enjoyable reinforcement, (4) more motivating through children interest in PC, (5) more motivating by virtual simulation of real environment. On the other hand, teachers also stated that smart toy application affected their motivation positively by teaching fast and easily.

Usability of the smart toy application was examined in terms of effectiveness, efficiency, and satisfaction for pilot and main version. According to the effectiveness results, after pilot application was changed, there was a positive difference between the data obtained in the baseline and intervention sessions of two versions (pilot and mian study) for each child and all participants showed higher scores in correct responses in the intervention phase. However, there was a significant difference between two versions in terms of teaching social studies concepts. Percentage of correct response rate was higher than pilot study. Efficiency data shows there is no significant difference intervention session time between pilot study and main study. On the other hand, the amount of the time spent for the intervention sessions in main and pilot study decreased for each participant. For example, while first intervention session duration in main study for participant M-TK was approximately 4 minutes, it was approximately 3 minutes at last session. Likewise, same trend in time spent for intervention sessions was valid for other participants too. Therefore, this is an important efficiency result; this application can be benefit for children having limited attention time. Satisfaction is another important factor of the usability testing. According to the interview data used for usability, all teachers have positive views about the use of smart toy and application.

In the study, three different reliability data were collected which are inter-observer reliability data, procedural fidelity data and, inter-coder reliability data. According to the result of inter-observer reliability data, agreement between two independent observers was 100 % for all sessions consisting of baseline, intervention, and follow-up. Result show that there was no inaccuracy in coding. According to procedural reliability data, accuracy in baseline session was 88%, intervention session was 100% and follow-up session was 92%. These rates show practitioner was applied implementation conveniently. In analysis of inter-coder reliability data showing reliability of the interview coding, while results was 0.90 for main themes, it was 0.92 for sub-themes. From the results, it could be seen that there was no disagreement in coding themes.

CHAPTER 5

DISCUSSION AND CONCLUSION

This chapter evaluated the findings by considering the research questions. More specifically, it covers the discussion on effectiveness of smart toys on teaching social studies concepts to children with ID and analyze how usable (effective, efficient and satisfactory) the smart toys technology was. First, result of effectiveness data is discussed then themes and teacher views were discussed. After the discussion part, suggestions are made about future research.

5.1 Discussion on Effectiveness of Smart Toy Application

In the study, all three participants (M-SA, M-TK, and M-BO) have same disability type, disability rate, IQ level, socioeconomic status, and age group. Effectiveness data were collected in same environment conditions. Multiple baseline across subjects design was carried out to answer second research question. In baseline sessions, mean value of correct response rate of three participants were 10.1%. Thought animal concept was asked four times sequentially to each participant. They gave correct response only once during these four responses for related animal character. Possibility to give right answer among four choices may be having effect on this result.

In the intervention sessions, while second participant (M-TK) learned related animal concept in first intervention, first (M-SA) and third (M-BO) participant learned the concept after second intervention. Children' interest in computers and toys, fun and interactive environment of the presented smart toy application, preparing the application considering characteristics of children with ID may be the reason behind the learning so fast. Based on these findings, smart toy application was effective on teaching social studies concepts to child with ID.

The current effectiveness data supports previous researches on the use of smart toys in educational purpose improving the skills (social interaction skills, communication skills, problem based learning, literacy, etc.) of individuals with IDs. As a similar study about the use of smart toys in educational purpose improving the skills, a toy company, LeapFrog Schoolhouse™ (2009), examined their smart toy named LeapPad Learning Toy for children with ID at different ages group in school environment. It was developed to enhance literacy skills of first grade or preschool children. In the study, preschool aged children with disabilities that use LeapPad learning toy, showed 29% growth in their reading ability. In another study (LeapFrog Schoolhouse, 2005), after a three-week intervention, children using LeapFrog toys with disabilities in grades K-3 improved performance in letter sound identification (44%), rhyming (87%), and initial sound fluency (43%) (LeapFrog Schoolhouse, 2005). The results of the both studies also reaffirm the effectiveness result of this study.

In another similar research (Karna-Lin et al, 2006), children who have intellectual difficulties and mild mental retardation used Lego robots for problem-based learning. Old plastic building blocks, LEGO, changed over the years and today it is a smart toy, which is animated and responsive. In the study, researcher worked with five groups of children, 8 to 18 years old. All the children were able to speak, but they had difficulties in reading and writing. Purpose of the study was to support children with disabilities in active learning. After systematic observation and teachers' and assistants' interviews, results show that group working skills and the interaction of children have increased in all five groups. The children were motivated (e.g., more communicative and active), and had an opportunity to practice problem solving, logical thinking, perseverance, concentration. The results of the research reconfirm that using smart toys is useful and provide new possibilities to learn and practice various important cognitive and social skills. It can be conluded from all these findings that smart toy applications are effective in teaching social studies concepts or improve the skills of children with ID (social interaction skills, communication skills, problem based learning, literacy, etc.).

5.2 Discussion on Usability of the Smart Toy Application

International Organization for Standardization that makes the important point that usability takes into account ‘specified users’. It is defined, as “Usability is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use” (ISO 9241-11, 1998). The important point is designed technology or product has to be designed considering special needs and limitations of individuals. In other words, the degree of usability depends on who use the system. In this study, usability testing was carried out with teachers by observing children while playing with the smart toy. Usability was analyzed comparing two versions of smart toy application (pilot and main study) in three scales: effectiveness, efficiency, and satisfaction.

According to the results of the effectiveness data, participants' success rate was different in main and pilot study. There is a positive difference between the data obtained in the baseline and intervention sessions for each child and all participants showed higher scores in correct responses in the intervention phase but percentage of correct response increased at different rate in the pilot and the main study. While average of correct responses for the pilot study increased to 91.7% from 18.8% (baseline session) after intervention, average of correct responses for the main study increased to 96.7% from 11.1% (baseline session) after intervention. However, while the amount of increase rate for the pilot study is 72.9%, it is 85.6% for the main study. It can be seen that there is a significant difference between two versions in terms of effectiveness of smart toys in teaching social studies concepts. The findings on the effectiveness of smart toy obtained in this study are in conformity with the findings of some previous studies. Hsieh (2008) conducted a usability study in which he identified the effect of adaptive electronic toys that can provide the feedback and reinforcement system to player. There were three participants having moderate to severe physical disabilities and mild intellectual disability. In the study, all participants showed higher scores in correct responses in the intervention phase. Adaptive electronic toys contributed more correct responses due to simplify the method or access of manipulating the toy. Similarly, Hinske (2009) conducted a user study to explore the effects of the augmented play set (Augmented Knight's Castle) on interactive play and storytelling. It is designed for enriching the pretend play of children by providing sound effects and verbal reactions. According to the result of children interview, questionnaire, and open questions, a great number of children are delighted with playing with the Augmented Knight's Castle. Similar to these findings, Vaucelle and Jehan (2002) conducted a user study with an early version of a computational toy called Dolltalk that simulates speech recognition by capturing the gestures and speech of a child. The result of this pilot study shows that children enjoyed while playing with Dolltalk. It can be concluded from all these findings that using smart toys allows children with intellectual disability to be able to respond more accurately. Smart toys affect children's performance in a positive way while learning cognitive concepts. Therefore, it could be used for this purpose.

Another critical finding of the usability study of the smart toy was that participants' time to complete intervention session. Efficiency data show that changes in the smart toy application did not change the amount of time spent for intervention. Main reason behind this result is similarity of main and pilot study. There were no changes in the number of steps in two applications in training of skill that effect application duration. Only some visual and sound editing was made. On the other hand, the amount of time spent between sessions in the intervention phase in main and pilot study decreased for each participant. For example, while the first intervention session duration in the main study for the participant M-TK was approximately 4 minutes, it was approximately 3 minutes in the last session. Likewise, while the participant AS completed the first intervention session in approximately 5 minutes, last session duration was 3 minutes in the pilot study. Similarly, the same trend in time spent between sessions for intervention phase was valid for other participants. So, this is an important efficiency result, after participants got used to the smart toy application, the amount of time-spent decreased. This application can be beneficial for children having limited attention time. In addition, changes in the application such as removing unnecessary parts and adding a RFID card to facilitate the pass between screens reduce time and effort required by teachers. It provides fast and easy learning. So, certain time of the course remains and they can evaluate the remaining time for different activities. Similar to these findings, Pennington and colleagues (2010) conducted a study to evaluate the effects of simultaneous prompting and computer assisted instruction on story-writing responses of 3 males with ID. They found that use of computer-assisted instruction required minimal instruction time. They stated that this is critical for children with ID having limited attention time and not engage in instructional activities for long periods of time. It can be concluded from these findings that smart toy applications could be beneficial to children with ID having limited concentration. It leads to learning easily and fast. So, certain time of the course remains and they can evaluate the remaining time for different activities.

