DESIGN, DEVELOPMENT AND USE OF A SMART TOY FOR PRESCHOOL CHILDREN: A DESIGN AND DEVELOPMENT RESEARCH

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

BY

NURİ KARA

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

JUNE 2015

Approval of the thesis:

DESIGN, DEVELOPMENT AND USE OF A SMART TOY FOR PRESCHOOL CHILDREN: A DESIGN AND DEVELOPMENT RESEARCH

submitted by **NURİ KARA** in partial fulfillment of the requirements for the degree of **Doctor of Philosophy in Computer Education and Instructional Technology Department, Middle East Technical University** by

Prof. Dr. Gülbin Dural Ünver ___________________
Dean, Graduate School of **Natural and Applied Sciences**

Prof. Dr. Soner Yıldırım ___________________
Head of Department, **Computer Education and Inst. Tech.**

Prof. Dr. Kürşat Çağıltay ___________________
Supervisor, **Computer Education and Inst. Tech., METU**

Examining Committee Members:

Assoc. Prof. Dr. Hasan Çakır ___________________
Computer Education and Inst. Tech. Dept., Gazi Uni.

Prof. Dr. Kürşat Çağıltay ___________________
Computer Education and Inst. Tech. Dept., METU

Prof. Dr. Zahide Yıldırım ___________________
Computer Education and Inst. Tech. Dept., METU

Assoc. Prof. Dr. Mehmet Buldu ___________________
Education Department, UNICEF TURKEY

Assist. Prof. Dr. S. Tuğba Tokel ___________________
Computer Education and Inst. Tech. Dept., METU

Date: June 26, 2015

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Surname: Nuri KARA

Signature:

ABSTRACT

DESIGN, DEVELOPMENT AND USE OF A SMART TOY FOR PRESCHOOL CHILDREN: A DESIGN AND DEVELOPMENT RESEARCH

Kara, Nuri
PhD, Department of Computer Education and Instructional Technology
Supervisor: Prof. Dr. Kürşat Çağıltay
June 2015, 305 Pages

The purpose of this dissertation is to design, develop and use of a smart toy for preschool children. Smart toys are technologically developed series of physical toy materials in accordance with the constructed and meaningful purposes. Design and development research method is the overall design of the study. In the analysis phase, semi structured interviews were conducted with early childhood teachers to investigate their opinions as to technology and technology use in early educational settings. Additionally, semi structured interviews were conducted with early childhood teachers to understand their opinions as to the smart toy developed as a pilot study. In the design phase, focus group meetings were held with early childhood teachers to determine objectives, story and storyboard of the smart toy. In the development phase, two prototypes were developed and formative evaluations were carried out with several participants, such as preschool children, early childhood teachers and scholars. In the evaluation phase, summative evaluation of the smart toy was done with not only preschool children but also early childhood teachers.

The study indicated that teachers had positive views about appropriate technology use in preschool education. Teachers declared that the content, visual design and interaction components of the smart toy need to be improved. Design principles also emerged for content, visual design and interaction of the smart toy. 36 – 48 months old children had slower performance than 48 – 72 months old children in completing cognitive tasks of the smart toy. Early childhood teachers preferred collaborative smart toy play at classrooms.

Keywords: Smart toys, preschool education, preschool children, design principles

ÖZ

OKUL ÖNCESİ ÇOCUKLAR İÇİN AKILLI OYUNCAK TASARIMI, GELİŞTİRİLMESİ VE KULLANIMI: BİR TASARIM VE GELİŞTİRME ARAŞTIRMASI ÖRNEĞİ

Kara, Nuri
Doktora, Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü
Tez Yöneticisi: Prof. Dr. Kürşat Çağıltay
Haziran 2015, 305 Sayfa

Bu tezin amacı, okul öncesi çocuklarına yönelik akıllı oyuncak teknolojisini tasarlamak, geliştirmek ve uygulamaktır. Akıllı oyuncaklar, fiziksel oyuncakların yapılandırılmış ve anlamlı amaçlar doğrultusunda teknolojik olarak geliştirilmiş şeklidir. Tasarım ve geliştirme araştırma modeli çalışmanın genel araştırma desenini oluşturmaktadır. Çalışmanın analiz safhasında, okul öncesi öğretmenlerinin teknoloji ve teknoloji kullanımına yönelik düşüncelerini ortaya çıkarmak amacıyla yarı yapılandırılmış görüşmeler uygulanmıştır. Bu süreçte ayrıca okul öncesi öğretmenleri ile, pilot çalışma olarak daha önceden geliştirilmiş akıllı oyuncağa yönelik düşüncelerini anlamak için yarı yapılandırılmış görüşmeler yapılmıştır. Çalışmanın tasarım safhasında, okul öncesi öğretmenlerinin katılımıyla, akıllı oyuncakta yer alacak kazanımlar, hikaye ve senaryoyu belirlemek amacıyla odak grup toplantıları gerçekleştirilmiştir. Çalışmanın geliştirme safhasında, iki prototip geliştirilmiş ve prototiplere ilişkin okul öncesi çocukları, okul öncesi öğretmenleri ve akademisyenler ile süreç değerlendirmeleri yapılmıştır. Çalışmanın değerlendirme safhasında ise, geliştirilen akıllı oyuncağın tasarımı ve uygulaması hem okul öncesi çocukları hem de okul öncesi öğretmenleri ile görüşmeler yapılarak değerlendirilmiştir.

Çalışma sonuçları okul öncesi öğretmenlerinin okul öncesi eğitimde uygun teknoloji kullanımına yönelik olumlu düşüncelere sahip olduğunu göstermiştir. Öğretmenlere göre akıllı oyuncağın içerik, görsel tasarım ve etkileşim bileşenlerinin daha da geliştirilmesi gerekmektedir. Çalışma sonucunda ayrıca akıllı oyuncağın içerik, görsel tasarım ve etkileşim boyutlarını ele alan tasarım ilkeleri ortaya çıkarılmıştır. Çalışma sonuçları göstermiştir ki, 36 – 48 aylık çocuklar akıllı oyuncaktaki bilişsel aktiviteleri tamamlamada 48 – 72 aylık çocuklara nazaran daha düşük bir performans sergilemiştir. Öğretmenler de akıllı oyuncağın sınıfta oynanmasında işbirlikli oyunu tercih etmişlerdir.

Anahtar Kelimeler: Akıllı oyuncaklar, okul öncesi eğitimi, okul öncesi çocukları, tasarım ilkeleri

To my family

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my supervisor Prof. Dr. Kürşat Çağıltay for his invaluable contributions, suggestions and guidance. His supportive and inspiring feedbacks helped me throughout all my PhD study.

I would like to express my sincere appreciation to the examination committee members Prof. Dr. Zahide Yıldırım, Assoc. Prof. Dr. Mehmet Buldu, Assoc. Prof. Dr. Hasan Çakır and Assist. Prof. Dr. Tuğba Tokel for their comments and suggestions.

I would like to thank to the manager, Hava Yılmazoğlu, and teachers of Şehit Emrah Yiğit Anaokulu for their valuable cooperation.

I would like to express my appreciation to members of Instructional Systems Technology at Indiana University, and especially Anne T Ottenbreit-Leftwich for her hospitality and guidance.

I would like to thank to The Scientific and Technological Research Council of Turkey (TÜBİTAK) supporting me with national scholarship during my PhD education.

Finally, I would like to thank to my mom, Nurten, dad, İbrahim and brother, Harun for their continuous support and love.

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

ICT	Information and Communication Technology
ECE	Early Childhood Education
MoNE	Ministry of National Education
IT	Instructional Technology
RFID	Radio Frequency Identification

CHAPTER 1

INTRODUCTION

This part is an introduction to the problem on which the study focused. In this section, background of the study, purpose of the study, research questions, significance of the study and definitions of terms were reviewed.

1.1 Background of the Study

Rapid developments in information and communications technology (ICT) have made great impact on young children's lives (Kalaš, 2010). Similarly, children are integrated with popular culture, media, and new technologies from birth (Marsh et al., 2005). Hence, it is important to integrate ICTs on early childhood educational settings. As Stephen and Plowman (2003) stated, "ICTs offer many opportunities for children to develop their knowledge and understanding of the world" (p. 231). From this perspective, ICTs can support learning in early educational settings. Although ICT has an alternative and supportive role in early educational settings, there has been limited number of practices as to integrating new technologies into early educational settings. Similarly, Kalaš (2010) affirms that provision of ICT is very limited in early educational settings. This is one of the problems on which the study focused. Since smart toys can be considered as a form of ICT, integrating smart toys into early educational settings can be evaluated as integrating a form of ICT from the broader perspective. Hence, this study aims to integrate new technologies, like smart toys to preschool education. ICTs capability of affecting the efficiency of learning is also an important issue for early educational settings. However, "there is no clear evidence that ICTs facilitate young children's learning in general or in any specific curricular area" (Stephen & Plowman, 2003, p. 231). This is another problem on which the study emphasized. Therefore, this study aims to investigate the effectiveness of using new technologies for the purpose of facilitating learning in specific objectives of the preschool curriculum.

In Turkey, the current preschool curriculum was introduced by The Ministry of National Education (MoNE) in 2013. Target group of the curriculum is the children, ages of between 36 months and 72 months. The curriculum is based on children centered approach. According to the curriculum, flexible learning environments in early educational settings and different learning experiences for children are of great importance (MoNE, 2013). However, there are no suggestions or guidelines as to integrating appropriate technologies in early educational settings. Technology enhanced learning environments may lead children to actively participate in the learning environment and also provide flexible teaching environment for early childhood teachers. Additionally, these environments may enable children to construct their learning based on their own experiences. However, in Turkey, children in general are not supported with ICTs in early educational settings. There is also a lack of technological materials prepared for using in early educational environments. Therefore, this study expects to design and develop a technological material called as smart toy.

Since play activity is seen as one of the central points in preschool education, designing a toy for allowing children to be included in the play activity is the first reason to design and develop a smart toy. Additionally, creating a technology which will be designed in consistence with children's needs is another reason to decide to design and develop a smart toy. Although today's children, in general, face with new kind of technologies, such as tablets and smartphones in their daily life, there have been limited practices including new kind of technologies especially at preschool education. Therefore, integrating appropriate play technology into preschool education is one of the important reasons of starting to design and develop a smart toy. Moreover, using technology separating children from the reality and leading them to only focus on the virtual environment can be criticized by several authorities. Hence, providing both physical environment and virtual environment at a toy enabling play activity with the help of technology based components is the other important reason of designing and developing a smart toy.

1.2 Purpose of the Study

The purpose of this study is to design, develop and use of a smart toy for preschool children from age 36 months to 72 months. It is expected with this study to produce key design principles about how to best integrate smart toys into preschool education. One of the important goals of the study is to design and develop smart toys in accordance with teachers' and children's needs.

Since the preschool curriculum requires early childhood teachers creating rich learning experiences for children and providing children centered flexible learning environment, it is important to include early childhood teachers to the study for the purpose of designing new technologies. Additionally, presenting preschool children's reactions as to the smart toy to understand the effectiveness of the design of the smart toy is another purpose of the study.

The other important goal of the study is to design and develop a smart toy for supporting several objectives mentioned in the preschool curriculum. In general, the main purpose of the study is to design and develop a smart toy in which technology has a supportive role to present the specific objectives from the preschool curriculum for preschool children.

1.3 Research Questions

What are the design, development and usability issues of smart toys supporting curriculum related objectives for preschool children?

1.3.1 Sub-Research Questions

1. What are early childhood teachers' opinions toward technology and technology use in early educational settings?
2. What are early childhood teachers' opinions about educational use of smart toys?
3. What are the design principles when designing a smart toy to support curriculum related objectives?
4. What are the usability issues of smart toys?
5. What are early childhood teachers' opinions about the design and use of smart toy?

1.4 Significance of the Study

This study aims to design, develop and use of smart toys for preschool children from age 36 months to 72 months. According to Donaldson and Knupfer (2002), technology has an important role in educational settings if appropriately used and integrated. Therefore, this study is a practice of integrating new technology, like smart toys into early educational settings. The results of the study are expected to provide new insights about using smart toys as new ICTs for supporting the preschool settings.

This study is of great significance in terms of young children. Personal, portable, and wirelessly- networked technologies have become widespread in the lives of learners including young children (Chan et al., 2006). Hence, it is important to offer practices in terms of integrating these new technologies to young children's lives. Appropriate technology use in early educational settings provides rich learning environments for young children who have difficulties in generalizing their learning to other environments. Children in early educational environments require a variety of learning materials that support young children's learning and enable active participation. Hence, this study has an important role for children because new technologies, like smart toys are provided to children for supporting the curriculum related objectives.

This study is also of great importance for early childhood teachers and preschool settings. Since the curriculum requires teachers providing dynamic and flexible learning environments and creating rich learning experiences for children, results of this study are expected to support teachers to create technology enriched classrooms. Design principles which are revealed at the end of this study are expected to guide teachers to choose technological materials which have an appropriate design and content for children.

Since there are very few studies integrating new technologies to early educational settings for educational purposes all over the world, this dissertation is one of the large scale studies, designing and developing a new technology for preschool children. On the other hand, this study is expected to lead both designers and researchers to develop new kind of smart toys which are oriented for both early childhood teachers and preschool children.

1.5 Definitions of Terms

Play: "Play is a free activity standing quite consciously outside 'ordinary' life as being 'not serious', but at the same time absorbing the player intensely and utterly" (Huizinga, 1955, p. 107).

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).

Early Childhood Education: Early Childhood Education is a term covers a variety of programs for young children between birth and age 8 (Bowman, 1993, p. 101).

Preschool Education: Preschool Education is a term covering an education program for 36 – 72 months old children.

Early Childhood Teacher: Early childhood teachers are individuals who work as teachers in early childhood education centers, such as preschools and kindergartens.

Preschool Children: Preschool children are defined as 36-72 months old children taking education in both public and private preschools.

Turkish Preschool Curriculum: Turkish Preschool Curriculum describes the curriculum prepared by The Ministry of National Education for 36 – 72 months old children.

Formative Evaluation: Formative evaluation is a sum of methods for collecting data to improve the product during design and development process.

Summative Evaluation: Summative evaluation is a sum of methods for collecting data to evaluate the final product.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the relevant literature to the role of technology in early childhood education (ECE), technology for preschool children and early childhood teachers, preschool curriculum in Turkey, technology design for children including curriculum focused design, general characteristics of smart toys, smart toys and developmental stages of children, use of smart toys in early educational settings and Constructionism as a main theoretical framework were reviewed. On the other hand, the gaps in the literature were determined and a theoretical framework was established.

In the first part, related literature regarding the effect of technology in early childhood education was reviewed. In the second part, the role of technology in preschool children's lives was reported. The third part presented technology use and current practices of early childhood teachers in early educational settings. In the fourth part, the current preschool curriculum in Turkey was analyzed. The fifth part mentioned about the several technology design methodologies for children. The sixth part specifically emphasized on curriculum focused design. In the seventh part, smart toys were defined and its general characteristics were reviewed. In the eighth part, smart toys were analyzed from instructional technology perspective. In the ninth part, smart toys and developmental stages of children were reviewed. The tenth part summarized the previous smart toy projects for early educational settings. In the last part of the literature review, Constructionism as a main theoretical background was defined and its connection with smart toy play was presented. In the summary part, the gaps in the literature and which one of them to be filled were explained.

2.1 Technology in Early Childhood Education

According to Bolstad (2004), the literature offers three main reasons for the significance of ICT in early childhood education:

1. *ICT already has an effect on the people and environments that surround young children's learning.*
2. *these technologies offer new opportunities to strengthen many aspects of early childhood education practice.*
3. *there is support and interest across the whole education sector for the development and integration of ICT into education policy, curriculum, and practice* (p. 2).

ICT already has an effect on the people and environments that surround young children's learning: Teachers play a key role for young children in early educational settings since they build a direct communication with these children. Hence, the practices and attitudes of early childhood teachers towards computer and other technologies may affect children's learning. Studies in the literature show that early educational teachers are in favor of introducing computers into early educational settings (Towns, 2010; Tsitouridou & Vryzas, 2004). More specifically, teachers use computers in accordance with children's personal skills, styles and social demands to help them learn (Chen & Chang, 2006). Similarly, "most teachers do recognize the contribution of the computer to the skills development of the young child, primarily in the intellectual and aesthetic fields and secondarily in the socio-emotional and psycho-motor fields" (Tsitouridou & Vryzas, 2004, p. 40). It can be concluded from these statements that teachers' practices and their beliefs toward computers in early educational settings are crucial to support children's learning. Since there has been an increase as to the number of studying new technologies besides computers in early childhood education in the last few years (Bolstad, 2004), teachers' effects on children can play an important role in terms of not only computer use and integration but also the adaption of other kinds of technologies, such as smart toys, robotics and digital materials.

These technologies offer new opportunities to strengthen many aspects of early childhood education practice: The dynamic and adaptive structure of technologies may support children from different perspectives in early educational settings. As Yelland (2005) emphasized, technological settings do not only offer concept based applications but also provide social interaction with peers and teachers in early educational settings. Although there is a common agreement as to the important potential of new technologies as learning tools in early educational settings, integrating and using these technologies in these settings are still not in an adequate level (Parette, Quesenberry & Blum, 2010).

There is support and interest across the whole education sector for the development and integration of ICT into education policy, curriculum, and practice: "National curricula need to embrace the fact that knowledge can be represented in new forms and this will have a fundamental impact on how a subject/topic is presented, taught and assessed" (Cox & Marshall, 2007, p. 68). As technology has a great impact on supporting children and creating better learning environments, the guidelines or methods and use types of technologies may enhance the quality of early childhood education. Yelland (2005) found in the review of the literature that innovation is the key term when ICT integrated into new early childhood curriculum. Since computers and new technologies have affected not only society or adults but also learners and educational settings, it is possible that innovation is required based on new technologies in accordance with developmental and learning needs. Similarly, Chen and Chang (2006) emphasized that computers are required to be integrated into curriculum to improve teaching and learning gains to the top level. Therefore, it can be reached that the specific explanations, guidelines and practice samples in ECE curricula as to implementing technology in early childhood settings support early childhood teachers to provide alternatife methods of teaching and create technology enriched learning settings.

Since new technologies in early childhood education can enhance the effectiveness of educational practice, more research studies need to be carried out. Similar to this view, Mangen (2010) pointed out that detailed practice and use of ICT in preschool need to be focused besides only offering new technologies to children. Bolstad (2004) listed research literature of ICT in five categories:

1. *"effects" research;*
2. *investigations of children's behaviour and interactions around computers;*
3. *research into children's experiences of ICT in early childhood education settings and at home;*
4. *research about practitioners' professional learning in, or through, ICT; and*
5. *case studies or exemplars of innovative use of ICT in early childhood education settings* (p. 13).

Based on these categories, it can be seen that outcome rather than process oriented studies are generally focused in the literature. Additionally, practices of technology use and interaction in early childhood settings are mostly considered in the research literature. In light of these statements, it can be concluded that there is a gap in the literature as to investigating design and development of new technologies in early childhood settings. Although investigating the experiences of young children and teachers towards new technologies play a significant role to understand the situation and reach the effective inferences, design studies including designing and developing new technologies based on the developmental characteristics of children and the literature should also be taken into account. To better use and integrate new technologies for young children in early childhood settings, these technologies need to firstly be designed effectively. Including early childhood teachers, preschool children and ECE scholars can also enhance the quality and appropriateness of new technologies to be used in early childhood settings. On the other hand, design principles to be found out at the end of the process can offer guidelines for other scholars and practitioners.

2.2 Preschool Children and Technology

In today's world, children face with technology from birth (Marsh et al., 2005). Development of new technologies has affected not only adults' but also children's life. As Kalaš (2010) reported, more and more children encounter with computer before going to preschool. Hence, it is impossible to eliminate technology from children's life. The capability of technology affecting children's life has also implications for ECE programs. The interest to ICT in early educational settings results from the value of computers in educational settings (Plowman & Stephen, 2005). Computers contribute to the learning of students by providing rich and alternative media. The supportive role of ICT has increased its availability in educational environments as well as early educational settings (Plowman & Stephen, 2003). Therefore, integrating ICT into early educational settings is seen as a significant issue.

The value of ICT in early educational settings is mostly based on educational purposes rather than play activities (Plowman & Stephen, 2003). Computers and other technologies support children's learning and enable individualized progress. Children can construct their own learning and take responsibility of their actions with the support of ICT. Similar to this view, ICT has a role in increasing self-esteem and confidence as well as supporting independence and dealing with difficulties (Plowman, Stephen, & McPake, 2010). One of the important characteristics of ICT in early educational settings is to provide rich context for children. Several multimedia options, such as graphics, films, and animations and authentic environments can be offered in rich learning environments. Children can actively and dynamically participate in these environments with the support of technologies. As Kalaš (2010) emphasized, the rich context that ICT provided in early educational settings is more important than the features of technology and has a great potential for supporting cognitive development. Another important characteristic of ICTs in early educational settings is to support cognitive skills of children. According to Stephen and Plowman (2003), "ICTs offer opportunities to use mathematical concepts, such as sorting, matching, shapes and patterning" (p. 231). Since these practices are mostly based on the cognitive processes of children, ICTs with multimedia capabilities can lead children to be included in cognitive activities.