Another findings of usability study of smart toy application are related with satisfaction results. According to the teachers' views, all of them liked this application and wanted to use smart toys and similar technologies in their classes. They felt themselves quite enough when use it even if some of them did not have good computing skills. All of them found smart toy technology as very easy and simple. Also, they stated that it is very effective program in teaching and learning activities for children with ID. Likewise, Hinske (2009) put emphasis on the augmented toy environments where children are involved, add much to their learning through playing. In the study of Hinske, interviews were done with teachers to get their opinions about Augmented Knight's Castle toy. According to the interview results augmented toy was considered as useful for learning by the teachers. In addition, Frei et al. (2000) examined a self contained smart toy called that Curlybot which supported children to learn basic mathematical and computational concepts. Consequently, these findings proved that smart toys can be used in teaching and learning activities of children with ID.

5.3 Discussion on Motivation of Child with ID

According to the results of the interviews held by teachers, smart toy application took children's attention and it was found very motivational for the children and also teachers. Regarding child motivation, they stated that it increased their motivation more than traditional learning materials. According to Kara (2015), "Designing plush toys according to the characteristics of child may enhance the motivation of both children and teachers to play with the smart toy" (pg.220). Similarly to these findings, Marsh et al. (2005) claimed that new technologies in the use of learning activities have a considerable positive impact on the improvement of child motivation. It can be concluded from these findings that teachers encourage integrating smart toys into special education settings to increase children motivation since smart toys create enjoyable and interactive play.

Moreover, teachers stated that smart toys increased child motivation by providing enjoyable reinforcement. Parallel to this finding, Hinske et al. (2009) found that augmented toy was preferred to play by the children rather than the non-augmented version due to its enjoyable and fun attributes. In a similar study, Wainer et al. (2010) used Lego robots in their study for children having autism and found that collaborative behaviors the children displayed during a class is more strongly related to the amount of enjoyment. In the application, children get immediate feedback as sound or visual when they put the objects to the surface of RFID reader. It also has effect on child's motivation to continue the application. Farr, Yuill and Hinske (2012) also found similar result in their research that "system response provided immediate feedback which motivated children to continue to interact" (p. 121).

Additionally, teachers stated that child motivation increased through their interest to technological tools such as the computer. They became more interested, willingly to continue on working with smart toys. Similar to this finding, Gok et al. (2011) pointed out in their study about views of preschool teachers on usage of information technologies; interest and attention of children are positively affected when these technologies are used appropriately. According to the teacher views, the smart toy increased child motivation by providing virtual simulation of real environment. Parallel to this finding, in the study of Bodén et al. (2013), they developed an augmented reality based system called *Save the wild* which allows children interacting with computer via origami paper characters. Result of the study showed that simulation of real environment creates a more exciting interactive and social experience for young children while they are teaching (Bodén et al. (2013). It can be concluded from these findings that the smart toy application increases children's motivation by making the learning activity more enjoyable by the help of their interest to the computer, and providing a more exciting and interactive environment with the simulation of the real environment. In terms of teacher motivation, teachers stated that smart toy application increased their motivation by making teaching faster and easier. One teacher said that concept teaching has not quite benn settled in the minds of children with ID, eventually succeed in grasping the idea once their teachers used smart toy applications.

5.4 Design Suggestions

Refined design principles emerged after the completion of the analysis, design, development, and evaluation stages. In this part, information is provided as to the design principles in accordance with interview results and the findings in the literature.

First design principle is: *Smart toy applications should not be complex and include all animals in one animation, there should be separate learning scenerios for each concept.* This principle is important because using a large number of toys or other items can reduce the playability of the smart toy application. Similar to this principle, Kehoe et al. (2004) conducted a study on the virtual peer system and stated that "a balance needed to be struck between the presence of too few toys and too many toys. Two or three items in each room seemed to be a good compromise" (p.4). In the pilot version of the application, learning scenerios of all animals were given in one animation without stopping, there were no separate application for each animal.

Similarly, second design principle is: The a*pplication should not include too much information together about the concept to be taught such as its sound, name, or living environment in one frame.* The reason behind of these design principles can be associated with keeping children's focus on toy play because; children with ID are often defined as "slow learners" and cannot easily integrate to the normal curriculum. They have low levels of cognitive functioning (Hammill, 1987). Therefore, virtual content in all learning scenarios and plastic toys need to be designed simple and considering the cognitive level or level of perception of child with ID. These design principles are also associated with Let's Play!" projects formulated a number of universal design guidelines for toy that suggests the toy should support the child's development: and stimulate physical or mental activity (Universal Design for Play Guidelines, 2004).

The third design principle is: *The applications should have different difficulty levels to make them usable by children with different cognitive levels*. It is related with the complexity of virtual content of smart toy. Challenge which is one of the important elements of flow in toy play can be advantageous in smart toy play to keep children in the play. Hovewer, difficulty level can be adjusted in both content and design of application accordingly. In this study, smart toy application allows children to repeat and practice learning content within his /her own cognitive capabilities. Besides, assessment part of the application has four different difficulty levels. Paralel to this design principle, Hanna et al. (1999) suggested that activities presented in computer products should be complex and adapted to each child's particular skills.

The fourth design principle is: *The reader surface should be large enough to fit the size of the toys used or toys should be enough size to fit the reader surface.* According to the findings, objects used in the smart toy applications should be in an appropriate size that child identify and control play environment easily without any effort. Hinske (2009) supported this principle proposing that the items exising in the play settings should be under the control of the players.

The fifth design principle is: *When an animal was chosen for play, its voice and background music should be added to the scenes to attract attention of children.* In the study, background music has been integrated into some scenes that include feedbacks. Hence, attractive interface could help children to adapt to the toy environment easily (Rolling and Morris, 2003; Prensky, 2001). Audio of play environment keeps the learners' attraction. (Tan et all, 2007). Likewise, Hinske, Lampe, Yuill, Price, and Langheinrich (2009) conducted a user study of an augmented toy environment and findings show that adding background music to the toy environment created fun and positive environement for children. And also, the sixth design principle was all *sound effects and narrations should be clear and same tone.* Because, narratives effects the focus on the flow of the game and offers better interaction between learners and games in a meaningful way (Siang and Rao, 2004).

The seventh design principle is: *Screens having forward buttons should be adjusted that can be operated without clicking it.* Smart toy should be easily controllable to improve the interaction (Kara, 2015). In the study, smart toy computer application was set to be controllable in two ways, one was in a form of RFID card, and other was in a form of forward button. Similar to this principle, Hinske (2009) suggested that play environment should allow controlling the learning environment.

The eighth design principle is: *Time intervals among assesment and reinformcement screens should be between 3 and 5 seconds as same in systems without technology to prevent loss of children's concentration*. In the application, if the child does not place the object on the reader surface within 5 seconds, the instruction was repeated until he/she does so. In classic learning environments without technology, time intervals that gives best results for same situation is as between 3 and 5 seconds. For that reason, it was choosen as 5 seconds.

Similarly, the nineth design principle *is : Instructions should be simple and not long to keep concentration of the child*. These principles are related with the flow of smart toy play should not be distracted with the long pauses. Children having ID have low concentration (Hammill, 1987). Therefore, unnecessary and long pauses can disturb the concentration of the child.

The tenth design principle is *Feedbacks should be given immediately in each correct move or wrong move after the child puts a toy onto the reader.* Since children may lose concentration easily, smart toy application should give feedback on demand to keep children's concentration high. Besides, giving feedback just in time could reduce misunderstandings and allow learners to apply the information correctly (Tand et all, 2007).

The eleventh design principle is: *Virtual visuals of the toys should match entirely with the real form to create effective interactive environment in smart toy play.* Additionally, the twelfth design principle was *Play character should be visible only when talking.* These principles related with the content and flow of the smart toy play should be consistent with real life. This finding can be associated with the study findings of Kehoe et all (2004), realistic characters or content improve interaction of children into play environments and enrich the visual design. Likewise, Lampe and Hinske (2007) stated in their research that "realistic illustrations of the figures, buildings, and objects of the playset intensify the immersion into the game" (p. 4).

5.5 Practical Implications for Special Education Teachers/ Practitioners

The results of the research render a number of practical implications for teachers and practitioners working in special education settings. According to them, it is possible to teach specific concepts using smart toy application in lessons.

Yet, following issues have to be considered when using this application (see Appendix M):

(1) The application fits children having the characteristics below:

- (a) able to perceive minimum five-word- sentences and simple verbal instructions;

(b) able to focus on a given subject for least 10 minutes,

(c) able to use hands and fingers without difficulty;

(d) able to use language and fingers in answering questions;

(e) having no physical disability or health problems other than ID.

(2) The practitioner should do the following tasks:

(a) remove distracting stimuli from the environment;

(b) announce the concept to be covered for the session;

(c) introduce smart toy application to child briefly;

(d) enter the child's name to login screen and start the application

(e) draw the attention of child to the application;

(f) control the application using RFID card in required steps;

(g) ensure the attention of child to focus on the application;

(h) wait patiently during the response time (5 seconds);

(i) help the children while the application provides positive, negative feedback and reinforcement to them.

Practitioner should repeat this process until all steps are completed. It is expected that, after three consecutive training sessions, children with ID learn the target concept using the developed smart toy application.

5.6 Suggestions for Future Research

This study was about investigating effectiveness of smart toys on cognitive skills of children with ID and analyzing usability issues of the technology from special education teachers' point of view. At the end of study, result of the effectiveness of smart toy, usability issues and smart toy practices of teachers and children were concluded. Although this study can provide a perspective about effectiveness and usability of smart toys, future research would be needed in following areas.

- There is a lack of study about effectiveness of technology enhanced learning environment in the special education. Especially, studies, exploring effectiveness of smart toys. For this reason, new kinds of smart toys supporting special education curriculum could be developed and much more research is needed about the effects of smart toys.
- In this study, developed smart toy was investigated in teaching cognitive concepts to children with ID and results of this study show that using smart toys is an effective method to improve cognitive skills of children with ID. For this reason, new smart toys could be developed and investigated with special education children to improve different kind of skill (communication, academic, daily living skills etc.).
- This study was performed with individuals having ID. The effectiveness of smart toy application could be investigated with children having different developmental disability.
- Parents could be included to analyze children experiences in informal learning environment.

5.7 Limitations

The limitations of this study were listed below:

- This study has some limitations in terms of participants. There were totally six children participants. Three of them were for the pilot and the other three were for the main study, which were selected with a convenience sampling. There is no random sampling.
- This study was limited to special education teachers and children with ID attended as participants.
- RFID technology was the mainly considered in the study that provide communication between plush toys and computer. While RFID technology has many advantages, other technologies might be equally suitable, depending on the particular scenario. How other existing technologies could contribute to the smart toy technology could be analyzed.

- Socioeconomic status of participant populations was not considered in this study, and may be a contributing variable.
- Validity of this research depends on the reliability of the used instruments and frankness of the participants' answers to the instruments.
- Researcher was the only person doing all analysis and transcription of study. Therefore, the result of the study is dependent to researcher's interpretation skills.

5.8 Conclusion

Today, children are exposed to a large array new technologies for various purposes. Therefore, the new generation is more enthusiastic and successful in using technological devices. As an extension of this trend, smart toys that can talk, respond, teach, and interact, have become the new forms of play activities for children. Play is an essential part in a child's life and vital for his/her social, emotional, intellectual, and physical development. Smart toys have the potential to support and enhance these play activities including not only the physical toys, but also adding the attractiveness of technology. Therefore, the following result can be reached that smart toys can encourage child development and enhance learning.

The main goal of this research was to investigate the effectiveness of smart toys in teaching the concepts of social studies and to determine if there is a positive impact on the motivation of children with ID. Hence, an educational smart toy system aiming to teach social studies concepts to individuals with IDs was developed and used. Besides, field experts were included to get their views for the design and development process. Finally, the usability issues of the smart toy presented in this study in terms of effectiveness, efficiency, and satisfaction from special education teachers' point of views.

Based on effectiveness study, smart toy applications have a positive effect on teaching the concept of social studies. It can be concluded that smart toys can be used in learning and teaching activities in special education for children with ID. Moreover, workload of special education teachers decreased with this study. Smart toy provides enjoyable feedback and reinforcement. It decreases learning time and makes learning enjoyable. In the traditional learning method, mentioned concepts can be taught by using cards and requires more time and effort. Teachers save their time and have an opportunity to do different activities at their remaining time. Therefore, it can be concluded that smart toys have big advantages for children having a limited time in the rehabilitation center.

Also, teachers' views were taken about the smart toy technology and use in this study. Smart toy application was found more motivating than the classic learning metarials by the all teachers. Virtual simulation of the real environment creates a more interactive and exiting ambience for children while they are learning. In the application, a child gets an immediate audial or visual feedback. It also has an effect on child's motivation to continue to interact. This result is important for the individuals with IDs who may have lower motivation than people without disabilities and the teachers who have a limited time for each disabled child. Therefore, it can be concluded that smart toys have the power to improve children and teachers' motivation toward learning activities. It might be concluded from teachers' statements that they are positive to using smart toy technology in special education settings.

A number of design principles emerged in the end of the research**.** In terms of the design and development of smart toys, these design principles were expected to be the best smart toy practices applicable in special education settings. Also, usability tests were conducted with children with ID. It might be concluded from the results that children have fun while playing with the smart toys. Since today's children are more enthusiastic to play with technological materials. Their virtual power can be supportive and fun when integrated into children's daily toys.

Although this study can provide a perspective about the effectiveness and usability of smart toys, much more research is needed to improve the smart toy literature. It is expected that the findings of this study help children with ID, special education teachers and researchers who are interested in smart toys.

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APPENDIX A

THE PARENT PERMISSION FORM

Sayın Veli,

Çalışmayı yürüten Cansu Çiğdem Ekin, Orta Doğu Teknik Üniversitesi, Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümünde doktora öğrencisi olarak çalışmaktadır.Orta Doğu Teknik Üniversitesi öğretim üyesi Prof. Dr. Kürşat Çağıltay danışmanlığında yürütülmekte olan bu çalışma Cansu Çiğdem Ekin'in doktora tez çalışması olacaktır. Çalışmanın amacı özel eğitime ihtiyaç duyan öğrencilierimize bilişsel kavramların öğretiminde akıllı oyuncakların etkisini araştırmaktır.

Katılımın gönüllü olduğu bu çalışmada çocuğunuz ile periyodik çalışmalar yürütülecektir. Çalışma çocuğunuz için psikolojik veya fiziksel bir risk taşımamaktadır, böyle bir risk taşıdığını hissettiğiniz zaman çocuğunuzun katılımını engelleyebilir ve çalışmayı bırakabilirsiniz. Çalışma sırasında bilimsel değerlendirme amaçlı görüntü kaydı alınacaktır. Çalışmada gizlilik esas olacak, çocuğunuzun ismi hiçbir yerde rapor edilmeyecektir. Cansu Çiğdem Ekin çalışma süresince kendisine soracağınız tüm sorulara cevap verecektir.

Çalışmaya ya da çocuğunuzun katılımına yönelik daha fazla bilgi için başvurulacak kişi Cansu Çiğdem Ekin'dir. Telefon: 0537 8221326 E-posta Adresi: cansu@atilim.edu.tr
İlginiz için teşekkürler,

Cansu Çiğdem Ekin
Yukarıda açıklamasını okuduğum çalışmaya, oğlumun / kızımın katılımınaizin veriyorum. Velinin:

Kodu: ____________________ İmzası: ______________________ Tarih:

İmzalanan bu formu lütfen öğretmeniniz aracılığı ile bize ulaştırın.