According to Siraj-Blatchford and Siraj-Blatchford (2006), four key areas of learning in ECE and its relationship with ICT are described as follows:

- Communication and collaboration – they naturally appear in collaborative problem solving, drawing, video recording, or construction, using screen-based applications, in experimenting with programmable toys.
- Creativity – to be creative, children need to acquire a repertoire of schemes, and they need the playful disposition to try out these schemes in new contexts.
- Socio-dramatic play – there is an enormous scope for the integration of ICT into young children's play environments.
- Learning to learn –the ICT applications that support the development of metacognition and learning to learn are also those that most effectively support communication and collaboration and socio-dramatic play.

ICT contributes to the learning and development of young children by supporting these key areas of learning. In early educational settings, children should actively be involved in several activities and leaded to produce their own meanings. As Siraj-Blatchford and Siraj-Blatchford (2006) emphasized, ICT can contribute to the metacognition skills of children. Hence, integrating ICT into early educational settings enables children to reflect their learning patterns.

2.3 Early Childhood Teachers and Technology

Stipek and Byler (1997) declared that teachers of young children consider their primary goal as preparing children academically to the first grade and emphasizing basic skills. These teachers focus on increasing the capabilities of young children and developing cognitive, affective, psychomotor and social skills. Early childhood teachers also take the main responsibilities in early educational settings. According to Stipek and Byler (1997),

> *Teachers of young children make myriad decisions-about whether to emphasize basic skills; about the degree to which activities are child- versus teacher-initiated, structured or unstructured, completed alone or with peers; about how strict to be in managing the classroom; and so on* (p. 305).

Early childhood teachers generally demonstrate child-centered beliefs (Isikoglu, Basturk & Karaca, 2009). The preschool curriculum in Turkey also expects teachers to follow child-centered practices in learning environments (MoNE, 2013). Technology's active and dynamic role in early educational settings can provide alternative child-centered practices. Technology's capability of including children into several activities as active participants gives an opportunity to teachers to create child-centered learning environment. Since the curriculum allows teachers to provide rich and a variety of activities for children (MoNE, 2013), technology can be integrated into early educational settings to support child centered learning.

Since early childhood teachers make several decisions in early educational settings, it is important to emphasize teachers' approaches and opinions. ICT use in early educational environments might also be affected by the teachers' views and intentions. Blackwell, Lauricella and Wartella (2014) found in their study that early childhood teachers' attitudes towards the role of technology are of great significance in terms of technology use. Kalaš (2010) affirms that ECE teachers support the educational value of ICT. Similarly, teachers of young children generally have positive attitudes or views towards the use and integration of new technologies (Marsh et al., 2005; Nikolopoulou & Gialamas, 2009). Teachers' positive approaches toward new technologies in early educational environments can accelerate the integration of ICT. Teachers who believe the educational value of ICT can lead children to technology related activities and integrate these activities to the preschool curriculum.

Although the survey studies in the literature provide numerical results as to the number of computers or use frequency, these studies show little information about teachers' integration of computers for supporting the learning of young children

(Chen & Chang, 2006). There should be more studies investigating the current situation of early childhood teachers in terms of technology integration and use in early educational settings. “To better prepare early childhood teachers for computer use, more information about their current skills and classroom practices is needed” (Chen & Chang, 2006, p.169). Hence, investigating the current practices of early childhood teachers can be an effective starting point for integrating new technologies into early educational environments.

The studies in Turkish literature have generally been based on survey research methodology, focusing on the attitudes and thoughts of early childhood teachers toward the use of technology, specifically computers (Kabadayi, 2006; Oguz, Ellez, Akamca, Kesercioglu, & Girgin, 2011; Onkol, Zembat, & Balat, 2011; Yurt & Cevher-Kalburan, 2011). Although Gok, Turan and Oyman (2011) made a research about investigating the preschool teachers’ views on usage of information technologies, the sample consisted of 10 teachers working at private schools and only focus group meetings were carried out to collect data. Based on the current studies in Turkish literature, it can be stated that the more detailed qualitative research studies should be conducted to understand the current practices and views of early childhood teachers. As Blackwell et al. (2014) declared, personal beliefs of early childhood teachers are of great significance in terms of technology use. Additionally, “in the classroom, teachers adapt computer use to accommodate children’s varying levels of skills, different personal interests, and optimal social groupings”. (Chen & Chang, 2006, p. 181). Therefore, understanding the current practices, views and beliefs of early childhood teachers towards the use of technology can play a critical role to integrate new technologies since they are the main practitioners in early educational settings.

2.4 Preschool Curriculum in Turkey

As of 2013-2014 educational year, there are 26,698 schools giving early childhood education with 1,059,495 children and 63,327 teachers in Turkey (MoNE, 2014).

“One of the major political issues in early childhood education in Turkey is to increase the schooling rate at this level because it is pretty high among EU countries (95%) compared to Turkey (16%)” (Atay-Turhan, Koc, Isiksal, & Isiksal, 2009, p. 352). Another important issue as to early childhood education in Turkey is updating the preschool curriculum in specific time periods. The final curriculum was prepared by the Ministry of National Education in 2013 towards 36-72 months age children. The main titles presented in the curriculum are; (1) General purposes of national education, (2) The purpose of preschool education, (3) The main principles of preschool education, (4) The significance of preschool period, (5) Introduction to the preschool curriculum, (6) Developmental characteristics, objectives and indicators, (7) Planning and implementing of preschool education, and (8) Evaluation of preschool education (MoNE, 2013). Child based, play based, flexible, eclectic, and well balanced activities are some of the important characteristics of preschool education (MoNE, 2013). Additionally, discovery based learning, enhancing creativity, and experiencing real life situations also play very important role in preschool education. Compared with the preschool curriculum developed in 2006, the major difference of new curriculum is to focus on enriching learning experiences of children. Although both of the curricula do not mention the term “technology” and “technology use”, the new developed curriculum, at least, shows statements regarding of using materials and providing alternative stimulus to enrich learning experiences and educational environments. Objectives and explanations of different domains based on the different age groups compose the main part of the curriculum. Cognitive objectives, language objectives, social and affective objectives, psychomotor objectives and self-care objectives toward 36-48, 48-60 and 60-72 months age children are explained in the curriculum in a detailed way (MoNE, 2013).

2.5 Design for Children

Norman and Draper (1986) created the basis of user centered design (as cited in Vredenburg, Mao, Smith, & Carey, 2002). The main goal of user-centered design is to design tools or materials by considering needs of the user (Sanders, 2002). Sanders also explains the user-centered design process as follow:

> *The social scientist/researcher serves as the interface between the user and the designer. The researcher collects primary data or uses secondary sources to learn about the needs of the user. The researcher interprets this information, often in the form of design criteria. The designer interprets these criteria, typically through concept sketches or scenarios. The focus continues then on the design development of the thing* (p. 1).

It can be said that researcher, designer and user are the main components of user-centered design, trying to create effective designs for user needs.

Learner-centered design is advanced version of user-centered design, taking into account the needs of learners rather than users (Brna & Cox, 1998). Compared to user-centered design, learner-centered design should support growth, diversity and engagement needs of learners (Hsi & Soloway, 1998). According to Hsi and Soloway (1998), the interface to be designed should be adaptable to support the growth of learners; it should be suitable for learners with different backgrounds to support diversity; and it should actively engage learners to the designed medium to support engagement. Therefore, it can be concluded that learner-centered design values the learner as the key person in design process.

As an alternative design methodology, child-centered design puts children to the center of the design process. In child-centered design, children is included in the different phases of design process with collaboratively work between designer and child to provide designs reflecting children's needs (Pardo, Vetere, & Howard, 2005). In child-centered design, children actively participate in the whole design process and their motivations and preferences are of great importance.

Smith and Reiser (1998) introduced classroom-centered design aiming at including different tools and materials which exist in classroom environment to enhance the quality of designs. In classroom-centered design, the computer, the teacher and all classroom materials play a significant role (Smith & Reiser, 1998). Compared to user or learner centered designs, classroom-centered design mainly focuses on the setting rather than users or learners to refine design practices for specific educational environments.

Rode, Stringer, Toye, Simpson and Blackwell (2003) introduced curriculum focused design which also underlies the design methodology of this study. According to Rode et al. (2003), the aim of design is to carry out the requirements determined in the national curriculum by including school children and teachers to provide the consistency and applicability of designed tools or materials in other similar settings. They also emphasized that the principles of learner-centered design, such as growth, diversity and engagement are valid for curriculum focused design and this design is a specific application of learner-centered design. On the other hand, “teachers have been more significantly involved in a process that requires that their professional concerns are explicitly acknowledged and addressed”. (Rode at al., 2003, p. 125). Therefore, it can be stated that curriculum focused design process includes teachers and children in consistent with the requirements in national curriculum.

2.5.1 Curriculum-Focused Design vs. Child-Centered Design

According to Druin (2002), children can participate in technology design process as *user*, *tester*, *informant* and *design partner*. While children use the end product to understand their skills and experiences in user role, they test the different prototypes to understand their experiences before creating the final product (Druin, 2002). As an informant, children participate in different phases of design process to get their feedbacks along with the design period; on the other hand, as a design partner, children have equal role with other people throughout the design process and actively join the process in each phase (Druin, 2002). Teachers have also important role in design process. According to Pardo et al. (2005), helping understand children’s reactions and feedbacks, building a bridge between designers and children, and providing children to be motivated to the task are the main roles of teachers during design process. They also summarized the roles of child and teacher for different design methodologies as follow (see Table 2.1):

Table 2.1 Teacher's and child's role (Pardo et al., 2005, p. 3)

	Learner Centered Design	**Classroom Centered Design**	**Curriculum Focused Design**	**Child Centered Design**
Teacher Role	• User • Informant	• User • Tester • Informant	• User • Tester • Informant	• Facilitator • Tester • Informant • Research Partner
Child Role	• User • Tester	• User • Tester • Informant	• User • Tester	• User • Informant • Tester • Design Partner

The most common way of including children to design process is as testers (Druin 2002; Hourcade, 2008). In a tester role, child can use and test the prototypes during the design and development period of a specific technology. Children's reactions are of great importance in reaching the final product. As seen in Table 2.1, child centered design seems the best methodology for technology design process since it includes teacher and child in different roles. But, in practice, teachers are not included in design process adequately (Pardo et al., 2005). They also emphasized that child centered design practices, in general, do not pay attention to the potential of teachers in design process. As indicated in Table 2.1, user role is not mentioned for teachers. Since children's needs as learners are defined by the teacher and the curriculum (Pardo et al., 2005, p. 2), including teachers as not only tester and informant but also user can provide valuable information about designing and developing the most appropriate technology for children. As preschool curriculum determines the objectives or goals for children and teachers are the main practitioners in early childhhod settings, curriculum focused design was selected as design methodology of this study. According to Scaife, Rogers, Aldrich and Davies (1997), “we also need to recognise, however, that children cannot design their own learning goals. Here input from teachers, psychologists and educational technologists can play a valuable role” (p. 344). In light of this view, scholars of instructional technology and early childhood education were included in design process to increase the number of informants and reach the most suitable and usable technology. Table 2.2 below summarizes the roles of participants for curriculum focused design selected in this study.

Table 2.2 Roles of participants

Participant	Curriculum Focused Design
Teacher role	• User • Tester • Informant
Child Role	• User • Tester
Instructional Technologist	• Informant
Early Childhood Academician	• Informant

As shown in Table 2.2, teachers participated in design process as user, tester and informant. In user role, they used smart toy after completing design and development period. In tester role, they tested prototypes to give their feedbacks for reaching the effective design for children. In informant role, they provided information about objectives mentioned in the preschool curriculum. Additionally, they told about children’s needs and expectations towards using a new technology in early childhood settings. They also shared their experiences and design suggestions with researcher and designers. Children are included in the design process as user and tester (see Table 2.2). In user role, children used the designed smart toy to get usability issues and they tested prototypes to get their reactions to the smart toy. Instructional technologist as an informant shared their views especially on the design of interface. On the other hand, early childhood academician as an informant provided information about the suitability of the design towards children.

2.6 Smart Toys

Smart toy concept can be considered as technologically developed series of physical toy materials in accordance with the constructed and meaningful purposes. "Constructed and meaningful purposes" is the main term separating smart toys from classic electronic or digital toys. While classic electronic or digital toys use technological features only for increasing the attraction of the toy, smart toys provide a meaningful technologically augmented environment for children to carry out purposeful tasks in an interactive way (Cagiltay, Kara, & Aydin, 2014). In the literature, computationally-augmented toys (Bers & Cassell, 1998; Glos & Cassell, 1997), digitally augmented physical spaces, or digitally enhanced physical spaces (Price & Rogers, 2004), and similar terms can be used instead of smart toys. We prefer to use smart toys because "smart (intelligent)" is a distinctive term and it reflects "dynamic" and "adaptive" concepts obviously. Smart toys are one of the examples of Information and Communication Technologies (ICT) for children. As presented by Kalaš (2010), ICT has great potential role in early childhood education. The report also pointed out that programmable toys provide still greater possibilities for developmental and learning issues in early childhood education. Smart toys, as an application of ICT especially for early childhood children, have also great potentials to promote learning and development of children. With the advent technology, popularity of smart (intelligent) toys has increased. Since not only play components but also technology based components are effective in new smart toy materials, influences of these smart toys to children' development and learning processes are of great significance.

2.6.1 Smart Toys from the Perspective of Instructional Technology

Cognitive tools enable learners to achieve goals they are already motivated to reach (Malone & Lepper, 1987). Since toys have a great potential to motivate children to reach specific goals, smart toys as cognitive tools can be effective for smart toy based learning environments. Goals of the instructional or cognitive tools are considered as not only increasing motivation and interest but also improvement of retention and higher order thinking skills (Hogle, 1996). From this perspective, the nature of smart toys as cognitive tools for children needs to be one of the important focus areas of instructional technologists. As Eisenberg (2003) stated, "we can look to various children's cultures around the planet; and we can explore how children's activities with materials might lend themselves to robust, creative, emotionally, and intellectually inspiring integration with technological artifacts" (p. 50). The important point is that smart toys have the capabilities to integrate children's thinking, creativeness, imagination, reflection, and etc. with the valued technology. The environment that these toys create does not only motivate children to play with it but also lead them to carry out cognitive activities. For instance, storytelling, mathematical thinking, and concept learning activities can be provided to the children with the help of smart toys.

Fantasy play is also an important dimension in children's playing. As Cassell and Ryokai (2001) stated, fantasy play composes the significant part of the children's emotional and social development. Fantasy play can be defined as authentic activity enabling children to reflect their inner feelings without any restrictions and difficulties. Similarly, Cassell and Ryokai (2001) defined the role of fantasy play as "allowing children to explore different possibilities in their life without the risk of failure and frustration from unexpected events" (p. 172). Technology oriented, meaningful and purposeful structure of smart toys can be a good example of fantasy play activities. Since these toys provide constructed computationally augmented environments to children, they can effectively use their imagination, and abstract thinking skills. Smart toys attract attention of children to meaningful and authentic environment to realize purposeful tasks in play activity so that children carry out fantasy play activity in mixed reality environment as an active player. Since mixed reality has more power than single physical reality, virtual reality and imaginary reality, smart toys have the potential to provide fantasy play environment to the children. Fantasy play is considered as an important factor in children's cognitive and language skills (Cassell & Ryokai, 2001) so that smart toys need to be supported to provide rich fantasy play environments to the children.

Interaction has also a great effect on both technological systems and instructional activities. Resnick (1998) emphasized that managing interactions among toys or other playable tools has a considerable effect on children's play and learning. From this perspective, it is clear that structured and meaningful interactions among toys have an important role in children's learning. Smart toys have a big potential to provide mutual interactions between children and system (Cagiltay et al., 2014). The characteristic of smart toys is to lead children to participate in mixed reality environment actively in an interactive way. This is also distinctive point than classic electronic or digital toys because smart toys use interaction for purposeful tasks in authentic play environment rather than using it only for taking a response. For instance, in smart storytelling toy-StoryTech, interactions can be applied for the purpose of leading children to tell their imaginative stories in mixed reality environment (Kara, Aydin, & Cagiltay, 2013). According to Price and Rogers (2004), interacting in digitally enhanced physical spaces has six aspects:

1. *Awareness. Physical interaction in the spaces enables awareness at different levels.*
2. *Experience. The experience of interacting in the spaces is more than just visual or multimedia.*
3. *Anticipation. Many of our physical–digital couplings were designed based on familiar physical actions and unexpected effects.*
4. *Exploration. The spaces allow for high levels of exploration and discovery.*
5. *Authenticity. They can provide children with the means by which to interact with the physical environment, allowing them to reflect on their own experience in relation to the learning experience.*

6. *Collaboration. Compared with static screen collaboration, digitally augmented physical spaces can support more diverse forms of collaboration, between children and others* (p. 148-149).

From these perspectives, it can be concluded that interaction has a key role in smart toy activities and it should be taken into account by instructional technologists in a detailed way.

Open ended features can also improve the effectiveness of smart toys. Rather than providing a determined system, smart toys allow children to explore new things in each play. For instance, children can handle physical plush toys in storytelling smart toy in accordance with their desires, and smart toy leads children to produce different stories for each of the selected plush toys (Kara, Aydin, & Cagiltay, 2014a). Combining physical and virtual realities in mixed reality also make open ended features easy to develop. An important contribution of these features is motivating children to play collaboratively. By the open-ended features of smart toys, children can share their play activity with other children and enhance learning experiences of each other. Similarly, Petersson and Brooks (2006) emphasized that "open-ended design features evoke children's motivation to learn and the physical and virtual explorations optimized a sense of being immersed which can enhance collaborative play and learning experiences" (p. 198). These features should also be considered by instructional technologists in design and development of smart toys.

2.6.2 Smart Toys and Developmental Stages of Children

This part will mainly analyze smart toys in accordance with the developmental stages of children. According to Piaget (1964), children have four main stages in their intellectual development: (1) sensory-motor (first 18 months), (2) preoperational representation (2 – 7 years old), (3) concrete operations (7 – 11 years old), and (4) formal operations (after 11 years old).

Sensory-Motor Stage: According to Piaget (1964), "When an object disappears from the perceptual field it no longer exists" (p. 21). Hence, children show simple actions or behaviors in this stage. Cagiltay et al. (2014) stated that smart toys aiming at presenting behavioral purposes may be suitable for children in the sensory-motor stage. For instance, “Furby allows children to control a virtual character, practicing behavioral tasks by caring for and treating it like a real creature” (Cagiltay et al., 2014, p. 707). Therefore, it can be concluded that children can play with the smart toys designed for the purpose of giving simple behavioral tasks.

Preoperational Stage: Piaget (1964) describes the preoperational stage as “the beginnings of language, of the symbolic function, and therefore of thought, or representation” (p. 21). Hence, both cognitive and behavioral activities supported in smart toys can be suitable for children in the preoperational stage (Cagiltay et al., 2014).

According to Ryokai and Cassell (1999), 3 years old children showing a parallel play do separate their own play from others. On the other hand, Ryokai and Cassell (1999) emphasized that by age 4, children start to be included in social play and interact with others in a cooperative way. Preschool children aged between 4 and 7 can also use their imaginative skills by telling their fantasy stories via narrative voice (Ryokai & Cassell, 1999). Similarly, Cagiltay et al. (2014) pointed out that “creativity and imagination should be emphasized for children in the preoperational stage” (p. 708).

Concrete Operations Stage: According to Piaget (1964), “there are the operations of classification, ordering, the construction of the idea of number, spatial and temporal operations, and all the fundamental operations of elementary logic of classes and relations (p. 21). Smart toys with medium level cognitive purposes can be suitable for children in the concrete operations stage.

Formal Operations Stage: According to Piaget (1964), “a child can reason on hypotheses, constructs new operations of propositional logic” (p. 21). Hence, smart toys with advanced cognitive purposes can be suitable for children in the formal operations stage. Cagiltay et al. (2014) stated that “at this stage, children begin to demonstrate a preference for computer-based applications rather than physical toys" (p. 708). According to Cagiltay et al. (2014), "Lego Mindstorms robotics kits, developed at the MIT Media Lab, may be more suitable for children at the formal operations stage" (p. 708).

2.6.3 Use of Smart Toys in Early Educational Settings

In this part of the literature review, existing smart toys and related research articles were analyzed.