APPENDIX B

THE DEMOGRAPHIC INFORMATION FORM

Öğrenci Kodu:		Veli Kodu:	
Öğretmen Kodu:			
Yaş:			
Tanısı:			
Yetersizlik Düzeyi (Özür oranı):			
IQ seviyesi:			
Ek engel durumu var mı? (protez vb.)			
Annenin Yaşı:		Babanın Yaşı:	
Annenin Eğitim Durumu:		Babanın Eğitim Durumu:	
Annenin Mesleği:		Babanın Mesleği:	
Kardeş Sayısı:			
Ailenin Gelir Seviyesi			
Farklı Bir Yerden Eğitim Alıyor mu? Alıyorsa Kurum Adı ve Sınıfı Nedir?			

BİLGİSAYAR KULLANMA BECERİLERİ

Çocugunuzun, bilgisayar kullanması ile ilgili neler söyleyebilirsiniz?	Evet	Hayır	Açıklamalar
1. Ekranı ve kasayı açar.			
2. Fareyi saga sola yukarı aşağı			

hareket ettirir.			
3. Bilgisayarda kayıtlı olan müziği dinler.			
4. Bilgisayarda oyun oynayabilir			
5. Word belgesi üzerinde yazı yazar.			

ALICI DİL BECERİLERİ

Çocugunuzun ,ondan bişey yapmasını istediğinizde istediğiniz şeyi yerine getirmesiyle ilgili neler söyleyebilirsiniz?	Evet	Hayır	Açıklamalar
1. 2 kelimelik yönergeleri yerine getirir.			
2. 3-5 kelimelik yönergeleri yerine getirir.			
3. 2 ya da daha fazla davranışta bulunması gereken yönergeleri yerine getirir.			
4. Sorulan soruya işaret ederek ya da sözlü olarak tepki verebilir.			

DİĞER ÖNKOŞUL BECERİLERİ	Evet	Hayır	Açıklamalar
Okula Düzenli Devam Etme			
Ellerini Kullanabilme			
Dikkatini en az 10 dakika sure bir etkinliğe yöneltebilme			

APPENDIX C

BASELINE AND FOLLOW-UP SESSIONS DATA COLLECTION FORM

Değerli Uzman,

Başlama düzeyi verilerini toplamak amacıyla, bu araç her bir deneğe en az üç oturumda uygulanacaktır. İzleme oturumu için ise en az bir oturum uygulanması gerekmektedir.Uygulama sırasında, öğrenci ile karşılıklı oturulacak, sırasıyla hayvanlar sorulacaktır.Örneğin ilk oturumda Öğrencinin tepki vermesi için 3-4 saniye beklenecek, öğrenci tepki vermemişse soru yönergesi tekrar edilecektir. Eğer öğrenci yine tepki vermez veya yanlış tepki verirse yanlış tepki veriyor olarak kabul edilecektir. Öğrencinin doğru ve yanlış cevapları için tepkisiz kalınacak, verdiği cevaplar bu çizelgeye işlenecektir.

<table>
<tr><td>Öğrencinin Kodu: ....</td><td colspan="3">Öğretmenin Kodu: ....</td><td>Tarih: ………………
…………</td></tr>
<tr><td>Çalışılan Kavram: ....</td><td colspan="3">Oturum Başlangıç Zamanı:..........</td><td>Oturum Bitiş Zamanı: ....</td></tr>
<tr><td colspan="5">Oturum Numarası: ....</td></tr>
<tr><td>Örnek Soru Yönergesi: Önündeki hayvanlardan.......(hayvanın adı) bul ve göster.</td><td>Sıra No</td><td>Doğru</td><td>Yanlış</td><td>Tepkide Bulunmuyor</td></tr>
<tr><td rowspan="4">Hedef Davranış
• Adı söylenen hayvanı gösterir.</td><td>1</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Gözlem Notu</td></tr>
</table>

APPENDIX D

INTERVENTION SESSIONS DATA COLLECTION FORM

Değerli Uzman,

Uygulama düzeyi verilerini toplamak amacıyla, bu araç her bir deneğe en az üç oturumda uygulanacaktır. İzleme oturumu için ise bu aracın en az bir oturum uygulanması gerekmektedir.Uygulama sırasında, öğrenci ile karşılıklı oturulacak, bilgisayar uygulaması ile ilgili kavramın eğitici metaryali çalışılacaktır. Bilgisayar uygulaması yeterli düzeyde seçilen kavramın eğitiminin yapılıp yapılmadığını otomatik ölçümlendirecek ve sırasıyla pekiştirme ve ölçme değerlendirme ekranlarına sizi yönlendirecektir. Örneğin uygulama, ilk oturumda öğrencinin tepki vermesi için 3-4 saniye bekleyecek, öğrenci tepki vermemişse soru yönergesini tekrar edecektir. Yanlış tepki verirse yanlış tepki veriyor olarak kabul edecektir. Uygulamacı öğrencinin doğru ve yanlış cevapları için tepkisiz kalacak, verdiği cevaplar bilgisayar ölçme değerlendirme rapor ekranından alınarak bu çizelgeye işlenecektir.

<table>
<tr><td>Öğrencinin Kodu..........</td><td colspan="3">Öğretmenin Kodu:</td><td colspan="2">Tarih:</td></tr>
<tr><td>Çalışılan Kavram:
.....................</td><td colspan="3">Oturum Başlangıç Zamanı:..........</td><td colspan="2">Oturum Bitiş Zamanı:
.............</td></tr>
<tr><td colspan="6">Oturum Numarası: ....</td></tr>
<tr><td>Örnek Soru Yönergesi: Önündeki hayvanlardan atı bul ve göster.</td><td>Sıra No</td><td>Doğru</td><td colspan="2">Yanlış</td><td>Tepkide Bulunmuyor</td></tr>
<tr><td rowspan="4">Hedef Davranış
• Adı söylenen hayvanı gösterir.</td><td>1</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td>2</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td>3</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td>4</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="6">Gözlem Notu</td></tr>
</table>

APPENDIX E

INTERVIEW PROTOCOL FOR THE SPECIAL EDUCATION TEACHERS (USABILITY)

Görüşülen Kişi : …………………………………………

Görüşmeyi Yapan : ……………………………………

Tarih & Saat : …../…../ 2015 & .... : …..

Görüşme Süresi : ……………….....................

Görüşmenin Yapıldığı Yer : ……………….........

Merhaba,

Bu çalışmanın amacı eğitsel amaçlı olarak geliştirilmiş olan akıllı oyuncakların zihinsel engelli öğrencilere hayat bilgisi kavramlarının öğretimi üzerindeki etkililiğini ortaya koymaktır. Öncelikle görüşlerinizi benimle paylaşmayı kabul ettiğiniz için teşekkür ediyorum. Bu konudaki düşünceleriniz ve görüşleriniz çalışma için büyük önem taşımaktadır. Yapacağımız görüşme sadece araştırma amaçlı kullanılacaktır. Bu çalışma sonucunda oluşturulacak olan dokümanlarda isminiz doğrudan ya da dolaylı olarak kullanılmayacaktır. Araştırma tamamlandıktan sonra ilgili analiz, sonuç ve tavsiyelerimizi eğer isterseniz sizlerle paylaşabiliriz. İzin verirseniz görüşmeyi kaydetmek istiyorum. Sizce sakıncası var mı? Sormak istediğiniz bir soru var mı?

Uygulamalar ile ilgili sorular:

1. Bilişsel becerilerin öğretiminde (örnekler verelim burada) Akıllı Oyuncak uygulamalarının etkili olacağını düşünüyor musunuz? Nasıl? Hangi yönde?
2. Akıllı Oyuncak uygulamalarını öğreticilik ve etkililik açısından nasıl değerlendiriyorsunuz?

3. Akıllı Oyuncak uygulamalarının özel eğitim öğrencileri için faydalı olduğunu düşünüyor musunuz? Faydalı yönleri var ise, nelerdir?
4. Akıllı Oyuncak uygulamalarını kullanırken siz ve öğrencileriniz eğlendiniz mi?

    a. Akıllı Oyuncak uygulamalarını kullanmak öğrencilerinizi motive etti mi?
    b. Klasik öğretim yöntemlerine göre daha az/çok motive oldu mu?
    c. Öğretim esnasında öğrenciler eğlendiler mi?
    d. Öğretmen olarak bu uygulamaların sizin motivasyonunuza etkisi nasıldı?

5. Akıllı Oyuncak uygulamalarını kullanmak siz ve öğrencileriniz için ne kadar kolay bir kullanıma sahiptir? Karşılaştığınız zorluklar nelerdir?
6. Akıllı Oyuncak uygulamalarını gelecekte öğretim etkinliklerinizde kullanmak ister misiniz? Hangi tür etkinlikler?
7. Akıllı Oyuncak uygulamalarında sizin hoşlanmadığınız yönler var mıydı? Varsa nelerdir?

Akıllı Oyuncak ile ilgili sorular:

1. Akıllı Oyuncak teknolojisini gelecekte öğretim etkinliklerinizde kullanmak ister misiniz?
2. Akıllı oyuncak kullanımının gelecek uygulamalarında nasıl çeşitlendirmeler görmek istersiniz?
3. Akıllı Oyuncak teknolojisini kullanmada kendinizi ne derece yeterli hissediyorsunuz?
4. Sizce Akıllı Oyuncak teknolojisinin eğitimde kullanımı zor ve karmaşık mı?

APPENDIX F

OBSERVER NOTIFICATION SHEET

Sevgili gözlemci: Bu bilgi formu, gözlemciler arası güvenirlik ve uygulama güvenirliği verilerini toplayacak olan gözlemciye bilgi vermesi amacıyla düzenlenmiştir. Bu nedenle, gözlemciye, araştırmada yürütülen uygulamalar hakkında bilgi sunulmuştur.

a) Bu araştırmanın amaçları nelerdir?

Bu araştırmanın amacı, zihinsel engele sahip öğrencilere hayat bilgisi kavramların öğretilmesinde, akıllı oyuncaklarla öğretiminin etkililiğini değerlendirmektir. Çalışmada aşağıda sıralanan sorulara yanıt aranmıştır.

1. Akıllı oyuncaklar zihinsel engele sahip öğrencilerde, hayat bilgisi kavramlarının öğretiminde olumlu etkiye sahip midir?
2. Akıllı oyuncaklar zihinsel engele sahip öğrencilerin motivasyonunu artırmada olumlu etkiye sahip midir?
3. Akıllı oyuncaklar özel eğitim hocaları gözünden ne kadar kullanılabilirdir?

b) Uygulamacı oturumlarda deneklerin dikkatini çalışmaya yöneltmek için hangi tür dikkati sağlayıcı ipucu sunmuştur?

Uygulamacı, araştırma süresince, deneklere "Ekrana bak", "Hayvanlara dikkatlice bak" , "Beni dikkatli dinle" biçiminde kişisel dikkati sağlayıcı ipucu sunmuştur.

c) Uygulamada deneklere sunulan hedef uyaran (ana yönerge) nedir?

Araştırma süresince, deneklerle gerçekleştirilen başlama ve izleme oturumlarında "Bana .(hayvanın ismi)... göster, ..(hayvanın ismi)... ver, .(hayvanın ismi).... hangisi bana ver vb." biçiminde öğretim oturumlarında hedef uyaran olarak ise "Sıra sende şimdi önündeki oyuncaklardan ..(hayvanın ismi)... bul ve sahneye koy" denilmiştir.

d) Öğretim oturumlarında kullanılan kontrol edici ipucu nedir?

Uygulamada bilgisayar aracılığı ile gerçekleştirilen öğretim oturumlarında deneklere "sözel ipucu + model ipucu" birlikte sunulmuştur. Bilgisayarda uygulamayı izlerken, sözel ipucu olarak örn: "Ekranda bir köpek var . Bak bu bir köpek" sesinin verilmesiyle birlikte bilgisayar ekranındaki animasyonda köpek animasyonu gösterilerek model ipucu sunulmuştur.

e) Araştırmada kullanılan yanıt aralığı nedir?

Araştırmanın öğretim ve izleme oturumlarının tümünde yanıt aralığı 5 sn olarak kullanılmıştır.

f) Deneklerin doğru ve yanlış tepkilerine hangi davranış sonrası uyaranlar sunulmaktadır?

Yoklama ve izleme oturumlarında, deneklerin doğru ve yanlış tepkilerine karşılık;

Deneklerin göstermiş olduğu doğru ve yanlış tepkiler için herhangi bir pekiştireç kullanılmamıştır. Denek tepki vermediği durumda hedef uyaran (ana yönerge) tekrar sunulmuş, tekrar tepki vermediği durumda çalışma sonlandırılmıştır. Oturumlar esnasında doğru ve yanlış gerçekleştirdiği basamaklar araştırmacı tarafından kayıt edilmiştir.

Öğretim oturumlarında, deneklerin doğru ve yanlış tepkilerine karşılık;

Deneklerin göstermiş olduğu her doğru tepki, hem araştırmacı hemde bilgisayar uygulaması tarafından sözlü ve görsel ifade ve animasyonlarla (Örn.: "Dogru bildin, Aferin, harikasın" gibi) sürekli pekiştirme tarifesiyle pekiştirilmiştir. Yanlış tepkilerinde ise, hata düzeltmesi olarak bilgisayar uygulaması tarafından "Bu bir köpek değil, haydi köpeği tekrar öğrenelim" sözlü ifadesi ile birlik görsel animasyon sunularak öğretim uygulamasının tekrar izlenmesi gerektiği söylenmiştir. Öğrenci önceki konumuna geri getirilerek,bilgisayardan animasyon tekrar izletilmiştir. İzledikten sonra hedef uyaran tekrar verilmiştir. Öğrencinin tüm basamakları kesintisiz olarak doğru yapıncaya kadar bu süreç tekrarlanmıştır.

APPENDIX G

BASELINE AND FOLLOW-UP SESSIONS

PROCEDURAL FIDELITY CHECKLIST

Amaç: Bu formun amacı, uygulamacının uygulamış olduğu yoklama ve izleme oturumlarını hazırlamış olduğu ölçme değerlendirme ve öğretim planlarına ne ölçüde uygunluk gösterdiğini belirlemektir.

Kullanma yönergesi: Bu formda, uygulayıcının gerçekleştirmesi beklenen beceri basamakları "Beceri basamakları" sütununda yer almaktadır. Gözlemci, uygulamacının bu basamakları yerine getirip getirmediğini kamera kayından izleyerek, uygunsa "Evet" sütununa; uygun değilse " Hayır" sütununa işaret koymak suretiyle belirleyecektir.

Öğrencinin Kodu :.................................. Uygulamacının Kodu :...............................
Gözlemcinin Kodu:................................ Tarih:..
Oturum No :.. Toplam Süre :...

Sıra No	Beceri Basamakları	Evet	Hayır
	Ortam ve Araç- Gereçler		
	Ortamı dikkat dağıtıcı uyaranlardan arındırır.		
	Becerinin gereğine uygun hayvanları seçer.		
	Kamerayı uygun açıda kullanıma hazır şekilde yerleştirir.		
	Ölçmeye Hazırlık		
	Çalışılacak olan hayvanı söyler (Ana yönergeyi verir.)		

	Dikkat işaretini verir.		
	Öğrenci ana yönerge bir kez sunulduktan sonra doğru tepki verirse,		
	Öğrencinin vermiş olduğu doğru tepkiyi ilerleme kayıt çizelgesinde ilgili bölüme kaydeder.		
	Öğrenci ana yönerge bir kez sunulduktan sonra yanlış tepki verirse,		
	Öğrencinin vermiş olduğu yanlış tepkiyi ilerleme kayıt çizelgesinde ilgili bölüme kaydeder.		
	Öğrenci ana yönerge bir kez sunulduktan sonra tepkisiz kalırsa		
	Ana yönergeyi tekrar eder.		

APPENDIX H

INTERVENTION SESSIONS PROCEDURAL FIDELITY CHECKLIST

Amaç: Bu formun amacı, uygulamacının uygulamış olduğu öğretim oturumlarını hazırlamış olduğu öğretim planlarına ne ölçüde uygunluk gösterdiğini belirlemektir.