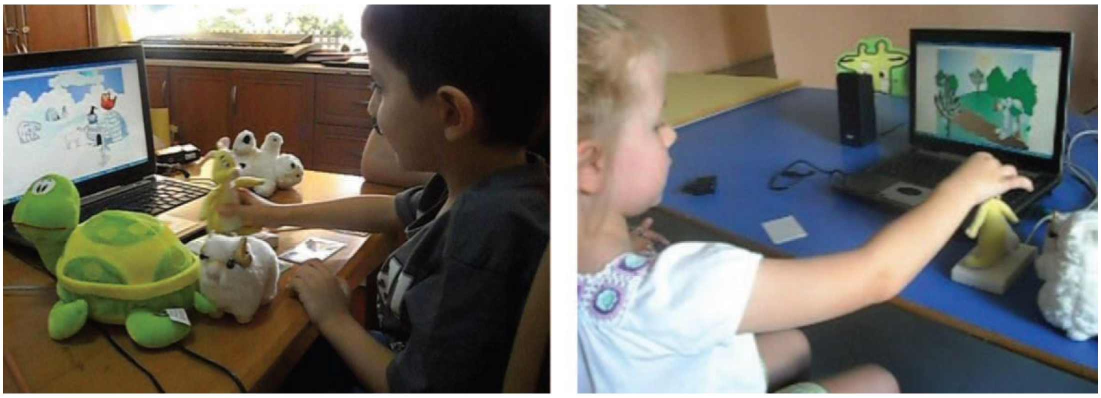


Figure 2.1 Children playing with the StoryTech (Kara et al., 2014a)

Kara et al. (2014a), who were faculty members in the department of Computer Education and Instructional Technology, developed StoryTech to make children create their imaginative stories. Radio frequency identification (RFID) reader, RFID tag inserted plush toys, background cards and flash animation were the main components of StoryTech and virtual view of plush toys or background cards were appeared in flash animation when the physical objects were put on RFID reader. Kara, Aydin and Cagiltay (2014b) also conducted a user study with 90 children and found that 6 years old children produced more complex stories than 4 and 5 years olds. (see Figure 2.1).

Cassell and Ryokai (2001), who were the members of Gesture and Narrative Language Group in MIT Media Lab, developed StoryMat offering a play space that records and recalls children's storytelling. Children could tell their fantasy stories by using stuffed animals on StoryMat space and they could listen to their stories which were recorded by the system. Cassell and Ryokai (2001) also carried out a user study with 36 children and concluded that children playing on StoryMat produced more imaginative objects in their stories than children playing on passive mat.

Fontijn and Mendels (2005), who were the researchers from Philips Research company and Eindhoven University of Technology, developed StoryToy which is an environment including several stuffed farm animals telling stories and reacting each other animal's actions. According to the findings of the experiment with children aged between 2 and 6, Fontijn and Mendels (2005) reached that older children (age 4-6 years) considered more complex dialogues enjoyable while it was hard to follow longer dialogues for younger children (age 2-3 years).

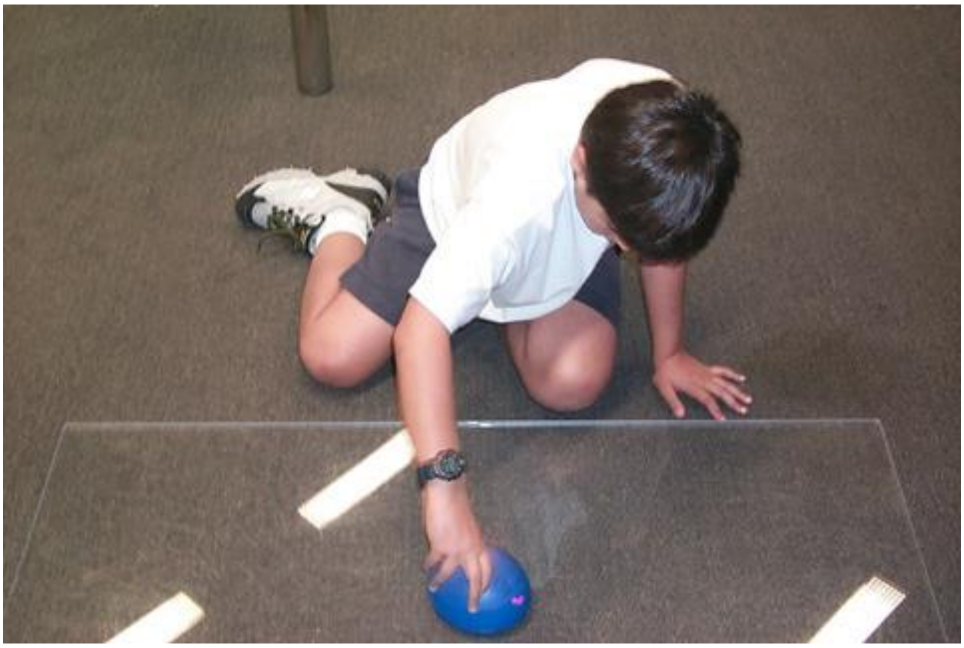


Figure 2.2 Child playing with *curlybot* on Plexiglas (Frei, Su, Mikhak & Ishii, 2000)

Frei, Su, Mikhak and Ishii (2000), who were the researchers from Tangible Media group in MIT Media Laboratory, developed Curlybot (see Figure 2.2) which is "an autonomous two wheeled vehicle with embedded electronics that can record how it has been moved on any flat surface and then play back that motion accurately and repeatedly" (p. 129). The aim of this educational toy was to enhance computational and mathematical thinking of children. Informal user study showed that children ages four and above played with Curlybot by engaging computational and mathematical concepts in a more creative way (Frei et al., 2000).

Glos and Cassell (1997), who were the researchers from MIT Media Laboratory, developed Rosebud system including stuffed animals integrated with computer. The aim of this system was to lead children to type their stories to the storybook on computer about stuffed animal recognized by computer. The researchers also conducted a user study with 6 children and found that the combined physical and virtual interface provided richer interaction for children (Glos and Cassell, 1997).

Lampe and Hinske (2007), who were the researchers from Institute for Pervasive Computing, presented The Augmented Knight's Castle playset for enriching the pretend play of children by providing sound effects and verbal reactions of toys. The aim of the smart toy was to provide Middle Ages topic by providing interactive environment based on Radio Frequency Identification (RFID) Technology. Lampe and Hinske (2007) generally mentioned about the characteristics of play and learning environment of the Augmented Knight's Castle playset.

Luckin, Connolly, Plowman and Airey (2003), who were the researchers from School of Cognitive & Computing Sciences in University of Sussex, investigated young children's use of interactive toy technology "Arthur" stuffed toy being used in conjunction with the software and DW toy without the software. The researchers concluded that "children can master the multiple interfaces of toy and screen and, when the task requires it and the help provided is appropriate, they will both seek it and use it" (p. 11).

Piper and Ishii (2002), who were the researchers from Tangible Media Group in MIT Media Laboratory, implemented Pegblocks which is an educational toy aiming at showing basic physics principles to elementary school students. The general mechanism of Pegblocks was to manipulate the wooden toys which were connected each other via electrical cables and to observe the kinetic energy changes that children produced by changing the places of Pegblocks in the network. Piper and Ishii (2002) presented general characteristics and advantages of Pegblocks toward group interaction and engaging in activities related with physical principles.

Vaucelle and Jehan (2002), who were the researchers from MIT Media Laboratory, developed a computational toy "Dolltalk" recording gestures and speech of children and playbacking their voices. Vaucelle and Jehan (2002) conducted a user study with 12 children at elementary school and concluded that children generally enjoyed their interaction with Dolltalk by frequently repeating the playback.

Looked at the smart toy practices in the literature, most of the smart toy projects have been carried out by researchers from MIT Media Lab. In other words, it can be stated that researchers mostly from computer science field have conducted smart toy projects for young children. As Cagiltay et al. (2014) stated, "Although the smart toys were developed for pedagogical purposes, early childhood scholars' or teachers' contributions have been limited" (p. 710). While most of the countries' ECE curricula made references to ICT and programmable toys (Plowman & Stephen, 2003), smart toy practices in the literature generally focused on specific purposes of young children, like storytelling, pretend play and so on. Existing smart toy projects have not provided applications for formal early educational environments in consistent with the ECE curriculum. Researchers developing new toy technologies for young children, also, tended to conduct small scale user studies to test the effectiveness of these toys for young children. Although there are still questions in the literature about how to best integrate new technologies to young children's formal or informal learning environments, design and development periods of new smart toy technologies have not been adequately emphasized by the researchers. It is important that design and development issues including young children's and early childhood teachers' views and perceptions during design and development period of these kind of technologies have a significant role in offering the effective design principles, rather than only testing the effectiveness of designed products. Although design based research methodology is seen as a proper methodology for designing new technologies for educational environments (Wang & Hannafin, 2005), the majority of researchers have not applied design based research in developing these smart toys as supportive technologies for young children.

All of these statements above present the gap in the literature about smart toy applications. With this study, design, development and usability of a smart toy for supporting several objectives mentioned in the preschool curriculum was investigated via design and development research methodology. Young children and young children's teachers were participated in the study and the process continued in parallel with developers, researcher, young children, young children's teachers, ECE and IT scholars. It is expected from the study to eliminate the gaps in the literature, provide design principles as to integrating smart toys to the formal early educational settings.

2.7 Constructionism: A Theoretical Framework

According to Papert (1991), constructionism bases on *building knowledge structures* underlying the main philosophy of constructivist paradigm. In constructivist view, people actively construct their knowledge with real life experiences (Resnick, 1998). Engaging learnings into constructing meaningful products extend the view of constructivism to constructionism (Papert, 1991; Resnick, 1998). Learning by making is seen as the critical determinant of constructionist paradigm (Papert, 1991). According to Reichel, Osterloh, Katterfeldt, Butler and Schelhowe (2008), "constructionism sees learners as active builders of their own knowledge and asserts that people learn with particular effectiveness when they are engaged in constructing personally meaningful artefacts" (p. 253).

Considering the smart toy practices, constructionist view has an important role. According to Yelland (1999), technological development has affected the toys' structure especially their interaction patterns with players. Since two-way interaction is one of the important characteristics of smart toys and computers or other technologies increase the chance of creating mutual interaction, technology has a great impact on smart toy applications. Reichel et al. (2008) emphasized that "the constructionist approach is based on an intimate connection between knowledge and activity" (p. 253). Children can construct their own knowledge or meaning by actively engaging into smart toy activity. For instance, children can create their own stories by handling plush toys and background cards in accordance with Flash animation in StoryTech play (Kara et al., 2014a). As Schweikardt and Gross (2007) stated, "significant learning and development can occur during play" (p. 57). It can be concluded from this statement that constructionist view can be valid during smart toy play if children build their own knowledge by making meaningful products.

According to Hay and Barab (2001), learners can collaboratively work and share their products in constructionist learning environments. In constructionist view, meaningful artefacts are built during the activity process and they can be shared by learners. For instance, StoryMat allow children to tell their fantasy stories and children can share their stories recorded by the toy (Cassell & Ryokai, 2001). It can be reached from this example that children can share their their products at the end of playing with the smart toy or they can build a collaboration between peers during smart toy play.

2.8 Summary

Although theoretical literature generally mentions about the importance and benefit of ICT toward young children, there is a significant gap about how to implement new technologies to early educational environments. There is also a gap in the literature as to investigating design and development of new technologies in early childhood settings. On the other hand, existing research studies mostly focus on the evaluation of the effectiveness of technological devices, especially computers, for young children's formal and informal learning. With the rapid growth of technology, wireless, hand-held, and augmented have increased its popularity for not only adults but also young children. However, there are no more detailed research studies including new technologies for early educational settings. Therefore, there is a need to investigate how to best integrate these new technologies to young children's formal learning environments.

With this study, design and development process of smart toys were analyzed to produce a framework to effectively integrate these technologies into early educational environments. Research studies in the literature generally focus on the evaluation of smart toys in young children's learning environments. On the other hand, this study mostly emphasized on design and development process of smart toys rather than only experimenting the effectiveness of these technologies for young children. Preschool children and early childhood teachers were the first contributors of this study because they are the main characters of formal early educational settings. Additionally, early childhood and instructional technology scholars existed in the study as informants. Since national preschool curriculum is followed by all early educational schools, curriculum focused design was the main methodological design of the study. Constructionism supporting Constructivist view was the main theoretical background of the study because Constructionist view supports children's building knowledge with their involvement to the activity. This study is expected to fill the gap as to providing detailed design and usability process of new technologies, specifically smart toys in early educational settings.

CHAPTER 3

METHODOLOGY

This chapter offered purpose and research questions, overall design of the study, participants and data collection procedures. Additionally, data analysis techniques, trustworthiness and ethical considerations were reviewed in this chapter.

3.1 Purpose of the Study and Research Questions

The purpose of this study is to design, develop and use of smart toys for preschool children from age 36 months to 72 months.

The main research question and sub research questions of the study are as follows:

3.1.1 Main Research Question

What are the design, development and usability issues of smart toys supporting curriculum related objectives for preschool children?

3.1.2 Sub-Research Questions

1. What are early childhood teachers' opinions toward technology and technology use in early educational settings?

2. What are early childhood teachers' opinions about educational use of smart toys?

3. What are the design principles when designing a smart toy to support curriculum related objectives?

4. What are the usability issues of smart toys?

5. What are early childhood teachers' opinions about the design and use of smart toy?

3.2 Overall Design of the Study

This study aims at designing and developing a smart toy for preschool children. Therefore, design and development research is the main research design of the study. Design and development research is defined as "the systematic study of design, development and evaluation processes with the aim of establishing an empirical basis for the creation of instructional and non-instructional products and tools and new or enhanced models that govern their development" (Richey & Klein, 2008, p. 748). Thus, design and development research can be seen as a research design involving all phases of creating a specific tool or model. Similarly, Wang and Hannafin (2005) defined design based research as "a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories" (p. 6). Design based research with the structure of including a series of approaches produces new theories, artefacts and practices that impact learning and teaching in naturalistic settings (Barab & Squire, 2004). One of the important features of design based research is to combine design and research activities to understand the educational phenomena deeply (Bell, 2004). Another important feature of design based research is to provide design principles which can guide other researchers in the field (Amiel & Reeves, 2008). Design based research's capability of including multiple design and research methodologies also enhance its strength (Wang & Hannafin, 2005). Although design based research or developmental research terms were used in several publications (Reeves, Herrington, & Oliver, 2004; Wang & Hannafin, 2005), design and development research term has been used recently

(Richey & Klein, 2008; Richey & Klein, 2014). Therefore, design and development research was applied in this study.

According to Wang and Hannafin (2005), design and development research has main five characteristics: (a) pragmatic, (b) grounded, (c) interactive, iterative, (d) integrative, (e) contextual (see Table 3.1).

Table 3.1 Characteristics of design-based research (Wang & Hannafin, 2005, p. 8)

Characteristics	Explanations
Pragmatic	• Design-based research refines both theory and practice. • The value of theory is appraised by the extent to which principles inform and improve practice.
Grounded	• Design is theory-driven and grounded in relevant research, theory and practice. • Design is conducted in real-world settings and the design process is embedded in, and studied through, design-based research.
Interactive, iterative	• Designers are involved in the design processes and work together with and flexible participants. • Processes are iterative cycle of analysis, design, implementation, and redesign. • Initial plan is usually insufficiently detailed so that designers can make deliberate changes when necessary.
Integrative	• Mixed research methods are used to maximize the credibility of ongoing research. • Methods vary during different phases as new needs and issues emerge and the focus of the research evolves. • Rigor is purposefully maintained and discipline applied appropriate to the development phase.
Contextual	• The research process, research findings, and changes from the initial plan are documented. • Research results are connected with the design process and the setting. • The content and depth of generated design principles varies. • Guidance for applying generated principles is needed.

Present study is consistent with these characteristics. The study is pragmatic because design principles of smart toys are offered. This study is also grounded because Constructionism is the main theoretical ground. Additionally, curriculum focused design is the main design theory of this study. The study is also interactive because several participants, such as preschool children, early childhood teachers, instructional technology and early childhood scholars were included in the study. The study is also iterative because prototypes were developed and necessary revisions were made during the design and development period. The study is also integrative because different research methodologies were applied for different phases. The study is also contextual because research results are connected with smart toy design and development process and the early childhood settings.

According to Richey and Klein (2014), creating a new knowledge, getting enough information about the field and the ability to make estimations are the main three goals of design and development research. They listed design and development research projects as 2 categories: “(1) research on products and tools and (2) research on design and development models” (p. 142). The present study fits on the first category because the focus is on design and development of a smart toy technology. Reeves et al. (2004) proposed a model for design and development research as illustrated in Figure 3.1. According to Cifuentes, Sharp, Bulu, Benz and Stough (2010), such a design and development research creates guidelines for both designers and practitioners by emphasizing the relationship between theory and practice. Reeves et al.’s (2004) model starts with the analysis of problems underlying the need for designing and developing specific solutions, continues with development of these solutions followed by evaluation of these solutions and ends with the documentation of all research procedure to provide guidelines and design principles (see Figure 3.1).

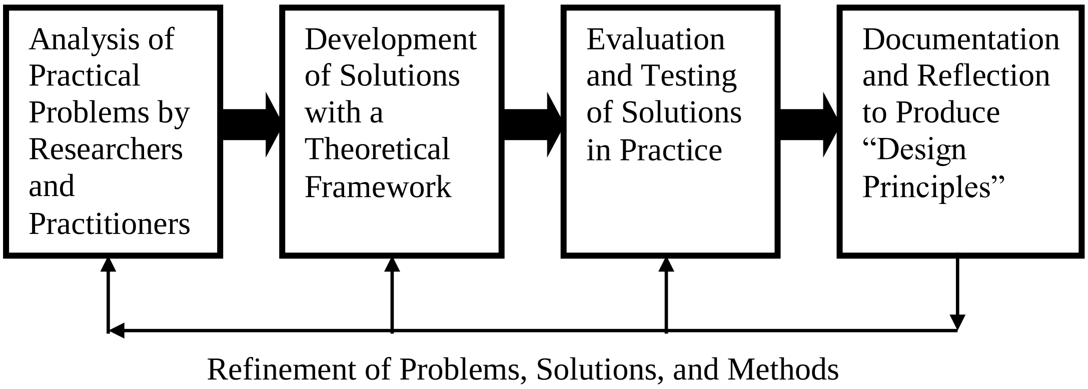


Figure 3.1 Development research model (Reeves et al., 2004, p. 60)

McKenney and van den Akker (2005) applied a design and development research for a computer based tool (CASCADE-SEA) for curriculum development. As seen in Figure 3.2, needs and context analysis, design, development, formative evaluation and summative evaluation compose the main phases of their study.

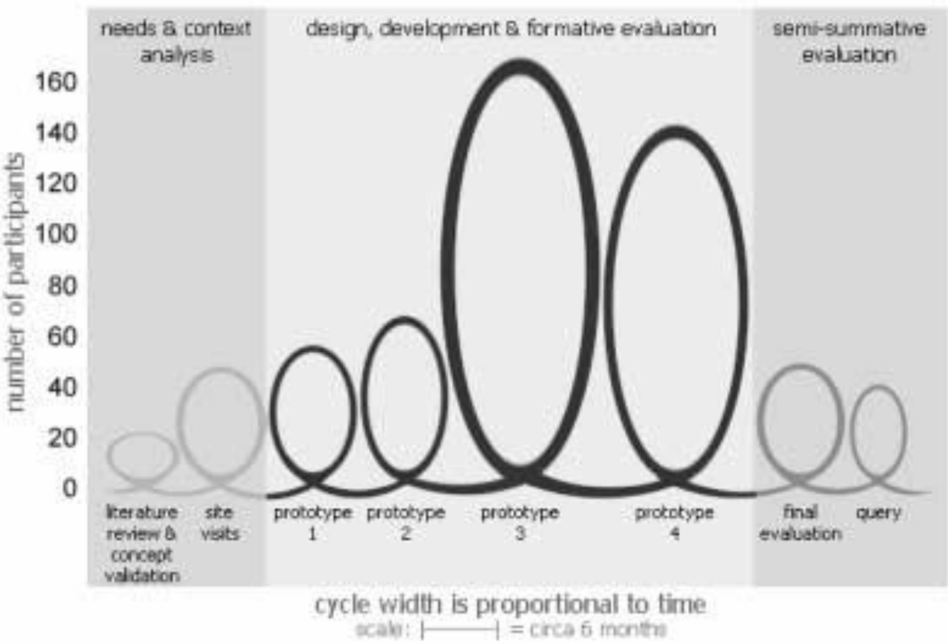


Figure 3.2 Display of the CASCADE-SEA study (McKenney & van den Akker, 2005, p. 49)

In the current study, both Reeves et al.'s (2004) and McKenney and van den Akker's (2005) design and development research models were followed. The final model of this study is shown in Figure 3.3.