Kullanma yönergesi: Bu formda, uygulayıcının gerçekleştirmesi beklenen beceri basamakları "Beceri basamakları" sütununda yer almaktadır. Gözlemci, uygulamacının bu basamakları yerine getirip getirmediğini kamera kayından izleyerek, uygunsa "Evet" sütununa; uygun değilse " Hayır" sütununa işaret koymak suretiyle belirleyecektir.

Öğrencinin Kodu :.................................. Uygulamacının Kodu :...............................
Gözlemcinin Kodu:................................ Tarih:..
Oturum No :... Toplam Süre :...

Sıra No	Beceri Basamakları	Evet	Hayır
	Ortam ve Araç- Gereçler		
	Ortamı dikkat dağıtıcı uyaranlardan arındırır.		
	Becerinin gereğine uygun hayvanları seçer.		
	Kamerayı uygun açıda kullanıma hazır şekilde yerleştirir.		
	Öğretime Hazırlık		
	Çalışılacak hayvanın ismini söyler		
	Ortamı tanıtır.		
	Dikkat işaretini sunar. (Haydi başlıyoruz!)		

	Becerinin her bir basamağı için ilgili uygulamayı adım adım çalıştırır.		
	Öğrencinin bilgisayar uygulamasını izleme esnasında ilgisi dağılırsa, dikkatini çeker.		
	Her basamak için uygun yönergeyi verir.		
	Yanıt aralığını bekler (5 sn).		
	Öğrenci ana yönerge bir kez sunulduktan sonra doğru tepki verirse,		
	Öğrenci, doğru tepki verdiğinde sözlü olarak pekiştirir.		
	Öğrencinin vermiş olduğu doğru tepkiyi ilerleme kayıt çizelgesinde ilgili bölüme kaydeder.		
	Öğrenci ana yönerge bir kez sunulduktan sonra yanlış tepki verirse,		
	Öğrenci yanlış tepki verdiğinde öğretimi tekrarlar.		
	Ana yönergeyi ikinci kez sunar.		
	Öğrenci doğru tepki verdiğinde sözlü olarak pekiştireç sunar.		
	Öğrencinin vermiş olduğu doğru tepkiyi ilerleme kayıt çizelgesinde ilgili bölüme kaydeder		
	Öğrenci ana yönerge bir kez sunulduktan sonra tepkisiz kalırsa		
	Ana yönergeyi tekrar eder.		
	Becerinin tüm basamaklarını doğru yapana kadar öğrencinin vermiş olduğu tepkilere uygun şekilde basamakları tekrar uygular.		

APPENDIX I

EQUIPMENTS USED IN THE STUDY

PC 	Samsung N210 Netbook Screen: 10.1-inch
	Processor: Intel Atom N570 1.66 GHz
	Operating System:Windows 7
	Weight:2.29 Kg
Video Camera 	Samsung Galaxy Note4 Mobile Phone
	Resolution:16 MP
	AutoFocus
	LCD Screen :5.7 inch
Toy Objects	

	
RFID Reader 	Name: RFID Antenna Resonant 125 kHz :Frequency Min Antenna Resonant 150 kHz :Frequency Max EM4100, Protocol: ISO11785 FDX- B, PhidgetTag
RFID Card 	3008_0 - RFID Tag - Credit Card Sized

APPENDIX J

INTERVIEW PROTOCOL FOR THE SPECIAL EDUCATION TEACHERS

For SOCIAL VALIDITY

(TURKISH)

1. ***Amacın*** sosyal olarak önemi:
    a. Öğrencinizin bu beceriyi öğrenmesi sizin açınızdan önemli mi?
    b. Öğrencinize öğretilmeye çalışılanların onun için önemli olduğunu düşünüyor musunuz?

2. ***Yöntemin*** sosyal olarak uygunluğu:
    a. Bu becerinin öğretiminde kullanılan yöntemi uygun buluyor musunuz?
    b. Araştırma süresince belirlenmiş çalışma kurallarını, ortam düzenlemesini, araç- gereçleri uygun buldunuz mu?

3. Oluşturulan ***etkinin*** sosyal olarak önemi***:***
    a. Oluşturulan etkiden öğrenci memnun mu?
    b. Öğrencinizin bu beceriyi öğrenmesinin yaşamına olumlu katkısı olduğunu düşünüyor musunuz?

APPENDIX K

TEACHERS’ VIEWS ABOUT THE SMART TOY TECHNOLOGY (TURKISH)

Tema	**Alt-Tema**	**Öğretmenlerin İfadeleri**
Akıllı oyuncak teknolojisini kullanmak isterim/kullanmak istemem, çünkü…		
Tutum (Gelecekte Kullanmak)	Çok Etkili	“Evet kullanmak isteriz tabiki de çok güzel bir program ve çok etkin çocuklar içinde etkili olacaktır”
Akıllı oyuncak teknolojisini kullanırken kendimi yeterli hissettim/hissetmedim, çünkü…		
Yeterlilik	Çok yeterli	“Bilgisayar kullanmayan birine anlatıldığı zaman bunu rahatlıkla anlayabileceğini düşünüyorum”
Akıllı oyuncak teknolojisini kullanmak zor ve karışık /zor ve karışık değil…		
Kolaylık	Kolay ve çok basit	“Kolay ve çok basit herkesin yapabileceği bir şey”
		“Yo yo hiç bir bir son derece kolay kullanımı hatta yani daha genç nesil bu tip şeyleri çok hızlı algılıyor mesela biz birlikte çalıştığımız hani daha böyle emekli öğretmenler daha ileri kuşaklar bilgisayarla çalışma dendiği zaman biraz ürkek davranabiliyorlar bence onların bile seri şekilde öğrenebileceği bir uygulama

APPENDIX L

TEACHERS' VIEWS ABOUT THE SMART TOY APPLICATION (TURKISH)

Tema	Alt-Tema	Öğretmenlerin İfadeleri
Akıllı oyuncak uygulaması etkili ve öğretici/etkili ve öğretici değil, çünkü…		
Etkililik	Öğretici ve etkili	"Evet hem öğretici hem de etkili olduğunu düşünüyorum. Zaten projeye katılma aşamasında fikir anlatıldığı zamanda çok etkili olacağını düşünerek hareket etmiştim."
	Aynı anda sunulan görsel ve sesli içerik	"Ben çok etkili olacağını düşünüyorum. Çünkü hayvanları hem görmüş oluyorlar hem bilgisayardan seslerini duymuş oluyorlar bunların ikisinin bir araya gelmesi bizim arayıp da bulamadığımız şeyler varya öyle bir durum."
	Birlikte sunulan oyuncaklar ve bilgisayar	"Evet, akıllı oyuncak uygulamalarının etkili olacağını düşünüyorum. Şu açıdan etkili olacağını düşünüyorum. Aslında biz tek başına bilgisayarı, tek başına 3 boyutlu oyuncakları ayrı ayrı kullanıyoruz. İkisinin bir araya gelme fikri bence çok özel eğitim açısından parlak"
	Dokunulabilir içerik	"Child like working with material they can touch, feel and detect the size of

		their fingers To merge these two materials in terms of special education, I think it would be beneficial to the child." Evet işitsel hem görsel hemde dokunsal bir çok duyuyu birden kullandığı için daha etkili olacaktır. Tek bir dokunsal duyu değil bir çok duyu organını birden kullanıyor çoçuk onun için daha etkin bir öğretim olduğunu düşünüyorum"
	Birçok duyuya hitap ediyor olması	"Evet evet özellikle bizim yaptığımız uygulamada alması ve sahneye koyabilmesi , parmaklarıyla hissetmesi " / "Tabi tabi bunların hepsi dediğiniz gibi bir kaç duyuya hitap ediyor olması çoçuklar için çok faydalı zaten bilgisayar en çok sevdikleri şey yani bilgisayar oyunları" /"Evet işitsel hem görsel hemde dokunsal bir çok duyuyu birden kullandığı için daha etkili olacaktır. Tek bir dokunsal duyu değil bir çok duyu organını birden kullanıyor çoçuk onun için daha etkin bir öğretim olduğunu düşünüyorum"
	İnteraktif	"Bu diyelimki sizin öğrettiğiniz gibi bu ördek ördek ördek ördek resimlerden gösterdiğimizde bu havada kalıyor biraz ama o materyalla akıllı materyalde hem bilgisayardan sesli bir şekilde geliyor etkileşimli hem çoçuk ordan ördeğin mesela canlı olarak cansız bir nesne ama

		görüyor hissediyor ördek diyor ve üzerine koyduğunda ördeğin olup olmadığını orda geri dönüş şeklinde alarak güzel bir öğretim gerçekleşmiş oluyor.”
Akıllı Oyuncak uygulamalarının özel eğitim öğrencileri için faydalı olduğunu düşünüyor musunuz?		
Faydalılık	Yaşayarak ve dokuanarak öğrenme	“Tabiki bizim öğrencilerimiz daha çok görsel zekaya dayalı öğretim yapabiliryoruz zaten. Görmeleri gerekiyor öncelikle o yüzden bu tür uygulamalar bizim öğrencilerimiz birebir zaten bu şekilde öğretim yapabiliyoruz göstererek yaşatarak. Yani burdaki mesela dokunarak yüzyüze temas kuruyor. Faydalı evet.”
	Birçok duyuya hitap ediyor	“Duyu organlarına fazladan hitap ettiği için güzel yani.”
	Hafızada kalıcılığı artırıyor	“Hani olsa bile görse bile bir müddet sonra çok kısa bir süre sonra unutuyor. Ama bu şekilde programlarla karşılaştığında birde devam etip sürekli pekiştirildiğinde kafada kalıcı olması çok daha rahat oluyor. Hani öğretim açısındada daha faydalı olduğunu düşünüyorum.”
Akıllı Oyuncak uygulamalarını kullanırken siz ve öğrencileriniz eğlendiniz mi?		
Eğlence	Çok eğlenceli	“I didn’t understand how the time passed, it was very enjoyable.”
	Hızlıca adapte olunabilir	“Yes, especially common features of both kID usually cannot adopt any

		application immediately. So they don't adopt any our work style quickly but they have adapted very quickly and asked them questions, they give very fast response, this is a very important thing for us"
	Eğlenceli geridönüt ve pekiştireçler	"We are giving food or some things as prizes in here, but when it comes to computer and other device *(smart toy)* which is interaction device with computer as a material in this way, child reinforces herself already. She is doing more enjoyable seeing she did right or wrong by hearing voice from there. Its benefit is too much."
	Hızlı ve kolay öğrenilir	"I think, education will be easier thanks to this material. When these types of programs come, our lessons are more enjoyable and a certain time of the course remains because learning is being fast than before. Therefore, we are enjoying very much with children by doing different activities at remaining time."
	Öğretmenin zamanını	"They like and also we save our time by enjoying much."
Akıllı oyuncak uygulaması öğrenciyi ve beni motive etti/etmedi, çünkü…		
Motivasyon	Very motivating	"Definitely more motivating, I think it's very motivating."
	"Oyunla öğrenme algısıyla öğrenci motivasyonu arttı.	"Kesinlikle daha motive edici oyun gibi geliyor onlara oyunla öğretmek gibi geliyor."

	Klasik öğrenme metotlarına göre öğrenci motivasyonu arttı.	“Klasik uygulama yapsaydık mümkün olduğu kadar fazla kedi resmi bularak gözünde canlandırması sağlayacaktık ve bunların hepsi 2 boyutlu kalacaktı ancak dışarıda bir kedi bulucazda hani o şekilde gösterebileceğiz. Burada bazen videolarını gösterebiliyoruz. Bu uygulamada çok fazla şey aramadan hani o 3 boyutlu maketle zaten kedinin aşağı yukarı neye benzediği ile ilgili bir zihinsel resim oluşturabiliyoruz. Evet evet daha motive edici.”
	Eğlenceli pekiştireçler sayesinde öğrenci motivasyonunu arttı.	“Tabiki orda mesela onun alkışlanması o hayvanı gösterdiğinde alkışlanması onun çok hoşuna gitti mesela o ondan hoşnut oldu sevindi tekrar yapmak istedi eğer yapmak istemeseydi zaten devam etmezdi eğer o hoşuna gitmeseydi devam etmezdi yani keserdi hemen etkinliği çok hoşuna gittiği için o alkışı tekrar almak istedi o onun için bir pekiştireç oldu. Onun için burada şey yani motive çünkü tekrar devamını getirdi o pekiştirmeler tabiki önemli çocuklar için. Sizin programınızda var bu.”
	Öğrencinin bilgisayara olan ilgisi sayesinde motivasyonu artıyor.	“Burada bir yıl boyunca çalıştığımız bir harfi belki unutuyor ama bilgisayar karşısında bu akıllı dediğimiz teknoloji karşısında çok daha rahat. Eğlenceli bir ortam olarak görüyor onu.”

	Gerçek ortamın sanal simülasyonu ile öğrencinin motivasyonunun artıyor.	"Tabi klasik yöntem daha basit kalıyor bu daha iyi çünkü bire bir içinde yaşıyormuş gibi çocuk sanki o olayın içindeymiş gibi şey sanki çiftliğin içindeymiş gibi gerçekçi şeyler var orda gerçekçi olduğu için sanki o onu yaşadı ortamlarda falanmış gibi hissedebilir yani."
	Hızlı öğretmeyi sağlayarak öğretmen motivasyonunu artırıyor.	"Evet çünkü kavram öğretmek gerçekten özel eğitim çocuklarına zordur dediğim gibi vermek istediğiniz kavramın çocuğun zihninde bir resim oluşturma aşaması çok hızlı ilerleyen bir aşama değildir. Ama biz o uygulamalar esnasında bunu hızlıca başarabildik ve daha önemlisi bir kaç uygulama sonra unutmadıklarını gördük."
	Öğretimi kolaylaştırarak öğretmen motivasyonunu artırıyor.	"Böyle uygulamaların olması beni tabiki motive ediyor. Artık öğretimim ve eğitimimin çocuğa verdiğim öğretimin daha doğrusu kolaylaşacağını düşünüyorum."
Akıllı Oyuncak uygulamasının kullanımı zor/kolay, çünkü…		
Kolaylık	RFID kart ile geçişler çok kolay	Çok kolay hiç bir kartın geçişinde de sıkıntı yaşamadım
	Uygulamada sürerlilik	"Kartın olması sürekliliği sağlamak açısından çok faydalı olmuş."
	Küçük bir eğitimden sonra kolayca kullanılabilir.	"Kullanım açısından son derece kolay başlangıçta belki biraz daha seri hareket edebilmek için küçük bir eğitim almak gerekiyor."
	Okuyucu yüzey	"Tabiki kullanımı çok rahat çok güzel

	daha büyük olabilir	bir program yani çok güzel düşünülmüş özellikle çocukların tutabileceği büyüklükteki hayvanlar mesela koydukları şey yalnız yüzey sahneniz biraz daha büyük olursa çocuklar hani mesela o büyük kalıyor nasıl koyacağını bilemeyebilir biraz daha büyük olabilir hayvanlara kıyasla.”
	Soyut nesnelerin öğretiminde kullanımı zor olabilir	“Somut nesnelerde bire bir mükemmel bir öğrenme gerçekleşir ama soyut nesnelerde biraz zor olacağını düşünüyorum. Hani heyecan gibi, sevgi gibi duygusal ifadelerde falan onları yansıtırken biraz zorlanacağını, zorlanacağımızı düşünüyorum.”
Akıllı Oyuncak uygulamalarını gelecekte öğretim etkinliklerinizde kullanmak isterim/istemem, çünkü…		
Tutum (Gelecekteki Kullanım)	Kullanım Kolaylığı	“Akıllı oyuncakları kullanmak isterim çünkü çok rahat kullanımlı ve net elimde olan bir materyal.”
	Kitap yada kartlardan öğretmekten daha eğlenceli	“İsterim evet çok eğlenceli bizim için eğlenceli kuru kuru kitaptan ya da kartlardan öğretmektense bu şekilde öğretmek çok daha bizim içinde eğlenceli.”
	Yaşayarak öğrenme	“Mesela çocuk çünkü onu birebir yaşıyor mesela renklerin öğretimi ekranda çıktığında buradaki gerçek renkler yanında olduğunda onla birlikte pekiştirildiğinde alacağı döngüler çocuğun orda pekiştirmesi alkışlanması veya aferin şeklindeki döngüleri o