The phase 1 was named as analysis. In the phase 1, needs analysis of teachers was considered. Since curriculum focused design values teachers in design period, determining needs analysis of teachers was the starting point of the study. Needs analysis started with conducting semi-structured interviews to understand early childhood teachers' current technology practices and their views towards technology. As smart toy is considered as an ICT tool, determining the teachers' approaches to technology was important. The second step of the needs analysis was to conduct semi-structured interviews with early childhood teachers to understand their views and opinions about a smart toy which was developed in pilot study. The details of this pilot study were given in the following section. Taking teachers' thoughts and reflections to that smart toy was of great significance to shape the smart toy to be designed and developed in this study. Needs analysis lasted about 6 months, between January and June, 2012. After finishing needs analysis, smart toy analysis was performed in Phase 1. The main aim of this step was to analyze the smart toy in pilot study and make inferences about cost analysis, requirements and etc. Smart toy analysis lasted about 4 months, between July and October, 2012.

The phase 2 was named as design of the smart toy. Curriculum focused design was the main design theory of this study because of the importance, validity and practicality of preschool curriculum for all preschool settings. Teachers have a critical role in curriculum focused design so that teachers as designers were included in the design phase (phase 2). Focus group meetings, 6 in total, were arranged with 4 early childhood teachers. A person who was responsible for programming and coding also attended to the meetings. The first step of the design phase was to determine tentative objectives mentioned in preschool curriculum (phase 2.1). Preschool curriculum which was valid in the time that these meetings were held was taken into account to determine the objectives. In the phase 2.2, the story of the smart toy was determined. Based on the determined objectives and story, the storyboard was developed in the phase 2.3. Lastly, final objectives were determined in the phase 2.4. The phase 2 lasted about 2 months, between December, 2012 and January, 2013.

The phase 3 was named as development of the smart toy. In the phase 3.1, the first prototype was developed based on the storyboard and the results of focus group meetings. The phase 3.1 lasted about 4 months, between February and May, 2013. In the phase 3.2, formative evaluations were carried out with preschool children, early childhood teachers and early childhood education (ECE) and instructional technology (IT) scholars. The main aim of this phase was to get feedbacks and views of multiple participants to enhance the quality of the second prototype to be developed. While children were mainly observed while playing with the first prototype, early childhood teachers and scholars played with the prototype and declared their feedbacks. The phase 3.2 was carried out in June, 2013. In the phase 3.3, the second prototype was developed based on the necessary revisions stated by multiple participants in the previous phase. The phase 3.3 lasted about 2 months, between July and August 2013. Formative evaluation of the second prototype was done with IT and ECE scholars in the phase 3.4. This phase was done in October, 2014. In the phase 3.5, the final version of the smart toy was developed in nearly 2 months, between November and December, 2014.

The phase 4 was named as evaluation of the smart toy. Summative evaluation of the smart toy was held with preschool children and early childhood teachers. Usability testing was carried out with children to determine efficiency, effectiveness and satisfaction. Children were observed during the smart toy play and asked simple questions to get their reactions. On the other hand, semi structured interviews were carried out with early childhood teachers using the smart toy in classroom settings for a while. The purpose of these interviews was to get teachers' views about the design and use of the smart toy for preschool education. The phase 4 lasted about 2 months between January and February, 2015. In the phase 5, final design principles were documented in March, 2015. As seen in the Figure 3.3, iterative analyses were applied among both phases and sub phases. Therefore, design principles were produced throughout all phases and they were finalized after finishing the summative evaluation.

In summary, design and development of a smart toy for preschool children was emphasized in this study. Detailed phases of the design and development research were presented (see Figure 3.3).

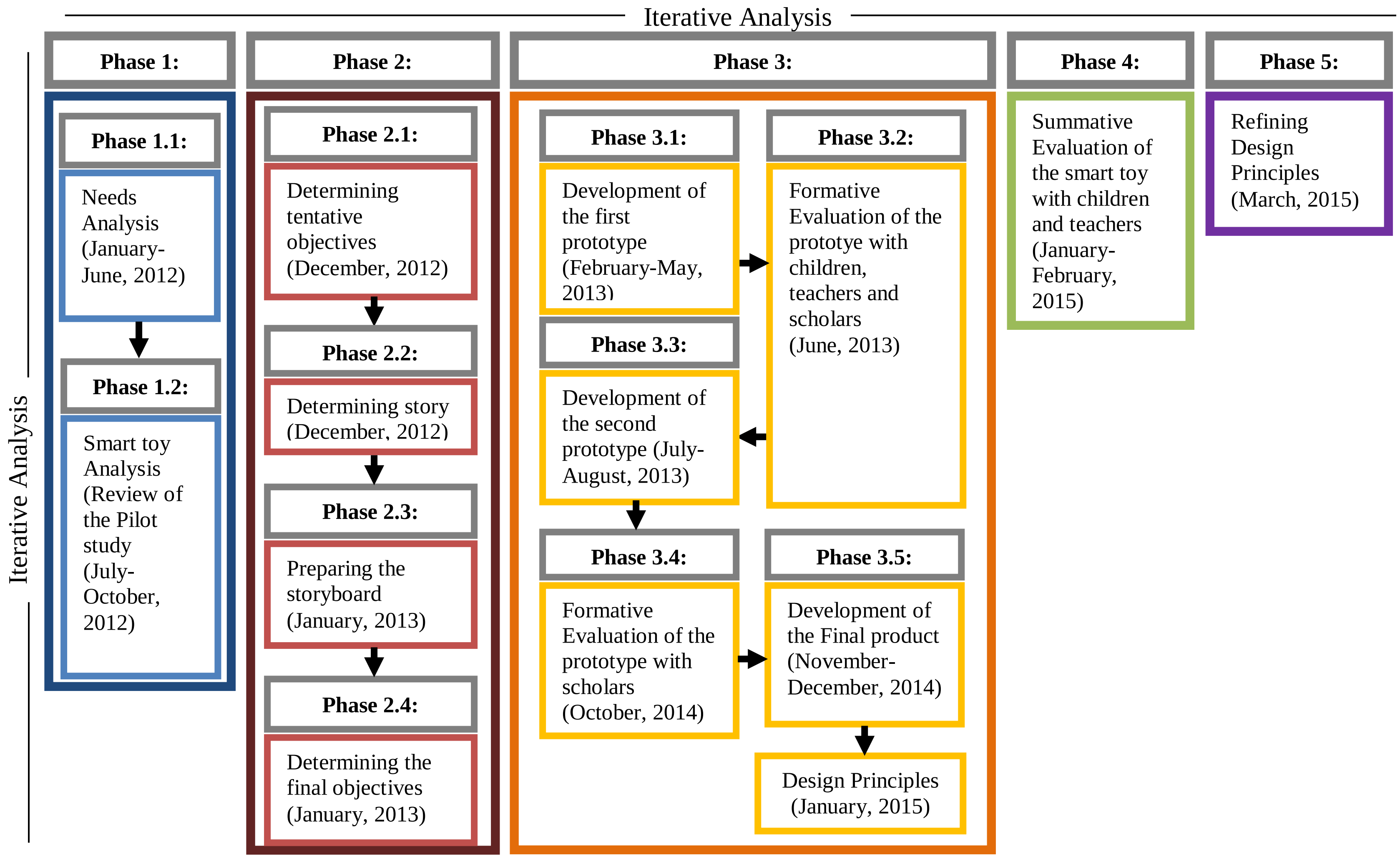


Figure 3.3 The study based on Reeves' and Mckenney and van den Akker's Design and Development Research Models

3.3 Pilot Study (Smart Storytelling Toy – StoryTech)

A smart storytelling toy which was called as StoryTech was designed and developed to promote storytelling skills of children (Kara et al., 2014a). As shown in Figure 3.4, the smart toy consisted of 4 main components, namely, flash animation, RFID based plush toys and background cards and RFID reader. When children put the plush toys or background cards on to the RFID reader, the virtual character of the object appeared on screen showing flash animation.

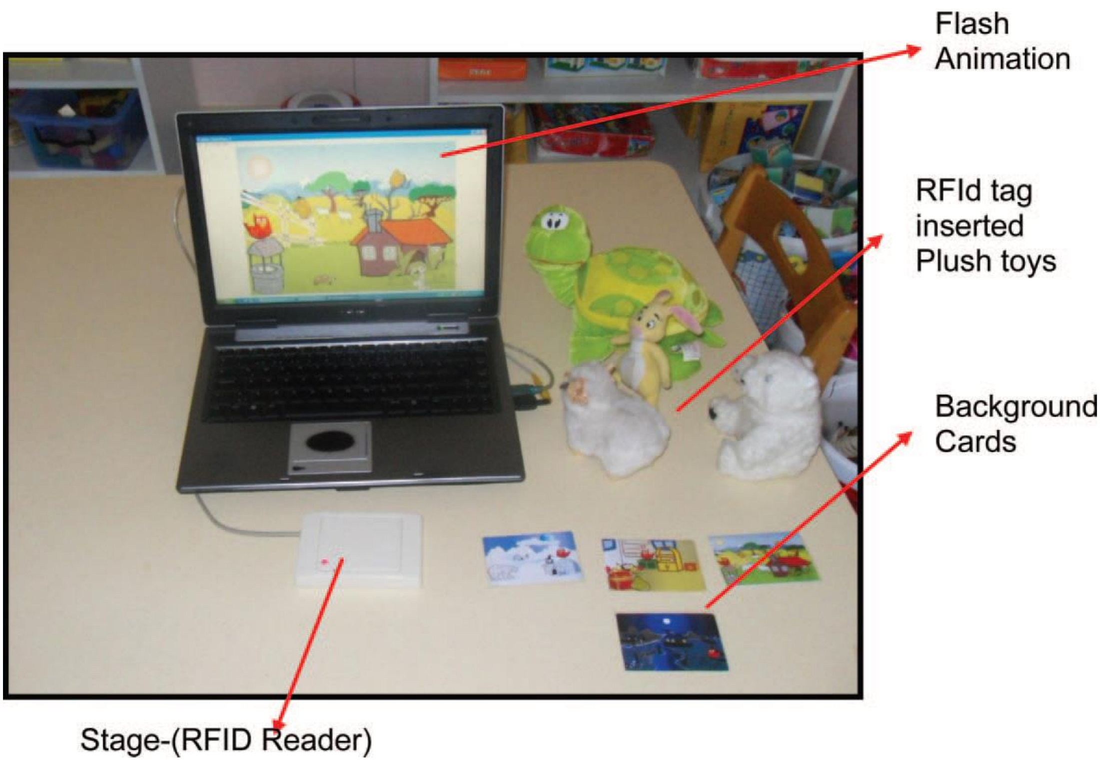


Figure 3.4 Main components of StoryTech (Kara et al., 2014a)

The smart toy consisted of two levels, namely the first level offering a known story to get accustomed to play with the smart toy and the second level expecting children to produce their own stories. In the first level, well known rabbit and turtle story was presented via flash animation and children were only expected to put the suitable rabbit or turtle plush toy when asked by narrator of the story. In the second level, children were free to put animals and background cards on to the RFID reader. Different animals, such as lion, rabbit, turtle, polar bear and sheep were available for children to handle and play. Additionally, different background cards such as night card, farm card and pole card were presented to allow children to change the environments shown in flash animation. For instance, they put the night card to change the environment into the night and they continued to tell their original stories. Children playing with both first and second level of the StoryTech are shown in Figure 3.5.

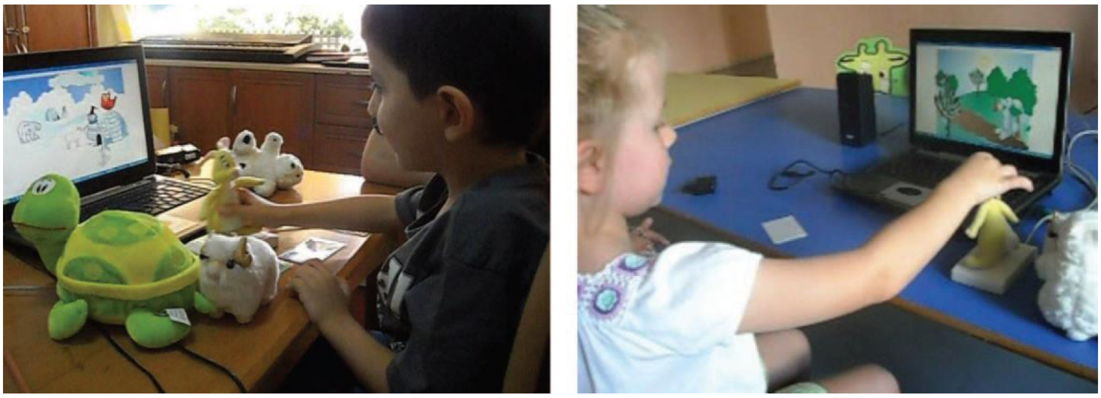


Figure 3.5 Children playing with StoryTech (Kara et al., 2014a)

Analysis, design, development and testing phases were applied for developing and usability testing of the StoryTech (see Figure 3.6). As presented in Figure 3.6, all phases of the project completed approximately in 10 months. In the analysis phase, meetings and interviews were carried out with both toy industry experts and ECE and IT scholars. The main goal of the researchers was to create a toy with meaningful and educational purposes for young children. To reach this aim, several meetings were held with ECE and IT scholars and existing toys were investigated. Additionally, the related literature and previous smart toy examples were reviewed. At the end of this process, smart toy idea was finalized and different smart toys ideas emerged. In the design phase, four different smart toy ideas were produced and templates and storyboards of each idea were prepared. After reviewing the prepared documents, researchers decided to develop smart storytelling toy. Development period started with buying RFID reader and RFID tags. Then, plush toys to be used in smart toy play were bought and RFID tags were inserted on these toys. The next step in the development period was, developing flash animation and programming to combine RFID with Adobe Flash program. In the testing period, preschools were selected to conduct usability testing with children. After getting required permits from authorities, testing studies were held in preschool settings.

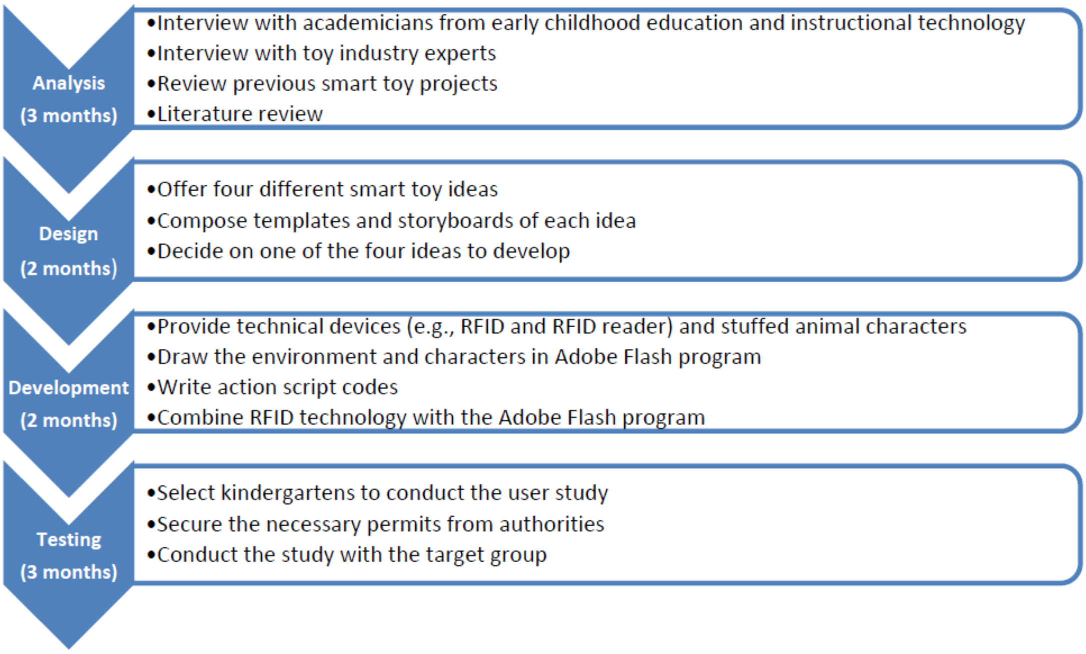


Figure 3.6 Timeline of the StoryTech project (Kara et al., 2013)

Kara et al. (2014a) conducted a usability study of Smart toy with a total of 24 children from 4, 5 and 6 age groups. At the end of the study, results and design principles based on children reactions were reported (see Figure 3.7).

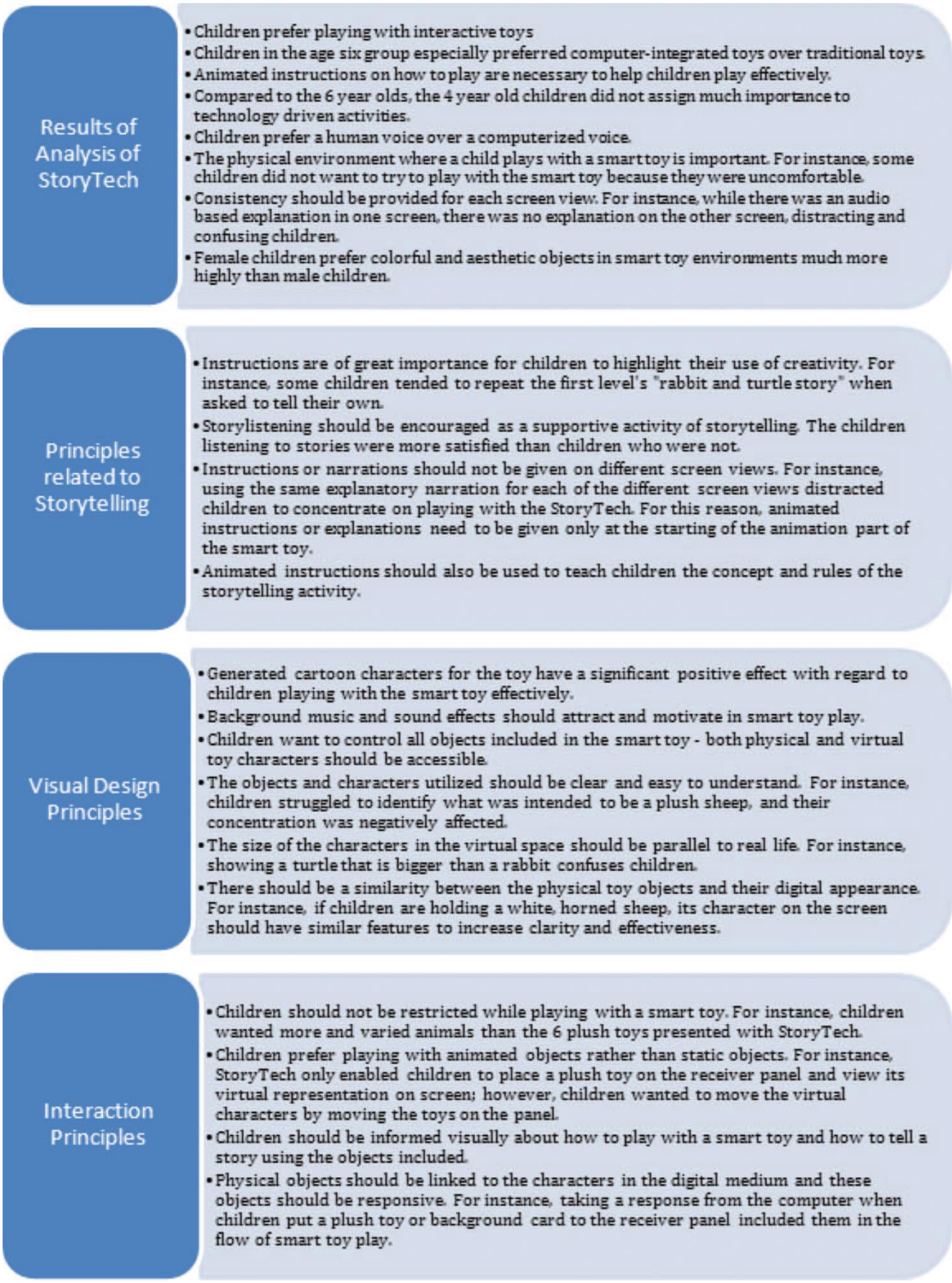


Figure 3.7 Design principles (Kara et al., 2014a)

Kara et al. (2014b) conducted an experimental study with a total of 90 children from 4, 5 and 6 age groups. They created four groups, namely a StoryTech and a control group for individual children, and a Storytech and a control group for pairs of children. They investigated both the differences between smart toy and passive toy play, and the effect of age to the storytelling experiences of children playing with passive toy and StoryTech. Based on the findings, age group 6 produced more advanced stories than both age group 4 and 5 (Kara et al., 2014b). They also found that age group 5 and age group 6 were interested in producing stories while age group 4 was mostly interested in playing with the smart toy.

Kara et al. (2013) also conducted an experimental study with a total of 90 children from 4, 5 and 6 age groups to investigate the narrative activities and creativity of children during StoryTech play. Children were randomly assigned into one of four groups, namely StoryTech and control group for single children, and StoryTech and control group for dyads. Based on the findings, age group 5 and 6 played with Storytech both alone and with peers talked more than the children played with passive toy (Kara et al., 2013). On the other hand, talking activity of age group 4 played with StoryTech both alone and with peers was not different from the children played with passive toy (Kara et al., 2013). The researchers also found that age group 5 and 6 who played with StoryTech both alone and with peers created more imaginative objects than the children played with passive toy.

3.4 Participants

Since design and development research requires several phases such as analysis, design, development and evaluation to conduct the study, several participants were included in the different phases of this study. Convenience sampling was the main sampling strategy to select and determine the participants. According to Marshall and Rossman (2011), “researchers’ site selection and sampling often begin with accessible sites” (p. 107). Therefore, convenience sampling was mainly applied in this study to reach the volunteers.

In the needs analysis phase, for the research question 1, 18 early childhood teachers participated interview sessions to understand their views toward technology and technology use. All teachers were women. Teachers who were eligible to attend the study and eager to share their views were selected from both public and private preschools (see Table 3.2). For the research question 2, the same 18 early childhood teachers were selected to understand their opinions toward a smart storytelling toy which was developed in the pilot study. Information about early childhood teachers was given in Table 3.2. Teachers were coded like ECT_NA as Early Childhood Teacher in Needs Analysis with a sequence number. All teachers declared that they use technology, mostly computers in their classrooms. Half of them showed a positive belief as to using technology in a competent way (see Table 3.2).

Table 3.2 Information about interviewed teachers in needs analysis

No	Age	Education Level	School	Teaching experience (year)	Technology / Computer Use at School	Belief as to using Technology competently
ECT1_NA	34	Bs - ECE	Public	13	Yes	No
ECT2_NA	37	Bs - ECE	Public	14	Yes	Yes
ECT3_NA	39	Bs - ECE	Public	12	Yes	No
ECT4_NA	37	Bs - ECE	Public	15	Yes	No
ECT5_NA	34	Bs - ECE	Public	15	Yes	No
ECT6_NA	29	Bs - ECE	Public	9	Yes	Yes
ECT7_NA	29	Bs - ECE	Private	9	Yes	Yes
ECT8_NA	26	Bs - ECE	Public	4	Yes	Yes
ECT9_NA	29	Bs - ECE	Public	7	Yes	No
ECT10_NA	32	Ms - ECE	Public	9	Yes	No
ECT11_NA	30	Bs - ECE	Private	9	Yes	Yes
ECT12_NA	30	Ms - ECE	Public	10	Yes	No
ECT13_NA	34	Bs - ECE	Public	14	Yes	Yes
ECT14_NA	24	Bs – Child development	Private	4	Yes	Yes
ECT15_NA	24	Bs - ECE	Private	4	Yes	No
ECT16_NA	29	Bs - ECE	Public	7	Yes	Yes
ECT17_NA	33	Bs - ECE	Public	8	Yes	Yes
ECT18_NA	26	Bs - ECE	Public	4	Yes	No

For the design phase, early childhood teachers as designers participated to focus group meetings. Since curriculum focused design was determined as the main design theory of this study, early childhood teachers were selected to attend focus group meetings for the purpose of determining specific objectives, story and storyboard to be considered in smart toy. To select the early childhood teachers, the public preschool was firstly determined based on the positive feeling and attitude of the school manager towards technology and technology related practices carried out in the school. After selecting the school, a meeting with the school manager was held to tell the study and permission was taken to conduct meetings at school at least 1 time in a week. After getting the permission, four early childhood teachers who were eager to share their thoughts, had at least 5 year teaching experience, had a positive attitude towards technology use in preschool education and able to attend group meetings regularly were selected as participants in focus group meetings. All teachers were selected from the same public preschool because of creating convenient schedule for meetings and providing friendly environment among teachers. All teachers were women and they used computers for several practices in early educational classrooms. (see Table 3.3). Teachers were coded like ECT_D as Early Childhood Teacher in Design with a sequence number. A person who was working in a private company producing digital solutions especially for learning environments also attended to the meetings because he was responsible for coding and programming of the smart toy. It was important to get the opinion of the developer because collaboration among various participants is a key characteristic of design and development research (Wang & Hannafin, 2005). The developer had at least 3 years experience on developing IT related products and he had developed educational softwares for children.

Table 3.3 Information about teachers in focus group meetings

No	Age	Teaching Experience (year)	Technology / Computer Use at School
ECT1_D	45	22	Yes
ECT2_D	30	8	Yes
ECT3_D	34	8	Yes
ECT4_D	32	5	Yes

For the development phase, early childhood teachers, preschool children and IT and ECE scholars were the main participants. After development of the first prototype, formative evaluation was carried out with preschool children, early childhood teachers and scholars. 5 children from a private preschool were selected to test the first prototype. In addition, 2 children from the public preschool in which early childhood teachers attended to focus group meetings were included. All children who showed an interest to play with the first prototype and could share their reactions were selected with the guidance of their teachers (see Table 3.4). Children were coded like C_FE1 as Child in the First Formative Evaluation with a sequence number.

Table 3.4 Information about children in formative evaluation of the first prototype

No	Age	Gender	School
C1_FE1	38 months old	Male	Private
C2_FE1	40 months old	Female	Private
C3_FE1	55 months old	Male	Private
C4_FE1	56 months old	Male	Private
C5_FE1	62 months old	Male	Private
C6_FE1	69 months old	Female	Public
C7_FE1	45 months old	Male	Public

The early childhood teachers who also participated to design phase of the study were selected to test the first prototype. The same teachers were interviewed because it was important to provide the connection between design and development. 3 teachers out of 4 attended to the formative evaluation because one teacher was out of school at that period (see table 3.5). Teachers were coded like ECT_FE1 as Early Childhood Teacher in the First Formative Evaluation with a sequence number.

Table 3.5 Information about teachers in formative evaluation of the first prototype

No	Age	Teaching Experience (year)	Technology / Computer Use at School
ECT1_FE1	30	8	Yes
ECT2_FE1	32	5	Yes
ECT3_FE1	34	8	Yes

Two IT scholars and an ECE scholar also attended to the formative evaluation of the first prototype because expert review was another important dimension of the study. These scholars were the doctoral committee members who had detailed information about the study from the beginning (see Table 3.6). Their reviews as to the first prototype were received in a focus group meeting.

Table 3.6 Information about scholars in formative evaluation of the first prototype

No	Research Area	Title	University
IT1_FE1	Instructional Technology	Prof. Dr.	Public University
IT2_FE1	Instructional Technology	Assist. Prof. Dr.	Public University
ECE1_FE1	Early Childhood Education	Associate. Prof. Dr.	Private University

The same scholars who attended to the formative evaluation of the first prototype also participated in formative evaluation of the second prototype. In addition, an ECE scholar joined the second formative evaluation phase. He was an Assistant Prof. Dr. in a public university and his research area was ECE. The same coding style used in the first formative evaluation was applied. Since this was the second evaluation, FE2 was used instead of FE1. On the other hand, the new scholar was coded as ECE2_FE2. A semi structured interview was carried out with this scholar to get his feedbacks.

For the research question 3, all sub phases of design and development phases were considered to document design principles. After carrying out the summative evaluations, finalized design principles emerged.

In the evaluation phase, for the research question 4, summative evaluation was done with 10 preschool children. Children who showed an interest to play with the smart toy and could share their reactions were selected from both public and private preschools (see table 3.7). Children were coded like C_SE as Child in Summative Evaluation with a sequence number.

Table 3.7 Information about children in summative evaluation of the smart toy

Child	Age	Gender	School
C1_SE	38 months old	Male	Private
C2_SE	41 months old	Female	Private
C3_SE	47 months old	Female	Private
C4_SE	50 months old	Female	Public
C5_SE	54 months old	Male	Public
C6_SE	61 months old	Female	Public
C7_SE	69 months old	Male	Public
C8_SE	69 months old	Female	Public
C9_SE	69 months old	Male	Public
C10_SE	69 months old	Female	Public

In the evaluation phase, for the research question 5, summative evaluation was done with early childhood teachers too. To provide the consistency between design, development and evaluation phases, the same teachers who also attended to focus group meetings in the design phase and formative evaluation in the development phase were selected. On the other hand, new teachers were also interviewed to enrich data and to get more teachers' opinions toward the smart toy. All descriptive information of teachers was shown in Table 3.8. Teachers were coded like ECT_SE as Early Childhood Teacher in Summative Evaluation with a sequence number.

Table 3.8 Information about interviewed teachers in summative evaluation

No	Age	Education Level	School	Teaching experience (year)	Technology / Computer Use at School
ECT1_SE	40	Bs – Child Development	Public	15	Yes
ECT2_SE	30	Bs - ECE	Public	8	Yes
ECT3_SE	25	Bs - ECE	Public	2	Yes
ECT4_SE	40	Bs – Child Development	Public	15	Yes
ECT5_SE	32	Bs - ECE	Public	5	Yes
ECT6_SE	34	Bs - ECE	Public	8	Yes

3.5 Researcher's Role

Analysis, design, development, evaluation and documenting were the main phases of the study. The researcher had several roles throughout the study. In the needs analysis sub phase of the analysis phase, two semi-structured interviews were carried out to answer the research questions 1 and 2. Since the researcher had a background about conducting semi-structured interviews for academic purposes, this provided an advantage for him to apply interviewing procedures. According to Marshall and Rossman (2011), building trust based relationships with the participants is the first important step in qualitative studies and experienced researchers who are able to create good communications are advantageous to gather good data. Thus, it can be said that the researcher was experienced in conducting qualitative study since this was not his first qualitative study including semi-structured interviews for collecting data. In the smart toy analysis phase, the researcher made inferences from the pilot study to integrate them to the current study. 3 articles which were published in SSCI indexed journals helped the researcher get information about the smart toy developed in pilot study.

In the design phase, focus group meetings were held to determine the objectives to be included in the smart toy, create the story and prepare the storyboard. The researcher attended to meetings as participant observer. In participant observation, the researcher is engaged to setting to not only hear and see the activities but also experience the whole reality with participants (Marshall & Rossman, 2011). Since curriculum focused design gives a key role to teachers in design process, it was important to carry out focus group meetings with teachers to reach the designed artefacts such as story and storyboard. Marshall and Rosmman (2011) listed 5 main questions that the researcher as participant observer needs to answer:

- *What is the nature of the involvement likely to be?*
- *How much will the study's purpose be revealed to the people in the setting?*
- *How intensively will the researcher be present?*
- *How focused will the participation be?*
- *How will ethical dilemmas be managed?* (p. 142)

The nature of the involvement to focus group meetings was getting teachers together to get their ideas for the design phase and lead them to produce the objectives, story and storyboard in a friendly environment. The developer also attended to focus group meetings with the request of the researcher because it was important to determine the suitability and complexity of the mentioned concepts to programmability. The researcher clearly explained the purpose of the study and showed the smart toy developed in the pilot study to concretize the smart toy concept in teachers' minds. Researcher was the one who determines the procedure to be followed throughout the meetings and he leaded teachers to be focused on the context of the study. Since teachers were not competent with preparing storyboards, the researcher mainly created the draft of storyboard and guided teachers to finalize it. He was also observer of the setting and teachers during all meetings. Additionally, the researcher took notes after each meeting and attended to next meeting as prepared. Although his participation was not very intensive, he actively participated in some points of the meetings to continue the process effectively. The ethical dilemmas were explained in the ethics section.

In the development phase, formative evaluation sessions were done with teachers, children and IT and ECE scholars to develop the final product. The researcher attended as participant observer while observing children playing with the first prototype. The researcher prepared the smart toy and setting for children and explained the details of how to play to the teachers accompanying children. The researcher also conducted semi-structured interviews to test the first prototype. Focus group meetings were held to get the feedbacks of IT and ECE scholars toward the first and second prototypes. The researcher carried out these meetings in doctoral thesis committee meetings. He explained the process and revisions made in each prototype to provide continuity and consistency. In the formative evaluation of the second prototype, an additional ECE scholar was interviewed to test the second prototype of the smart toy. In the evaluation phase, the researcher carried out usability testing with children by observing them while playing with the smart toy. Since the researcher took a graduate course including usability testing theory and practice, it was very helpful for researcher to conduct usability testing. The researcher also carried out summative evaluation with teachers by interviewing with them. In the last phase, documenting phase, researcher noted all process and refined design principles emerged at the end of the each phase, such as analysis, design, development, and evaluation. As a final note, the researcher considered his experiences and used data analysis techniques to provide final design principles.

3.6 Data Collection

3.6.1 Data Collection Instruments

Semi-structured interviews, records of focus group meetings and observations were the main data collection instruments of the study.

Semi-structured Interviews: According to Marshall and Rossman (2011), "interviews have particular benefits because an interview yields data in quantity quickly" (p. 145). Interviews were one of the main data collection instruments of this study. Interviews allow researcher to understand the interviewee's thinking (Bogdan & Biklen, 2007). In the current study, semi-structured interviews were preferred. As Brenner (2006) stated, "a semi structured protocol has the advantage of asking all informants the same core questions with the freedom to ask follow-up questions that build on the responses received" (p. 362). Semi-structured interviews were used in analysis, development and evaluation phases of the study. In the needs analysis step of the analysis phase, semi-structured interviews were conducted with early childhood teachers to answer the research questions 1 and 2. These interviews were coded as NAI-1 for Needs Analysis Interview for the research question 1, and NAI-2 for Needs Analysis Interview for the research question 2. In the formative evaluation of the first prototype step of the development phase, semi-structured interviews were conducted with early childhood teachers. These interviews were coded as FEI for Formative Evaluation Interview. In the summative evaluation step of the evaluation phase, semi-structured interviews were conducted with early childhood teachers. These interviews were coded as SEI for Summative Evaluation Interview.

Need Analysis Interview for the research question 1 (NAI-1): NAI-1 interview protocol (see Appendix A) was used to conduct semi-structured interviews with 18 early childhood teachers to understand their opinions toward technology and technology use in early educational settings. NAI-1 interview protocol included three main categories, namely interview plan, demographic questions and questions as to content and process. The researcher explained the purpose of the study and gave information about the interview process in the plan category. Interviewees' demographic information was gathered in the category of demographic questions. This category included 3 questions for knowing the interviewee's teaching year experience, age and the university graduated. The category of questions as to content and process included 13 main questions in total. What kind of technologies early childhood teachers use, in which courses they use, for what purposes they use, what contributions technology provides in terms of teachers, children and curriculum, what kind of institutional support they get towards technology use, how the curriculum supports in terms of technology use, what the advantages and disadvantages of technology use are in preschool settings, why children need technology, what the positive and negative effects of technology use are on children, what contributions of technology use are in terms of educational life, what the description of technology can be, how the teacher's attitude toward technology is, and what the competence of the teacher is toward technology were the main questions of NAI-1 interview protocol. Alternative questions were added for 4 different main questions. Additionally, prompts were used in 4 different questions to increase the clarity of the questions. Interview style, organization and questions were reviewed by a scholar who was working as professor in the department of educational sciences and expert on the qualitative research. Doctoral committee members' feedbacks were also received for the questions of NAI-1 interview protocol. After getting feedbacks and revisions to be made, the final version of NAI-1 interview protocol was prepared. Finally, interviews were conducted with early childhood teachers one by one in different public and private preschools in Ankara district.

Need Analysis Interview for the research question 2 (NAI-2): NAI-2 interview protocol (see Appendix B) was used to conduct semi-structured interviews with 18 early childhood teachers to understand their opinions about smart toys. NAI-2 interview protocol included two main categories, namely interview plan and questions as to content and process. Since this interview was conducted with the same teachers in NAI-1, there was no need to get descriptive information again. The researcher explained the purpose of the study and gave information about the interview process in the plan category. After giving the information about the interview process, the smart storytelling toy- StoryTech was presented to teachers. Interview questions were about the StoryTech and teachers got information about the smart toy averagely in 5 minutes before answering the interview questions. After finishing the smart toy play, related questions in the interview protocol were asked to teachers. The category of questions as to content and process included 6 main questions in total. What the first expressions of teachers toward the smart toy are, what the reasons of using smart toy in preschool education can be, what the contributions of smart toys to teaching and learning can be, what the advantages and disadvantages of smart toy use can be in preschool settings, what kind of objectives in the curriculum smart toys help provide and what the opinions of teachers are in terms of design of the smart toy were the main questions of NAI-2 interview protocol. A prompt was used in the question of 4 to increase the clarity of the question. Interview style, organization and questions were reviewed by a scholar who was working as professor in the department of educational sciences and expert on the qualitative research. Doctoral committee members' feedbacks were also received for the questions of NAI-2 interview protocol. After getting feedbacks and revisions to be made, the final version of NAI-2 interview protocol was prepared. Finally, interviews were conducted with early childhood teachers one by one in different public and private preschools in Ankara district.

Formative Evaluation Interview (FEI): FEI interview protocol (see Appendix C) was used to conduct semi-structured interviews with 3 early childhood teachers to get the opinions of the early childhood teachers about the first prototype of the smart toy. FEI interview protocol included two main categories, namely interview plan and interview questions. Since this interview was conducted with the teachers who also participated to design phase of the study, there was no need to get descriptive information of the teachers. The researcher explained the purpose and interview procedure in the plan category. After giving the information about the interview process, the first prototype was presented to teachers one by one. Interview questions were about the first prototype of the smart toy and teachers got information about the prototype averagely in 5 minutes before answering the interview questions. After finishing the smart toy play, related questions in the interview protocol were asked to the teachers. Early childhood teachers had also chance to play with the first prototype during the interview process because they needed to see the screens to answer the interview questions. The category of questions included 5 main questions in total. What they think about the general design of the first prototype, what the design problems of the first prototype are, what revisions the first prototype needs to eliminate the design problems, what the problems of the first prototype as to content are and what revisions the first prototype needs to eliminate the problems as to content were the main questions of FEI interview protocol. Interviews were conducted with 3 early childhood teachers one by one in a public preschool in Ankara district.

Summative Evaluation Interview (SEI): SEI interview protocol (see Appendix D) was used to conduct semi-structured interviews with 6 early childhood teachers to get the opinions of the early childhood teachers about the design and use of the smart toy. SEI interview protocol included three main categories, namely interview plan, demographic questions and questions as to content and process. Researcher explained the purpose of the study and gave information about the interview process in the plan category. Interviewees' demographic information was gathered in the category of demographic questions. This category included 4 questions for knowing the interviewee's teaching year experience, age, the university graduated and using technology at classroom or not. The category of questions as to content and process included 8 main questions in total. What teachers think about the design components of the smart toy, what they think about the content and scenario of the smart toy, what they think about the interaction, how the smart toy affects motivations of children, how smart toy can be used for assessment and evaluation, how smart toy can be used in both classroom and out of classroom activities, what the advantages of the smart toy are and what the limitations of the smart toy are, were the main questions of SEI interview protocol. Interviews were conducted with 6 early childhood teachers one by one in 2 public preschools in Ankara district.

Focus Groups: According to Bogdan and Biklen (2007), “for qualitative researchers, focus groups are group interviews that are structured to foster talk among the participants about particular issues” (p. 109). Focus groups can range from 4 persons to 12 persons (Marshall & Rossman, 2011). One of the advantages of the focus groups is creating a supportive environment to help participants express and understand their own views (Bogdan & Biklen, 2007). As Marshall and Rossman (2011) emphasized, “in action research and in program design and evaluation, focus groups are especially useful” (p. 149). One of the main data collection instruments of this study was the records of focus groups. Focus groups were arranged in design and development phases of the study.

Six focus group meetings were held with 4 early childhood teachers and a programmer in the design phase of the study. In the first meeting of the study, a focus group meeting script explaining the purpose of the meetings and giving the information about the study was presented to the participants (see Appendix E). The purpose of the meetings was to design a smart toy including determining specific objectives, story and storyboard. Before conducting the first meeting, the smart storytelling toy (StoryTech) was presented to the participants by the researcher to have an idea about the smart toy concept. After doing the presentation, the meeting was started. The main theme of the first meeting was to determine specific objectives mentioned in the preschool curriculum and start to brainstorming about the draft story. After deciding the objectives, preparing the final story and storyboard were the main themes of the following meetings.

A focus group meeting was carried out with 2 IT scholars and 1 ECE scholar, who were the members of doctoral committee in the formative evaluation of the first prototype in the development phase. The main goal of the meeting was to test the first prototype and get the views of the scholars to determine the problems and necessary revisions.

A new focus group meeting was carried out with the same scholars mentioned above in the formative evaluation of the second prototype in the development phase. The main goal of the meeting was to test the second prototype and get the views of the scholars to determine the problems and necessary revisions.