		çocuğu çok mutlu edecektir ve çocuk içinde değişik bir ortam.”
	Renk, şekil, günlük yaşam becerilerinin öğretiminde kullanılabilir.	”Bunu nesne öğretiminde renk öğretiminde şekil öğretiminde günlük yaşam becerilerinin öğretiminde şeylerde falanda her şeyde bir şekilde kullanabilirsiniz.”
	Renkli, hareketli ve canlı bir ortam sayesinde daha hoşnut	“Çocuk bir şey izlediğinde elindeki şu kağıttan daha çok zevk alacak çünkü onu orda renkli canlı olarak gördüğü için hareket halinde oldukları için daha çok hoşuna gidecek.”
	Animasyon öğeleri gerçek olabilir.	“Ekranda daha gerçek oyuncaklar daha gerçek hayvanlar kullanılırsa çocuğun genellemesi daha kolay olur.”
Akıllı Oyuncak uygulamalarında sizin hoşlanmadığınız yönler var mıydı? Varsa nelerdir?		
Değiştirilmesi istenen özellikler	Büyük hayvanlar için geniş okuyucu yüzey	“Hani dediğim gibi bu mesela hayvan biraz daha küçük olabilir hani yüzeye göre şeyde ama güzel bir program çok güzel öyle eleştirebileceğim fazla bir şey yok.”

APPENDIX M

PRACTICAL IMPLICATIONS FOR SPECIAL EDUCATION TEACHERS /PRACTITIONERS (TURKISH VERSION)

Akıllı hayvalar oyuncak uygulaması ile kavram öğretimi yapılırken uygulamacıların/ özel eğitim öğretmenlerinin takip etmesi gereken adımlar aşağıda sunulmuştur:

(1) Uygulama aşağıdaki özelliklere sahip öğrenciler için uygundur:

(a) Öğrenci basit sözlü talimatları takip edebilir olmalı (cümleler en az beş kelime içermektedir);

(b) belirli bir konuda en az 10 dakika dikkatini yöneltebilmeli;

(c) zorluk çekmeden el ve parmakları kullanabilmeli;

(d) cevabı parmak kullanarak veya sözlü olarak cevaplayabilmeli;

(e) zihinsel engel dışında herhangi bir fiziki işlev bozukluğu veya sağlık problemi bulunmamalı.

(2) Uygulayıcı aşağıdaki görevleri yerine getirmelidir:

(a) rahatsız edici uyaranları çevreden çıkarmalı;

(b) oturumda çalışılacak konsepti sözlü olarak söylemeli;

(c) akıllı oyuncak uygulaması kısaca öğrenciye anlatılmalı

(d) ilgili öğrencinin ismi kayıt ekranına girilmeli ve uygulama başlatılmalı

(e) öğrencinin dikkatini toplamasını sağlamalı;

(f) uygulama devam ederken öğrencinin odağını korumasına yardımcı olmalı;

(g) öğrencinin tepki süresi boyunca beklemeli (5 saniye);

(h) uygulama, olumlu, olumsuz geribildirim verirken öğrenciye yardımcı olmalı.

Uygulayıcı, tüm adımlar tamamlanıncaya kadar bu işlemi tekrarlamalıdır. Üç ardışık eğitim oturumundan sonra, zihinsel engelli öğrencilerin geliştirilen akıllı oyuncak uygulamasını kullanrak hedef konsepti öğrenmeleri beklenir.

APPENDIX N

Akıllı Hayvanlar Kullanıcı Kılavuzu

İÇİNDEKİLER

AKILLI HAYVANLAR KULLANIM KILAVUZU
Uygulama Hakkında

Akıllı Hayvanlar Oyuncak Projesi'nin temel amacı öğrenme güçlüğü çeken zihinsel engelli öğrencilere hayat bilgisi kavramlarını öğretirken yardım etmektir. Bu kapsamda da, çiftlik hayvanlarının öğretimi için geliştirilen modüllerde hem "Öğretim" hem de "Ölçme-Değerlendirme" adımları bulunmaktadır. "Öğretim" adımında öğrenciler öncelikle ilgili hayvanları tanıyacaktır. Daha sonra ise pekiştirme ekranları ile öğretilen kavramı pekiştirilmesi sağlanacaktır. Ölçme değerlendirme adımında ise "Öğretim" adımında öğrendiklerinin ölçüm ve değerlendirilmesi yapılacaktır. Bu adımlarda oyuncaklar ve öğrenci bire bir etkileşim içinde olacak ve uygulama öğrencilere süreçle ilgili geri-dönütler verecektir.

Uygulamaya Başlamadan Önce

Uygulamanın mentor öğretmen/veli tarafından açılması ve ilk olarak "Öğretim" adımının öğrencilere gösterilmesi beklenmektedir. Öğretim adımından önce mentor öğretmen, çalışacağı öğrenci için kayıt işlemini gerçekleştirir. Uygulama çalıştırıldığında ilk ekran "Giriş" ekranıdır. "YeniKayıt" isimli buton kullanılarak öğrencinin kayıt işlemi tamamlanır. Daha sonra kayıt sırasında kullanılan bilgiler ad-soyad alanına girilir ve "Başla" butonuna basılarak uygulama başlatılır.

Öğrenci Kayıt Ekranı

Yeni Kayıt Ekranı

Nasıl Oynanır?

Akıllı Oyuncak uygulamasında "Başla" butonu kullanılarak başlatıldığı zaman karşınıza "Oyun Arkadaşını Seç" ekranı gelir. Kullanıcı, hedef kitlenin istek ve ihtiyacına göre karakter seçimini gerçekleştirir. Karakter seçimi yapmak için ilgili karakterin üzerine tıklanır. Örneğin, öğrenciniz/çocuğunuz kız ise Cici'yi, erkek ise Can'ı seçmeniz uygun olacaktır.

Karakter Seçim Ekranı

Uygulamada hedef kitlenin karşısına çıkacak olan ve hedef kitlenin uygulamaya başlamadan önce tanıması gereken objeler şunlardır:

Sahne: Sahne olarak adlandırılan obje, uygulamanın "Öğrenme" ile "Ölçme Değerlendirme" aşamalarında kullanılır. İlgili aşamalarda, öğrencinizin oyuncakları bu sahne üzerine koyması gerekmektedir . Oyun sırasında öğrencinizinden ilgili oyuncakları alıp, sahneye koyması istenecektir.

Sahne

Plastik Oyuncaklar: Plastik oyuncaklar, uygulamanın "Öğrenme" ile "Ölçme Değerlendirme" aşamalarında kullanılır. Oyun sırasında öğrencinizinden ilgili oyuncakları alıp, sahneye koyması istenecektir.

Plastik Oyuncaklar

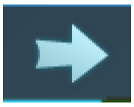
İlerleme Kartı: Bu kart öğretmen tarafından uygulamada ilerleme butonunun olduğu sahnelerde bir sonraki ekrana geçmek için kullanılacaktır.

İlerleme Kartı

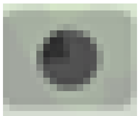
Butonlar: Uygulama içerisinde, kullanıcıyı ilgili bağlantılara götüren butonlar bulunmaktadır. Bu butonlar şunlardır:

Ana ekrana dönmek için “Home” butonu

Bir sonraki ekrana geçmek için “İlerle” butonu



Ölçme -Değerlendirme ekranına geçmek için “Ölçme –Değerlendirme “ butonu



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High School	İbn-I Sina High School, Ankara	2000

AREAS OF EXPERTISE

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WORK EXPERIENCE

2004-2007 IT Specialist, Atılım University, Computer Center, Ankara, Turkey

2007-Present Instructor, Atılım University, Management Faculty/Engineering Faculty, Ankara, Turkey

PUBLICATIONS

Journal Publications (Indexed in SSCI, SCI)

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