Observations: According to Marshall and Rossman (2011), "observation captures a variety of activities that range from hanging around in the setting, getting to know people, and learning the routines to using strict time sampling to record actions and interactions and using a checklist to tick off pre-established actions" (p. 139). Marshall and Rossman (2011) also emphasized that recording the observations is of great importance. Observations were mainly applied in usability testing of the smart toy in the development and evaluation phases of the study. Observation as a data collection tool was used for children because of the difficult nature of interviewing young children (Marshall & Rossman, 2011).

According to Nielsen (1993), usability has five main attributes; *learnability*, *efficiency*, *memorability*, *errors* and *satisfaction*. Nielsen defines *learnability* as the 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). He defines *memorability* as easiness of the system to remember. According to him, the system should not include big and too many *errors*. In *satisfaction*, users should be satisfied when they use the system (Nielsen, 1993). These five components create the main structure of usability. Usability testing, on the other hand, can be considered as a method to evaluate the system in terms of main components of the usability. Usability testing includes users as testers to accomplish specific tasks determined before the testing (Nielsen, 1993). In light of this view, the main task was determined and usability testings were done with children in the development and evaluation phases of the study. The task was to play with the smart toy from beginning to end.

Subtasks were also prepared to make the analysis of the data easier. Observation checklist 1 (OC-1) (see Appendix F) was developed to conduct the usability testing of the first prototype of the smart toy in the first step of the formative evaluation phase. OC-1 had four columns, namely tasks, performed, not performed and comments. Tasks composed of all actions that the child needs to do in each screen. OC-1 included 30 tasks for usability testing of the first prototype. Observation Checklist 2 (OC-2) (see Appendix G) was also developed to conduct the usability testing of the smart toy in the evaluation phase. Similar to OC-1, there were four columns, namely tasks, performed, not performed and comments. Tasks composed of all actions that the child needs to do in each screen. While analyzing the tests, smart toy play was splitted to 4 parts namely, introduction, personal care skills, cognitive skills in Ayse's room and pattern skills. Hence, these parts were considered as 4 main tasks and subtasks of these main tasks were included in OC-2. 40 subtasks in total were included in OC-2 for usability testing of the smart toy. Video camera was used to observe children during usability testing.

3.6.2 Data Collection Process

In the analysis phase, semi-structured interviews were conducted to determine the needs of early childhood teachers. Needs analysis started with conducting semi-structured interviews with early childhood teachers for answering the research question 1, "what are early childhood teachers' opinions toward technology and technology use in early educational settings?". These interviews were done with early childhood teachers from different public and private preschools in Ankara district. Each interview was carried out in a room of the preschool where the teacher worked. Tape recorder was used to record the interview session by getting the permission of the interviewee. Interviews took 27 minutes on average. The second step of the needs analysis was to conduct semi-structured interviews with early childhood teachers for answering the research question 2, "what are early childhood teachers' opinions about educational use of smart toys?". These interviews were conducted with the same teachers participated in the first interview phase of the needs analysis. The smart storytelling toy – StoryTech- which was developed in the pilot study was shown to the teachers before starting to each interview session. The researcher introduced StoryTech and gave enough information about the smart toy while playing with it. This process took 5 minutes on average. After finishing introduction, playing and getting information part, interviews were conducted. Similar to the interviews in the first step of the needs analysis phase, each interview was held in a room of the preschool. Tape recorder was used to record the interview session by getting the permission of the interviewee. Interviews took 10 minutes on average.

In the design phase, focus group meetings were arranged to determine specific objectives, story and storyboard. The data collected in the analysis, design, development and evaluation phases was used for answering the research question 3, “What are the design principles when designing a smart toy to support curriculum related objectives?”. Therefore, it was important to get the records of focus group meetings to help reveal the design principles. 4 early childhood teachers and a developer participated in focus group meetings. 6 focus group meetings in total were arranged in 6 weeks. Only 1 meeting was arranged in a week. The focus group meetings were started on 28.11.2012 and ended on 08.01.2013. The meetings were held in a room of the public preschool where teachers worked. Video recorder was used to record the meetings in permission of the teachers and school manager. Focus group meetings took 75 minutes on average.

In the development phase, usability testing of prototypes with children, semi-structured interviews with teachers and focus group meetings with scholars were held to test the prototypes and develop the final product at the end of the development phase. After developing the first prototype, formative evaluation was conducted with children, teachers and scholars. The first step of the formative evaluation was usability testing of preschool children. The main task was to play with the first prototype of the smart toy from beginning to the end. 7 children joined in usability testing and video camera was used to observe them while playing with the prototype.

Necessary permissions were acquired to use a video camera for children. Each child played with the prototype individually and a teacher in each preschool accompanied child during the play. Before starting the usability testing, the researcher gave information to the children to be accompanied by teachers in both schools about the working mechanism of the smart toy and how to proceed in play. Children were observed during usability testing and these tests took 13 minutes on average. The second step of the formative evaluation was conducting semi-structured interviews with early childhood teachers to test the first prototype. 3 teachers who also joined in the design phase of the study participated to the study. It was conducted in a room of the preschool and teachers played with the prototype one by one. Short information about the prototype was given to the teachers and they had chance to play with the prototype before answering the interview questions. This process took 5 minutes on average. During the interview process, questions led teachers to play with the prototype when they wanted to show specific screens of the smart toy. Video recorder was used to record the interview process because it helped researcher not only hear teachers' responses but also see the smart toy's related screens mentioned by the teachers. Early childhood teachers allowed researcher to use a video recorder and declared to join voluntarily. Semi-structured interview process took 24 minutes on average. The last step of the formative evaluation was arranging focus group meeting with scholars to test the first prototype of the smart toy. Doctoral committee members composed of 2 IT scholars and an ECE scholar joined the meeting. The duration of the meeting was nearly 60 minutes. The researcher presented the first prototype of the smart toy to the scholars by using video projector and they shared their ideas. Audio recorder was used to record the meeting by getting permissions of the scholars. At the end of the formative evaluation of the first prototype of the smart toy, second prototype was developed in accordance with the data gathered in the formative evaluation process. After developing the second prototype, a new formative evaluation was carried out with scholars in a focus group meeting way. Doctoral committee members joined the meeting and shared their ideas about the second prototype. The duration of the meeting was nearly 70 minutes. In addition to focus group meeting, a review was done with a different ECE scholar who was working as assistant professor in a public university to test the second prototype. Audio recorder was used to record testing and it lasted nearly 30 minutes.

In the evaluation phase, summative evaluation was conducted with preschool children and early childhood teachers. Summative evaluation started with usability testing of children to answer the research question 4, “what are the usability issues of smart toys?”. The main task was to play with the final version of the smart toy from beginning to the end. While analyzing the tests, smart toy play was splitted to 4 parts namely, introduction, personal care skills, cognitive skills in Ayse’s room and pattern skills. An observation sheet including tasks based on these 4 main parts was created. 10 children joined the usability testing and video camera was used to observe them while playing with the smart toy. Necessary permissions were acquired to use a video camera for children. Each child played with the smart toy individually and a teacher in each preschool accompanied each child during the play. Before starting the usability testing, the researcher gave information about the working mechanism of the smart toy and how to proceed in play to the children to be accompanied by teachers in all schools. Children were observed during the usability testing and these tests took 15.44 minutes on average. The second step of the summative evaluation was to conduct semi-structured interviews with early childhood teachers for answering the research question 5, “what are early childhood teachers’ opinions about the design and use of smart toy?” These interviews were conducted with teachers from 2 different public preschools in Ankara district. The smart toy was introduced to the teachers by the researcher and then researcher left the smart toy at preschools for 2 weeks. That is, teachers had chance to play with the smart toy in their classes during two weeks. The main aim of providing a time period rather than showing and interviewing immediately was to decrease novelty effect. After 2 weeks, the researcher went to the preschools to conduct the interviews with teachers. Each interview was carried out in a room of the preschool where the teacher worked. Tape recorder was used to record the interview session by getting the permission of the interviewee. Interviews took 16 minutes on average.

3.7 Data Analysis Techniques

According to Bogdan and Biklen (2007), "qualitative data analysis means the process of systematically searching and arranging the interview transcripts, field notes, and other materials that you accumulate to enable you to come up with findings" (p. 159). Marshall and Rossman (2011) emphasized that qualitative data collection and data analysis go parallel to reach suitable and effective interpretations. Hence, the researcher tried to carry out data collection and data analysis processes at the same time to get the results of one of the data to make them input for the next data collection process. For instance, the results of the analysis phase were important for the design phase of the study because of the implications provided. In this study, inductive analysis was mainly applied with content and descriptive analysis. Content analysis is a technique enabling researcher to generally analyze written contents (Fraenkel & Wallen, 2006). They also stated that "content analysis can be used in any context in which the researcher desires a means of systematizing and quantifying data" (p. 484).

Bogdan and Biklen (2007) listed qualitative analysis steps as "working with the data, organizing them, breaking them into manageable units, coding them, synthesizing them, and searching for patterns" (p. 159). Similarly, Marshall and Rossman (2011), explained the qualitative analytic procedures as "organizing the data, immersion in the data, coding the data, writing analytic memos, generating categories and themes, offering interpretations, searching for alternative understandings and writing the report" (p. 209).

In light of these views, qualitative data analysis was started with organizing and working with the data for this study. In this step, all data gathered via interviews, focus group meetings and observations were organized and transcribed to MS Word document. After organizing the data, the coding which bases the main process of content analysis was applied. Qualitative coding requires reviewing the data to find patterns and generating words or phrases to represent these patterns (Bogdan &

Biklen, 2007). Therefore, researcher coded all themes and sub themes for different kind of data, such as interview transcripts and focus group meeting notes. Axial coding was applied in the coding part of the analysis process because "axial coding enables researcher to group the codes according to conceptual categories that reflect commonalities among codes" (Marshall & Rossman, 2011, p. 215). After finishing the coding process, themes emerged based on the axial coding. The researcher composed themes by considering the commonalities among codes created. After creating themes, the next step was making interpretations. The researcher tried to create meaningful connections by looking at the themes and related codes in this step. In the writing up step, researcher created all themes as title and explained all titles in accordance with the research question by giving quotations.

Qualitative data analysis of this study was carried out by the researcher who had several experiences about conducting qualitative analysis. The researcher published several articles and conference proceedings including qualitative methods. Additionally, he took qualitative research course in the department of educational sciences.

Table 3.9 summarizes the research questions, data collection, participants and data analysis steps.

Table 3.9 Data collection process of the study

Research Questions	Phase	Participants	Data Collection Instruments	Data Analysis
1. What are early childhood teachers' opinions toward technology and technology use in early educational settings?	• Analysis	• Early Childhood Teachers	• Semi structured interviews	• Content analysis
2. What are early childhood teachers' opinions about educational use of smart toys?	• Analysis	• Early Childhood Teachers	• Semi structured interviews	• Content analysis
3. What are the design principles when designing a smart toy to support curriculum related objectives?	• Design • Development	• Early Childhood Teachers • Preschool Children • IT and ECE Scholars	• Semi structured interviews • Focus groups • Observations	• Descriptive analysis • Content analysis
4. What are the usability issues of smart toys?	• Evaluation	• Preschool children	• Observations	• Descriptive analysis
5. What are early childhood teachers' opinions about the design and use of smart toy?	• Evaluation	• Early Childhood Teachers	• Semi structured interviews	• Content analysis

3.8 Trustworthiness of the Study

Trustworthiness of the study is related with reliability and validity issues. Reliability and validity are mainly seen as the criteria of a good qualitative research (Marshall & Rossman, 2011). Since trustworthiness of the study is of great significance for the quality of the study, several strategies as to reliability and validity issues were taken into consideration.

3.8.1 Reliability

According to Gibbs (2007), "qualitative reliability indicates that the researcher's approach is consistent across different researchers and different projects" (as cited in Creswell, 2009, p. 190). Gibbs (2007) suggested several reliability procedures:

- *Check transcripts to make sure that they do not contain obvious mistakes made during transcription.*
- *Make sure that there is not a drift in the definition of codes, a shift in the meaning of the codes during the process of coding. This can be accomplished by constantly comparing data with the codes.*
- *Cross-check codes developed by different researchers by comparing results that are independently derived* (as cited in Creswell, 2009, p. 190).

For accomplishing the first two procedures mentioned above, researcher reviewed all transcripts gathered from interviews and focus groups again and again. To prevent the mistakes while transcribing instruments, transcriptions were compared with original data. The last procedure for the reliability issue was cross-checking also called as intercoder agreement (Creswell, 2009) or intercoder reliability (Marshall & Rossman, 2011). The detailed process of intercoder agreement was explained in below.

Intercoder reliability: According to Marshall and Rossman (2011), intercoder reliability means consistency between independent coders in terms of the definitions of each code. Creswell (2009) also stressed that intercoder agreement requires two or more coders coming together on the codes derived from the same part of the written content. Since coding is the main and essential activity of intercoder reliability, it is very important to find intercoder who has information about intercoder reliability and enough experience of coding. Therefore, a research assistant who conducted qualitative research studies and carried out qualitative coding participated to this study as an intercoder. She was a doctorate candidate at the department of Computer Education and Instructional Technology. Her main research field was instructional technology and she published several proceedings including qualitative research methods. She was also one of the intercoders in one of her studies in the past so that she was considered as experienced in qualitative coding.

According to Miles and Huberman (1994), interrater realiability is calculated as below:

Intercoder reliability score = Number of agreements / (Number of agreements + Number of disagreements)

Miles and Huberman (1994) emphasized that the score which is at least .80 is accepted as good reliability. In this study, Miles and Huberman (1994)'s criteria was the basis on evaluating the intercoder reliability.

In this study, intercoder reliability was performed for 3 different data. The first intercoder reliability process was done for interviews conducted with 18 early childhood teachers to answer the research question 1 in the analysis phase. Before starting coding activity, purpose of the study and research questions were explained to the intercoder by the researcher. Researcher who was the main coder and the intercoder got an agreement about the process of coding like coding independently, comparing the codes and coding again if necessary. After transcribing the 18 interviews, an information rich transcription was selected by the researcher. The transcription together with a document including the research question and a short info about the study was sent to the intercoder via e-mail. The researcher and intercoder coded the transcription independently and finished coding in nearly 7 days. After finishing the coding, intercoders got together to compare the codes. Since the codes given were not consistent between the intercoders and intercoder reliability score was not enough to meet the criteria of good reliability score, the intercoders decided to code a new transcription. They also talked about the codes and tried to understand why they gave different codes to the same text. They also reached an agreement about the codes having close meanings. The same coding procedure was also applied for coding the second transcription from 18 interviews. After finishing the coding, the intercoders got together and compared the codes. Number of agreements including the codes with similar meanings and number of disagreements were calculated. Based on Miles and Huberman's (1994) formula, intercoder reliability score was calculated as .88 which was good level of reliability.

Intercoder reliability process was also performed for interviews conducted with 18 early childhood teachers to answer the research question 2 in the analysis phase. The same procedures of the intercoder reliability process in interviews for the research question 1 were also applied for this data. Intercoder reliability score was calculated as .90 which was good level of reliability.

Intercoder reliability process was also performed for interviews conducted with 6 early childhood teachers to answer the research question 5 in the evaluation phase. The same procedures of intercoder reliability process in interviews for the research question 1 and research question 2 were also applied for this data. Intercoder reliability score was calculated as .86 which was good level of reliability.

3.8.2 Validity

According to Creswell and Miller (2000), qualitative validity means the accuracy of the findings in terms of the researcher, the participant or the reader. They also stated that several terms such as authenticity, goodness, trustworthiness and credibility refer to the similar meaning with validity. In order to provide validity issues of this study, several procedures such as triangulation, member checking, prolonged engagement, audit trail, thick description and peer debriefing were taken into account (Creswell & Miller, 2000).

Triangulation: According to Bogdan and Biklen (2007), "triangulation means that many sources of data were better in a study than a single source because multiple sources lead to a fuller understanding of the phenomena you were studying" (p. 115-116). Creswell (2009) also stated that triangulating different data sources can enhance the validity of the study. Creswell and Miller (2000) emphasized that multiple methods, such as observations, interviews and documents are common triangulation methods for qualitative inquiry. In this study, interviews, focus groups and observations were used to gather data in accordance with the triangulation of methods. Additionally, several participants, such as early childhood teachers, preschool children and scholars were the main data sources of the study in accordance with the triangulation of data sources. These sources participated to the study in different phases.

Member Checking: "Member checking determines the accuracy of the qualitative findings through taking the final report or specific descriptions or themes back to participants and determining whether these participants feel that they are accurate" (Creswell, 2009, p. 191). Creswell and Miller (2000) stated that sending transcriptions to the participants can be considered as a method for applying member checking. Hence, one of the transcriptions of 18 interviews conducted for answering the research question 1 and 2 was sent to the interviewee to check the raw data of the taped interview. The feedback of the interviewee was that the data was consistent with the taped interview and there was no need to change anything in the data. The same feedbacks were also received from an interviewee participated to semi-structured interview session in the evaluation phase of the study to answer the research question 5.

Prolonged engagement: Prolonged engagement basically means that staying at the research setting for a long time allows researcher to build close relationship with participants (Creswell & Miller, 2000). As Creswell (2009) emphasized, "the more experience that a researcher has with participants in their actual setting, the more accurate or valid will be the findings" (p. 192). Since a design and development research was the main research design of this study, the researcher spent a long time in analysis, design, development and evaluation phases. In the design phase of the study, focus group meetings were arranged with early childhood teachers to design the smart toy. 6 meetings were carried out for this purpose and this process took 6 weeks in total. Additionally, the researcher conducted formative evaluations in the development phase of the study and visited real settings for the evaluation of the prototypes. It can be concluded from all these statements that prolonged engagement was provided in this study because the researcher spent a very long time in the phases of the study to design, develop and evaluate the smart toy.

Audit trail: “In establishing an audit trail, researchers provide clear documentation of all research decisions and activities including keeping a research log of all activities, a data collection chronology and data analysis procedures” (Creswell & Miller, 2000, p. 128). In this study, all research activities were separated into different phases, such as analysis, design, development and evaluation. In each phase, researcher noted the data collection and data analysis procedures by giving time information. All research procedures mentioned in this study can be an example for researchers, practitioners or academics to conduct similar design and development research studies.

Thick Description: According to Creswell (2009), “when qualitative researchers provide detailed descriptions of the setting, for example, or provide many perspectives about a theme, the results become more realistic and richer” (p. 192). In the current study, the researcher provided all descriptions of the settings where the main data collection instruments were applied. For instance, in the design phase, focus group meeting process was explained in a detailed way. In addition, the researcher provided all descriptions of the sub phases in the development phase of the study. Giving detailed explanations of the research process throughout all research study from analysis to evaluation could add validity of the study.

Peer Debriefing: Peer debriefing means reviewing the research process by a person who has information about the study (Creswell & Miller, 2000). As Marshall and Rossman (2011) emphasized, peer debriefing allows researcher to check whether analyses in the research are consistent with the study itself. In this study, the advisor and doctoral committee members were considered as peer reviewers since they reviewed all phases of the study. In addition, data collection and analyses processes of the study were checked by peer reviewers.

In addition to validity strategies mentioned above, Content validity strategy was also performed to provide the validity of the data collection instruments used in the study. Doctoral committee members were considered as experts and all data collection instruments were reviewed by these members. Additionally, two interview protocols used for research question 1 and research question 2 were reviewed by a scholar who was the instructor of a qualitative research course and professor in the field of educational sciences. For providing content validity of data collection instruments, such as interviews and observations, experts' feedbacks as to content and format of the protocols were received. After making the necessary revisions, interview and observation protocols were used as data collection instruments.

3.9 Ethical Considerations

According to Marshall and Rossman (2011), "for any inquiry project, ethical research practice is grounded in the moral principles of *respect for persons*, *beneficence* and *justice*" (p. 47). Respect for persons means showing respect to identity, decision as to participation or not and confidentiality (Marshall & Rossman, 2011). They also stated that beneficence refers to participation which is not leading any disadvantage or problem for participants. Finally, justice means giving equal rights to the participants (Marshall & Rossman, 2011). In the current study, all participation to the different phases of the study was completely voluntarily. Each participant was treated as an important and respectful person during the study.

First of all, permission from Ministry of Education was taken because the main participants of the current study were early childhood teachers and preschool children from public and private preschools (see Appendix H). Marshall and Rossman (2011) declared that institutional review boards play a significant role in protecting human subjects by judging the suitability of the ethical issues in a study. Therefore, permission from ethical review board was taken before starting this study (see Appendix I). Since respect for persons is considered as the most remarkable principle in three moral principles, informed consent form including the purpose of the study, expectations from the participant, and the process how to protect participants' privacy is a valuable document for respecting people (Marshall & Rossman, 2011). Hence, informed consent form was prepared for applying the permission from ethical review board (see Appendix J). This form was also shared with the participants. Because young children participated to the study in several phases, such as development and evaluation, it was important to get parents' permission as to involvement of their children to the study. For this purpose, consent form for parents were prepared (see Appendix K) and children whose parents gave permission to participation were included in the study. In addition, post study information document was also prepared (see Appendix L) and shared with the participants.

CHAPTER 4

RESULTS

In the results section, the research questions were analyzed in accordance with the related phases. The research question 1 and 2 were investigated in the analysis phase. The research question 3 was mainly investigated in the design and development phases. However, findings of the analysis and evaluation phases were also included in presenting the eventual principles. The research question 4 and 5 were analyzed in the evaluation phase.

4.1 Phase 1 (Analysis Phase)

4.1.1 Needs Analysis Phase

4.1.1.1 Research Question 1

What are early childhood teachers' opinions toward technology and technology use in early educational settings?

To answer the first research question, semi-structured interviews were carried out with 18 early childhood teachers. Eleven main themes emerged to understand early childhood teachers' opinions toward technology and technology use in early educational settings. These themes were:

- Used Technologies
- Specific Characteristics of Technology
- Educational Use of Technology for Various Purposes
- Advantages of Technology for Children

- Potential Disadvantages of Technology for Children
- Turkish Preschool Curriculum in terms of Technology use
- Advantages of Technology for Teachers
- Teachers' Problems about Technology Use
    - Pedagogical Problems
    - Infrastructural Problems
- Teachers' Expectations about Technology Use
- Technology Use Activities of Teachers
- Teachers' Thoughts about Technology Use

These themes were explained in detailed in the following section.

4.1.1.1.1 Used Technologies

All of teachers said that they use computers in preschool education. Additionally, 14 of 18 teachers declared using projector as a technology at school. For instance, a teacher stated:

> *If I need to present something to children, I make presentation via projector* (ECT10_NA).
>
> *Çocuklara göstermem gereken herhangi birşey varsa projeksiyonla göstermeye çalışıyorum* (ECT10_NA).

Overhead projector was another technology used by 10 of 18 teachers. 5 of 18 teachers said that they use TV as a technology at school. For instance, a teacher stated:

> *We also benefit from television. Children watch educational cartoons from television* (ECT10_NA).
>
> *Biz ayrıca televizyondan da faydalanıyoruz. Çocuklar televizyondan eğitici çizgi filmler izliyorlar* (ECT10_NA).

In conclusion, computer, projector, overhead projector and TV were the technologies that teachers used in preschool settings. It can be inferred from this finding that teachers prefer to use various technologies rather than using only computers.

4.1.1.1.2 Specific Characteristics of Technology

All of teachers mentioned the visual characteristic of technology. In addition, 15 of 18 teachers considered the audial characteristic of technology. For example, a teacher stated:

> *I use technology since its visual and audial sides take attention of children more and help remembering easily* (ECT8_NA).
>
> *En önemlisi görsel ve işitsel yönleri, daha çok akılda kaldığı için, daha çok ilgilerini çektiği için o amaçla kullanıyorum* (ECT8_NA).

The concrete characteristic of technology was also mentioned by 4 of 18 teachers. A teacher explained this characteristic like:

> *A child can get feedback as concrete while using technology. This starts to motivate the child for the next step* (ECT7_NA).
>
> *Mesela orada birşey yaparken somut olarak anında dönütünü alabiliyor. Bu da onu daha motive etmeye başlıyor bir sonraki aşama için.* (ECT7_NA).

The affective and quick characteristics of technology were said by 3 of 18 teachers. Lastly, only 2 of 18 teachers considered the repetitive characteristic of technology.

In conclusion, teachers mentioned the visual, audial, concrete, affective, quick and repetitive characteristics of technology. It can be inferred from this finding that teachers are aware of the power of technology having multiple characteristics.

4.1.1.1.3 Educational Use of Technology for Various Purposes

12 of 18 teachers stated that they use technology in storytelling activities. For instance, a teacher said:

I like storytelling by using slides from the computer. I use it once per a week because it is a very effective method for children (ECT10_NA).

Ben mesela bilgisayardan slaytlarla hikaye anlatmayı da çok seviyorum. Genelde haftada bir kez anlatıyorum slaytlarla hikaye bilgisayardan, o da çocuklar için etkili bir yöntem oluyor (ECT10_NA).

10 of 18 teachers said that they use technology in native language activities. A teacher gave an example to the native language activity as follow:

I use technology especially in native language activities. I use it in the activity of preparation to literacy (ECT6_NA).

Genelde Türkçe anadil etkinliklerinde bunları kullanıyorum. Okuma-yazmaya hazırlık etkinliklerinde kullanıyorum (ECT6_NA).

10 of 18 teachers also declared that they use technology in math activities. Technology use in cognitive activities was mentioned by 7 of 18 teachers. For instance, a teacher stated:

I can give cognitive objectives, such as counting and matching to children with educational games (ECT6_NA).

Bilişsel alana yönelik kazanımları verebiliyorum eğitici oyunlarla. Sayı sayma, eşleştirme bunları verebiliyorum. Genelde bilişsel alana yönelik kazanımlar (ECT6_NA).

7 of 18 teachers also said that they use technology for listening music in an educational purpose for children. 6 of 18 teachers pointed out that they use technology in science and nature activities. For instance, a teacher explained:

Technology is a need in science education because we can present the visuality with computers or projector more than books (ECT2_NA).

Fen eğitiminde ihtiyaç oluyor. Çünkü o görselliği başka türlü kitaplarla da veriyorsunuz ama bilgisayar ortamında ya da projeksiyonla daha etkili oluyor (ECT2_NA).

Based on 6 of 18 teachers' responses, technology is used for teaching several concepts. For example, a teacher said:

We have educational software CDs about concepts. We can use these CDs by putting them into computers and reflecting via projector (ECT12_NA).

Yani kavramlarla ilgili öğretici CDlerimiz var. Bunları bilgisayara takıp projeksiyondan yansıtma şeklinde kullanıyoruz (ECT12_NA).

According to 6 of 18 teachers, technology is used for presenting educational cartoons. 5 of 18 teachers stated that they use technology for presenting animations to children with educational purposes. 3 of 18 teachers also emphasized that they use technology for presenting art activities and documentaries.

In conclusion, teachers preferred to use technology in storytelling activities, native language activities, math activities, cognitive activities, music activities, science and nature activities, concept teaching, showing cartoons and animations, and art activities and documentaries. It can be inferred from this finding that teachers adapt technology into several classroom or curriculum based activities.

4.1.1.1.4 Advantages of Technology for Children

According to 15 of 18 teachers, technology takes attention of children. For instance, a teacher stated:

> *Watching television rather than only seeing in story book or listening the character with seeing its visual takes attention of children* (ECT4_NA).
>
> *Hikaye kitabındansa televizyonda görmek veya ordan bir başkasının sesini duyarak izlemek çocukların daha dikkatini çekiyor* (ECT4_NA).

12 of 18 teachers said that technology allows visual learning of children. A teacher explained this as follow:

> *I showed from computer by supporting with visual things. They listened Beethoven while watching the pictures of Van Gogh. If I presented only pictures, it would not give that effect* (ECT7_NA).
>
> *Şu anda bilgisayardan da görsel şeylerle destekleyerek gösterdim. Van Gogh'un tablolarıyla birlikte Beethoven'ı dinlediler. Ama bunu sadece resimlerini yapıştırıp gösterseydim bu kadar olmayacaktı* (ECT7_NA).

Based on the responses of 11 of 18 teachers, technology helps permanent learning. For instance, a teacher stated:

> *Children do not forget things that they watch from technology. For example, we have educational software CDs related with animals. They can carefully learn from that CDs and they do not forget* (ECT4_NA).
>
> *Kuru kuru çocuklara anlatmaktansa orada gördükleri, izledikleri şeyleri unutmuyorlar gerçekten. Mesela bizim burda CDlerimiz var, belgesel hayvanlarla ilgili. Oradan çok dikkatli alıyorlar ve unutmuyorlar* (ECT4_NA).

7 of 18 teachers stated that technology improves cognitive skills of children. A teacher's view was as follow:

> *Children's thinking skills are developed while watching. We generally interrupt the watching activity and ask several questions to understand how they perceive. Technology helps children from this perspective* (ECT15_NA).
>
> *İzleyerek düşünme becerileri gelişiyor. Biz genelde izlettirdiğimiz zaman, yarıda durdurup soru soruyoruz. İşte şöyle miydi, böyle miydi, algılamalarına bakıyoruz genelde. O açıdan yardımcı oluyor* (ECT15_NA).

7 of 18 teachers also said that technology addresses many senses of children. For instance, a teacher stated:

> *Since technology addresses many senses of children, they can learn several concepts and activities in a shortest time and permanent way* (ECT5_NA).

> *Çocukların zaten birçok duyu organına hitap ettiği için birçok etkinliği, birçok kavramı çok kısa sürede ve çok renkli bir şekilde kalıcı olarak öğrenmeyi sağlayabiliyorsunuz* (ECT5_NA).

According to 6 of 18 teachers, technology considers individual differences. For example, a teacher said:

> *While auditory intelligence of some children is dominant, visual intelligence is dominant for some other children. Technology compensates children who have different dominant intelligences and try to keep them in the same level* (ECT14_NA).
>
> *Bazı çocuklar işitsel zekası, bazı çocukların görsel zekası daha fazla. İşitsel zekası fazla olan ve görsel zekası fazla olan çocukları denkliyor, aynı seviyede tutmaya çalışıyor* (ECT14_NA).

Improving psychomotor skills was another advantage of technology and stated by 6 teachers. For instance, a teacher stated:

> *It's important for hand skills in an objective of giving psychomotor skill. We also give that objective by using play dough but it is important to give the objective while using computer too* (ECT7_NA).
>
> *Bir psikomotor kazanımında el becerileriyle ilgili. Aslında çok önemli, biz onu hamurla da veriyoruz diyoruz ama bilgisayar kullanırken de bu çok önemli* (ECT7_NA).

6 of 18 teachers mentioned about improving motivation as an advantage of technology for children. A teacher explained this advantage as follow:

> *Children can concentrate on the same event together when used technology. Male students, especially, contribute on the process. Technology motivates some children who are not interested in teaching and learning process* (ECT8_NA).
>
> *Bir anda hepsi aynı anda aynı olaya konsantre oluyorlar teknolojiyle ilgili birşey kullandığınızda. Özellikle erkek çocuklarının sürece daha katkısı olmuş oluyor. Ya da sınıfta birkaç kayıp öğrenci var. Genellikle teknoloji gibi şeyler onları çekiyor* (ECT8_NA).

Besides, 5 teachers emphasized that technology adapts children to future easily. In addition, 5 of 18 teachers pointed out that technology improves the curiosity of children. For example, a teacher said:

> *Technology helps me especially in creating a problem situation in introduction to the course. When I show something by using technology, children listen to me curiously and I can progress from that point* (ECT7_NA).
>
> *Özellikle girişlerde, problem durumu oluşturmada benim çok işime yarıyor. Mesela onlara birşey gösterdiğim zaman merakla dinliyorlar ve ben de onun üzerinden gidebiliyorum* (ECT7_NA).

4 of 18 teachers also stated that technology improves hand-eye coordination of children. A teacher's view for this advantage was as follow:

> *If the goal is to make a child to use the computer, the child should use the computer individually to build hand-eye coordination* (ECT6_NA).
>
> *Amaç çocuğa bilgisayarı kullandırtmaksa, çocuk kendisi kullanmalı ki orada el, göz koordinasyonu kursun* (ECT6_NA).

Moreover, 3 teachers pointed out that improving self-confidence of children and allowing learning by doing were other advantages of technology for children. Furthermore, rehearsal learning, helping children transfer their knowledge to real life and improving creativity of children were the other advantages of technology for children and only stated by 2 teachers.

In conclusion, based on teachers' responses, taking attention of children, allowing visual learning, helping permanent learning, improving cognitive skills, addressing many senses of children, considering individual differences, improving psychomotor skills, improving motivation, adapting children easily to future, improving the curiosity, improving hand-eye coordination, improving self-confidence, allowing learning by doing, rehearsal learning, helping children transfer their knowledge to real life and improving creativity were the advantages of technology. It can be inferred by considering these advantages that teachers believe the support and contribution of technology to children in many areas.

4.1.1.1.5 Potential Disadvantages of Technology for Children

According to 11 of 18 teachers, preventing socializing was a disadvantage of technology for children. A teacher explained this as follow:

> *Technology prevents building communication of children with their friends. It is clear that children do not play games outside so much. They generally spend their times at home and they are interested in indoor activities* (ECT11_NA).
>
> *Arkadaşıyla iletişim kurmasına engel oluyor. Şu bir gerçek ki çocuklar artık çok fazla sokakta oyun oynamıyorlar. Evde daha çok vakit geçiriyorlar ve evin içinde yapılabilecek şeylere yöneliyorlar* (ECT11_NA).

Based on the responses of 5 teachers, technology also prevents social play. For instance, a teacher stated:

> *Children play with computers or watch television rather than playing outside* (ECT6_NA).
>
> *Yani artık çocuk bahçeye inip de oyun oynamaktan çok evde olduğu için evde de bilgisayar başında, televizyon başında onlarla oynuyor* (ECT6_NA).

Besides, 5 teachers pointed out that children spend excessive amount of time while using technology. In addition, 4 teachers emphasized that children face with undesired things while using technology. A teacher explained this by saying:

> *Many of the children know how to connect to internet and they can face with undesired things on the internet* (ECT2_NA).
>
> *Çocukların birçoğu internete nasıl girildiğini biliyor ve çok hoş olmayan şeylerle karşılaşabiliyorlar* (ECT2_NA).

Besides, 4 teachers mentioned about psychological problems as one of the disadvantages of technology for children. For example, a teacher said:

> *Fighting games as computer games which are not suitable to age group of children can lead them to become aggressive* (ECT3_NA).
>
> *Yaş grubuna uygun olmayan savaş türü işte, o tür oyunlar daha çok saldırganlık yönünde olumsuz etkileyebiliyorlar* (ECT3_NA).

Additionally, uncontrolled use of technology was another disadvantage of technology for children and stated by 3 teachers. 3 of 18 teachers also stated that technology use can cause health problems for children. A teacher's view for this disadvantage was as follow:

> *Sitting in front of the computer for a long time affects physical development of children in a very negative way because they sit immovably* (ECT12_NA).
>
> *Çocuğun bedensel gelişimini çok ciddi olumsuz etkiliyor bilgisayar karşısında çok uzun süre oturmaları çünkü hareketsiz bir şekilde oturuyorlar* (ECT12_NA).

Moreover, speech problems and becoming addict were the other disadvantages of technology use for children and stated by 2 teachers as well.

In conclusion, preventing socializing, preventing social play, spending excessive amount of time, facing with undesired things, psychological problems, uncontrolled use of technology, causing health problems, speech problems and becoming addict were the disadvantages of technology mentioned by teachers. It can be reached from these disadvantages that teachers are aware of the problems in case of inappropriate technology use.

4.1.1.1.6 Turkish Preschool Curriculum in terms of Technology Use

According to 13 of 18 teachers, Turkish preschool curriculum does not include goals and objectives for using technology. For instance, a teacher stated:

> *There is no any objective including the word of technology. Tools can be exist but there is no any goal and objective related with technology* (ECT2_NA).

> *Teknolojiyle ilgili içinde direkt teknoloji sözcüğünün geçtiği hiçbir kazanım yok. Araç gereç belki olabilir ama sırf teknolojiyle ilgili bir amaç ve kazanımımız yok* (ECT2_NA).

Additionally, 9 of 18 teachers emphasized that the curriculum is lack of guidance in use of technology. A teacher explained this as follow:

> *There is no much guidance. This can be caused from the limited numbers of computers. There are some statements like including technology into education or activities but they are only written statements which are not practical* (ECT5_NA).
>
> *Çok fazla yönlendirmiyor açıkçası. Bu da zannediyorum ki bilgisayar kısıntısından kaynaklı ama tabiki etkinliklerinize, eğitimlerinize teknoloji katın gibi bu tarz ibareler var ama ibare olmaktan kalıyor. Hani sadece evrak, kağıt üzerindeki ibareler* (ECT5_NA).

Besides, 6 teachers pointed out that there is a necessity of detailed goals and objectives of technology use in the curriculum. In addition, 6 of 18 teachers stated that there is a necessity of having standardization in the curriculum about technology use. A teacher's view for this statement was as follow:

> *Yes, standards should be exist because Ministry of Education should be a professional institution. I think that the things each teacher needs to know or do should be the same* (ECT11_NA).
>
> *Bence evet standartlar olmalı çünkü Milli Eğitim kurumsallaşmış olması gereken bir yer. Her öğretmenin yapması ve bilmesi gereken şeylerin aynı olması gerektiğini düşünüyorum ben* (ECT11_NA).

Moreover, lack of detailed explanations as to technology use in the curriculum was another statement for the theme of Turkish preschool curriculum in terms of technology use and stated by 4 teachers.

In conclusion, not including goals and objectives for using technology, lack of guidance in use of technology, necessity of detailed goals and objectives of technology use, necessity of having standardization in curriculum about technology use and lack of detailed explanations as to technology use were the views of teachers about technology use in Turkish Preschool Curriculum. It can be inferred from these findings that teachers consider the curriculum as insufficient in terms of statements about technology use.

4.1.1.1.7 Advantages of Technology for Teachers

According to 15 of 18 teachers, technology makes the teacher's job easier. For instance, a teacher stated:

> *Quick access makes my job easier. On the other hand, I need to search, find pictures and show them to children. But, I can find them from internet easily and get colored copy of the pictures from the printer. So, it becomes a very easy process* (ECT4_NA).
>
> *Çabuk ulaşmam benim işimi kolaylaştırıyor. Yoksa öteki türlü arıycam, resimlerini bulucam, çocuklara göstericem. Ama bilgisayarla internetten hemen buluyorum, yazıcından çıkartıyorum gerektiği zaman renkli yazıcıdan. Çok kolay oluyor tabi* (ECT4_NA).

In addition, 7 of 18 teachers pointed out that technology allows teacher to use different materials. A teacher explained this as follow:

> *I use technology as different educational materials. It provides a different teaching environment to me. Education becomes successful if we give so many different stimuli to children* (ECT12_NA).
>
> *Teknolojiyi farklı eğitim materyalleri anlamında kullanıyorum. Yani bana farklı bir eğitim ortamı sağlıyor, farklı bir materyal sağlıyor. Çocuklara ne kadar farklı uyarıcı içinde kalırsak, farklı uyarıcılı ortamda bulunursak o derece eğitim çok daha etkili olur* (ECT12_NA).

Besides, using technology for acceleration of teaching was another advantage of technology for teachers and stated by 6 teachers. For example, a teacher said:

> *For instance, I prepared something about cultures. How do you take children to different cultures? It is very abstract when told like this. Children can understand easily when showing attractive things like power point presentation* (ECT16_NA).
>
> *Mesela ben kültürlerle ilgili birşey hazırlamıştım. Çocukları kültürlere nasıl götürüp gösterebilirsiniz? Böyle anlattığınız zaman da çok soyut*

> *kalıyor. Onunla ilgili slayt, sunu gibi ilgi çekici birşey gösterdiğinizde daha rahat anlıyorlar* (ECT16_NA).

Besides, 6 teachers pointed out that technology helps teacher in classroom management. For instance, a teacher stated:

> *You create a magical atmosphere in the classroom environment with the help of technology. It takes the attention of all children immediately. Hence, you don't need to concentrate them one by one. Technology becomes a magic tool taking attention of children altogether at the same time* (ECT11_NA).
>
> *Tabi onlara biraz daha sınıfta sihirli bir ortam yaratmışsınız gibi bir ortam oluyor. Hepsinin dikkati bir anda ona doğru yöneliyor. Böylece siz tek tek birisini yönlendirme ya da onun ilgisini çekmek yerine otomatik olarak siz ilgilerini oraya çekmiş oluyorsunuz. Sihirli bir araç oluyor benim için aynı anda herkesin ilgisini çekecek* (ECT11_NA).

Lastly, saving time of teachers was the other advantage of technology for teachers and stated by only 3 teachers.

In conclusion, makes the teacher's job easier, allowing teacher to use different materials, acceleration of teaching, helping teacher in classroom management and saving time were the advantages of technology for teachers. It can be inferred by considering these advantages that technology supports teaching activities in preschool education.

4.1.1.1.8 Teachers' Problems about Technology Use

Pedagogical Problems: According to 6 of 18 teachers, they have difficulties in one to one interaction with technology for all children. For example, a teacher stated:

> *There is only one computer in the classroom and all of the children want to play with the computer. So, this situation creates a problem* (ECT3_NA).
>
> *Ama sınıfta bir tane bilgisayar var, hepsi oynamak istiyor, beklemek zorundalar. O sıkıntı oluyor biraz* (ECT3_NA).

In addition, inadequacy in teacher knowledge of technology use and limited technology use skills were the other pedagogical problems of teachers about technology use and stated by 4 teachers.

Infrastructural Problems: 7 of 18 teachers declared that there is a lack of high quality resources. A teacher explained this as follow:

> *There are a lot of CDs. Each publisher produces educational CDs but they are not usable. CDs include some things but I never use them* (ECT6_NA).
>
> *Şimdi var CD, çok fazla var. Her yayınevi CD çıkarıyor ama çok da kullanışlı olduğunu sanmıyorum, düşünmüyorum. Bakıyorum birkaç birşey atmışlar içine ama kaldırıp atıyorum kenara* (ECT6_NA).

Additionally, 6 of 18 teachers pointed out that there are difficulties in having a computer for each class. For example, a teacher said:

> *I can make limited individual study with children by using technology because we don't have computers in the classrooms* (ECT7_NA).
>
> *Çocuklarla bireysel çalışmayı teknoloji kulanarak çok az yapabiliyorum çünkü sınıflarımızda bilgisayar yok* (ECT7_NA).

Besides, 5 teachers emphasized that there is a lack of projector in classrooms. 5 of 18 teachers also declared that classrooms are crowded. A teacher's view for this infrastructural problem was as follow:

> *The problem is that the classroom is crowded. If you allow 5 children to use technology, you also need to give something to other 15 children at classroom* (ECT10_NA).
>
> *Tek sıkıntımız kalabalık olması. Siz şimdi o 5 kişiye makine verip oynattığınızda diğer 15 kişiyi de oyalamanız gerekiyor, onlar için de birşey bulmanız gerekiyor* (ECT10_NA).

Lastly, lack of computer lab was the other infrastructural problem of technology use and stated by only 2 teachers.

In conclusion, having difficulties in one to one interaction, inadequacy in teacher knowledge of technology use and limited technology use skills were the pedagogical problems about technology use. On the other hand, lack of high quality resources, having a computer for each class, lack of projector in classrooms, crowded classrooms and lack of computer lab were the infrastructural problems about technology use. It can be reached from these findings that teachers face with problems not only related with their personal technology use skills but also schools' technical capacities.

4.1.1.1.9 Teachers' Expectations about Technology Use

Based on the responses of 16 of 18 teachers, teachers expect professional development courses of advanced technology use in preschool education. For instance, a teacher stated:

> *In fact, I would like to get informed about computer programs especially graphical programs. I would like to learn programs about how to present pictures in different ways. I would also like to learn computer programming* (ECT12_NA).
>
> *Aslına bakarsanız bilgisayar programları konusunda bilgi edinmek isterdim, özellikle grafik konusunda. Fotoğrafları daha farklı sunma programlarını öğrenmeyi isterdim. Program öğrenmeye yönelik eğitimin olmasını isterdim açıkçası* (ECT12_NA).

Additionally, 16 of 18 teachers expect limitations on technology use for children. A teacher explained this as follow:

> *I also use technology at school or in my activities. Technology use can be limited based on time limitation or the level of reaching an objective* (ECT9_NA).
>
> *Bunu okulda ben de uyguluyorum ya da ben de kullanıyorum teknolojiyi etkinliklerimde. Süre kısıtlaması olduğu sürece ya da kazanıma ulaşma derecesine göre bu sınırlandırılabilir* (ECT9_NA).

Besides, 12 of 18 teachers stated that there is a need for teacher control in technology use. For instance, a teacher said:

> *In my opinion, technology should be used as useful for children and there should be a teacher control in using technology for children* (ECT12_NA).
>
> *Bana kalırsa teknoloji az önce söylediğim gibi çocuklara faydalı olacak şekilde ve başında öğretmen olarak kullanılmalı* (ECT12_NA).

11 of 18 teachers also emphasized that there is a need for parental control in technology use. A teacher's view for this expectation was as follow:

> *Children think quickly and they are aware of everything. The parental control is very important at this point* (ECT4_NA).
>
> *Çocuklar çok hızlı düşünüyorlar bir kere. Herşeyin farkındalar. Ailenin bu noktada kontrolü önemli* (ECT4_NA).

Besides, 10 of 18 teachers pointed out that there is a necessity of using technology in an appropriate way. For instance, a teacher stated:

> *Technology should be used for teaching purpose. It shouldn't be used for watching educational cartoons although it is very common in preschool education. Using technology for spending time is also very common. That is, teachers use technology as an entertainment tool rather than using for developing themselves or finding new methods of teaching for children* (ECT12_NA).
>
> *Sadece öğretici amaçlı kullanılmalı. Çizgi film izletmek amaçlı kesinlikle kullanılmamalı. Bu okul öncesinde şu an için çok yaygın. Zaman geçirme amaçlı şu an çok yaygın. Yani teknolojiyi şu anda büyük bir rahatlık anlamında kullanıyoruz. Kendimizi geliştirme veya çocuklara nasıl farklı bir şekilde neyi sunabilirim amaçlı değil de nasıl rahat bir şekilde kullanabilirim amaçlı kullanıyoruz* (ECT12_NA).

Besides, 10 of 18 teachers declared that there is a need for technology integrated courses. For instance, a teacher told:

> *I will chat with children who don't have any idea about the topic. If I don't present anything about the topic, children's attention won't be taken and they who are in a specific developmental level cannot give a meaning to the topic. Hence, I need to use a presentation or a cartoon to teach the topic* (ECT9_NA).

> *Hiç bilmedikleri bir konu hakkında sohbet edeceğiz ya da fikir sahibi olmaları için sohbet etmek istiyoruz. Hiçbir şey olmadığında bu yaş gelişim düzeyindeki bir çocuk bunu anlamlandıramadığı için ilgisi uyanmayacaktır. Bunu anlatmak için bir sunum ya da bir çizgi film kullanmak gerekir* (ECT9_NA).

Besides, 7 of 18 teachers stated that there is a need for teaching how to use technology. For example, a teacher stated:

> *Teacher should teach children how to use technology in an appropriate way* (ECT12_NA).
>
> *Teknolojiyi nasıl kullanacağını, doğru bir şekilde nasıl kullanacağını özellikle öğretmen öğretmelidir* (ECT12_NA).

7 of 18 teachers also emphasized that there is a need for giving training to parents on how children use technology appropriately. A teacher's view for this expectation was as follow:

> *Training about using technology in an appropriate way should be given to parents. School-family cooperation should be carried out in preschool education* (ECT2_NA).
>
> *Bence biraz aile eğitimi konusunda teknolojinin doğru kullanımına çokça yer verilmelidir. Okul öncesi eğitiminde vardır ya okul aile işbirliği, aile katılımı, o konularda bu ailelere kesinlikle bilgiler verilmesi gerekiyor* (ECT2_NA).

Besides, 6 teachers pointed out that there is a necessity of having materials suitable for children. For instance, a teacher said:

> *Children should spend their times with softwares suitable for them. For example, let's consider the topic of traffic. There will be a traffic game and the child will see and chat with his/her friend. He/She will practice stopping the car in red light or moving the car in green light in that game. So, technology will be used in a right way and the child will learn how to use computer appropriately* (ECT4_NA).
>
> *Çocuklar bilgisayarla çocuklara uygun hazır yazılımlarla vakit geçirmeliler. Mesela, trafik konusunu ele alalım. Çocuk orada görecek, arkadaşıyla sohbet edecek. Belki küçük bir trafik oyunu*

> *olacak, onu oynayacak ki bizim anlattıklarımız işte kırmızı ışıkta arabayı durduracak, orada yeşil ışıkta geçirecek ki amacına ulaşmış, çocuk da doğru kullanmayı öğrenmiş olsun bilgisayarı* (ECT4_NA).

Moreover, 5 teachers stated that there is a need for using different kind of technologies. A teacher explained this as follow:

> *You need to use a variety of technologies. For instance, you give CD sometimes or you use projector or overhead projector in different times. If you use the same technology every time, it will lose its effect* (ECT2_NA).
>
> *Ama mesela bir gün CD verirsiniz, bir gün işte projeksiyonla yaparsınız, bir gün işte tepegözle yaparsınız. İşte onu çeşitlendirmek lazım. Hep aynı yöntemle olursa o da işe yaramaz bence* (ECT2_NA).

Besides, 4 teachers declared that there is a necessity of computer lab. Lastly, need for a computer in each classroom, need for projector in classrooms and need for assigning computer teachers were the other expectations of teachers about technology use and stated by only 3 teachers.

In conclusion, professional development courses of advanced technology use in preschool education, limitations on technology use for children, teacher and parental control in technology use, using technology in an appropriate way, technology integrated courses, teaching how to use technology, giving training to parents on how children use technology appropriately, having materials suitable for children, using different kind of technologies, having computer lab, having computer in each classroom, having projector in classrooms and assigning computer teachers were teachers' expectations about technology use. Based on these findings, teachers expect from not only teachers but also parents to lead children to use technology appropriately. Findings also indicate that preschools need to be equipped with adequate computers or projectors.

4.1.1.1.10 Technology Use Activities of Teachers

According to 13 of 18 teachers, they search for educational softwares or programs suitable for children. For instance, a teacher stated:

> *I used internet too much to find programs suitable for children. For instance, I don't know how to prepare animations in flash but I took a few animations from my friends knowing how to prepare them. But, I generally try to find them from internet* (ECT17_NA).
>
> *İnternetten çok yararlandım yaş grubuna uygun şeyler bulmak için. Mesela flash animasyon yapmayı çok bilmiyorum ben ama yapan arkadaşlarım vardı, onlardan birkaç birşey almıştım. Ama genelde internetten bulmaya çalışıyoruım* (ECT17_NA).

Additionally, 13 of 18 teachers stated that they use technology based on their choice. A teacher explained this as follow:

> *Technology use is the decision of teacher. Teacher decides to use computer or projector. There is no any statement forcing teacher to use technology in goals and objectives of the curriculum* (ECT2_NA).
>
> *Teknoloji kullanımı öğretmenin insiyatifindedir. Bilgisayar ortamında ya da projeksiyonla verecekse öğretmen verir. Ama hiçbir şekilde müfredatta ya da amaç kazanımların içinde böyle birşey yok* (ECT2_NA).

Besides, 12 of 18 teachers emphasized that they use technology to support teaching concepts or objectives. For example, a teacher stated:

> *For example, we read from the books of The Scientific and Technological Research Council of Turkey and we make visual conversations with children. Then, we draw things that we read, look for the things at the garden, etc. While doing these things, I also show video about the things that we read. For instance, I show a web site about birds and children see different birds and listen to their sounds. This is very pleasant for children and it is also effective on learning* (ECT7_NA).
>
> *Mesela TÜBİTAK'ın kitaplarından sırayla okuyoruz, orada görsel bir de sohbet ediyoruz. Sonra resmini çiziyoruz, bahçede arıyoruz vs.*

Bunu yaparken bir de ben onlara ilgili bir video izletiyorum. Mesela kuş var orada ben kuşla ilgili bir site açıyorum oradan. Farklı kuşlar, özellikleri ve seslerini dinliyorlar. Mesela bu çok daha keyifli. Bu şekilde olduğunda tabi ki çok daha etkili öğrenme üzerinde (ECT7_NA).

Besides, 10 of 18 teachers pointed out that they lead children to use computers at school. For instance, a teacher's view for this activity was as follow:

We use computer in an individual way for drawing or designing something in paint (ECT7_NA).

Bireysel kullanımlarda olmak üzere paint üzerinden birşey tasarlıyoruz, çiziyoruz. O şekilde kullanıyoruz bilgisayarı (ECT7_NA).

Moreover, 7 of 18 teachers declared that they make pre-lesson preparation of electronic materials. For example, a teacher said:

I generally prepare programs by myself. Although I can't prepare advanced programs I can make very simple ones. I can prepare them in power point, media player or movie maker because I have a special interest (ECT16_NA).

Genelde kendim hazırlıyorum ben. Komple yazılım hazırlamıyorum ama çok basit şeyler hazırlayabiliyorum. Power point, media player ve movie maker kullanarak hazırlayabiliyorum. Ben kendi özel ilgimden dolayı hazırlayabiliyorum (ECT16_NA).

7 of 18 teachers also stated that they present stories or several topics on power point. For instance, a teacher told:

I can only prepare power point slides. I add pictures to the slides based on the story or the topic that I chose before. I make the slides interactive with a few questions by giving clapping sound when children find the right answer of the question (ECT18_NA).

Yapabildiğim şu var sadece, slayt hazırlamak. Slaytlara resim ekliyorum öyküye göre ya da öykü olmak zorunda değil, değişik bir kavram belirliyorum kendimce, o kavrama yönelik resimler ekliyorum slayta. Küçük sorularla bazen onu etkileşimli hale getirebiliyorsunuz,

> *işte doğruyu bulduğunda alkış sesi falan, o tarz şeyler, slayt gösterisi şeklinde* (ECT18_NA).

Lastly, using own personal computer at school and guidance of teacher at the beginning of technology use were the other technology use activities and stated by 4 teachers.

In conclusion, searching for educational softwares or programs suitable for children, using technology based on their choice, using technology to support teaching concepts or objectives, leading children to use computers at school, making pre-lesson preparation of electronic materials, presenting stories or several topics on power point, using own personal computer at school and guidance of teacher at the beginning of technology use were teachers' technology use activities. Based on the findings, teachers mostly use technology for supporting teaching and learning activities.

4.1.1.1.11 Teachers' Thoughts about Technology Use

According to 13 of 18 teachers, there is a necessity of using technology in preschool education. For instance, a teacher stated:

> *Technology must be used in preschool education and it must be considered at specific parts of education based on the age group characteristics of children* (ECT7_NA).
>
> *Okul öncesi eğitimde teknoloji kullanılmalı kesinlikle zaten yaş grubu itibariyle bu belli noktada çok daha devreye girmeli diye düşünüyorum* (ECT7_NA).

Additionally, 11 of 18 teachers considered technology as a tool making life easier. A teacher explained this as follow:

> *I define technology as a tool making life easier, entertaining and providing information* (ECT11_NA).

> *Benim için hayatı kolaylaştıran, zaman geçirmemi sağlayan, eğlendiren, bilgilenmemi sağlayan bir araç olarak görüyorum* (ECT11_NA).

Besides, 7 teachers called computer as the first idea of technology. They remembered computer when asking what they think about the specific definition or example of technology. Moreover, 6 of 18 teachers emphasized that there are high technology use capabilities of today's children. For example, a teacher said:

> *Children know how to use Ipad and Iphone because of their social environment. They do not need to be taught about these technologies. They know about technology more than me and other teachers. They have a variety of technologies at home* (ECT8_NA).
>
> *Bulundukları çevre itibariyle çocuklar Ipad kullanmayı da biliyor, Iphone kullanmayı da biliyor. Bunlar öğretilmeye ihtiyaç duymuyor. Benden ve diğer öğretmenlerden daha iyi biliyorlar. Zaten onlar evlerinde var, o olanaklara sahipler* (ECT8_NA).

Besides, based on the responses of 6 teachers, technology is a tool rather than a goal. Furthermore, 6 of 18 teachers pointed out that teacher is a guide in technology use. For instance, a teacher stated:

> *I guided children and helped them use technology. Some of them are used to handling the mouse and they can build coordination. However, some of them do not use so much. Hence, I helped them* (ECT6_NA).
>
> *Yani ben rehberlik ettim, yardımcı oldum. Kimisi evde mouse kullanmaya alışkın ve koordinasyonu sağlayabiliyor. Kimisi çok fazla kullanmamış, yapamıyor. Ben yardım ettim onlara* (ECT6_NA).

Lastly, wrong parental guidance was the other thought about technology use and stated by 4 teachers. For instance, a teacher stated:

> *Parents allow children to use computer and TV for playing games and watching cartoons. This is not a correct way of technology use because I support technology use activities of children playing individually to develop their creativity* (ECT9_NA).

> *Evlerde biz velilerimizle konuştuğumuzda televizyon ve bilgisayarı genelde oyun amaçlı ve çizgi film amaçlı kullanıyorlar. Ben böyle kullanılmasındansa daha çok çocukların bireysel, kendi çabalarıyla yaratıcılıklarını destekleyecek etkinlikleri ben de destekliyorum* (ECT9_NA).

In conclusion, necessity of using technology in preschool education, considering technology as a tool making life easier, computer as the first idea of technology, high technology use capabilities of today's children, technology as a tool rather than a goal, teacher as a guide in technology use and wrong parental guidance were thoughts' of teachers toward technology and technology use. It can be inferred from these findings that teachers give importance to technology use for children in appropriate guidance of teachers and parents.

As a result of this section including the findings of the research question 1, teachers had positive views about appropriate technology use in preschool education. They also emphasized that early educational settings need to be equipped with adequate technologies. Moreover, findings indicated that they expect to be supported by the preschool curriculum and several programs aiming at enhancing their technology use skills. Lastly, teachers were aware of not only the advantages of technology but also the potential disadvantages.

4.1.1.2 Research Question 2

What are early childhood teachers' opinions about educational use of smart toys?

To answer the second research question, semi-structured interviews were carried out with 18 early childhood teachers. The smart toy which was developed in the pilot study was mainly considered to investigate the research question. Four main themes and sub themes emerged to understand early childhood teachers' opinions about educational use of smart toys. These themes were:

- Teachers' Expectations of the Smart Toy
    - Visual Design

        - Content
        - Interaction
        - Educational Use
- Benefits of the Smart Toy
- Problems of the Smart Toy
- Teachers’ Strategies as to the Smart Toy Play

These themes were explained in detailed in the following section.

4.1.1.2.1 Teachers’ Expectations of the Smart Toy

Visual Design: According to 11 of 18 teachers, there is a need for more advanced design of the virtual environment for children. Teachers expected professional design of the virtual environment. For instance, a teacher stated:

> *Children get confused in case of very messy environment. For instance, at first glance I thought it was a kitchen, then I thought it was a coop and finally I thought it was a room. Children can become bored. The objects or anything presented in the virtual environment should be clear* (ECT5_NA).
>
> *Bir de şu var, genelde bu kadar çok karışıklığın içerisinde çocuk içinden çıkamayabiliyor da. Mesela ben ilk bakışta mutfak dedim, sonra kümes dedim, sonra oda dedim. Çocuk sıkılabilir. Yani objelerin boyutu vs. karşıdan bakıldığı zaman daha net olması gerekiyor* (ECT5_NA).

Additionally, 9 of 18 teachers declared that size of the objects should be parallel to real life. For example, a teacher said:

> *This is a big turtle as a toy but its virtual character is small. I don’t know how a child thinks about it. Bird was designed as bigger than snowman and bear was designed as smaller than snowman. Toys should be close to their life sizes* (ECT4_NA).
>
> *Şimdi bu burada büyük kaplumbağa, orada koyunca küçük çıkıyor ya. Nasıl düşünür çocuk orasını bilemiyorum. Kuşu büyük yapmışsınız kardan adamdan, ayı ondan küçük. Gerçek boyutlarına da yakın olsa iyi olur* (ECT4_NA).

Besides, 8 of 18 teachers pointed out that there is a need for more attractiveness of graphics, toys and animations for children. A teacher's view for this expectation was as follow:

> *Graphics should be more attractive. Since this is a different toy, it can still take attention of children. If you want to develop this toy more, it should be designed aesthetically and attractively* (ECT9_NA).
>
> *Grafikler daha ilgi çekici olabilir. Bu farklı bir oyuncak olduğu için şu haliyle de inanıyorum ki çok dikkat çekecektir. Oyuncaklar şimdi güzel ama ilerletmek isterseniz estetik açıdan daha sevimli gelebilecek şekilde olabilir* (ECT9_NA).

8 of 18 teachers also stated that there is a need for more realistic animations and graphics. A teacher explained this as follow:

> *Colors of the animals shown in the virtual content should be realistic. Children can be confused if the colors of the animals are not consistent with real life* (ECT2_NA).
>
> *Bir de hayvanların renklerinin de gerçeğe yakın olması lazım, o da sıkıntı olabilir. Normalde o hayvanın rengi bu renk değildi diye de gelir çocuklardan* (ECT2_NA).

Lastly, need for animations and graphics suitable for children was the other expectation and stated by 4 teachers. For instance, a teacher said:

> *In the first story, the rabbit couldn't spell the letter "r" correctly. This is a bad stimulus for children and it needs to be corrected. It is also not a good example for children because some of them can not spell the letter "r" too* (ECT11_NA).
>
> *İlk hikayede tavşan "r" harfini söyleyemiyor. O bence kötü bir uyaran, onun değişmesi lazım. O güzel bir örnek olmamış çünkü gerçekten öyle konuşan çocuklar var. Onun düzeltilmesi gerekir* (ECT11_NA).

In summary, teachers' expectations as to visual design of the smart storytelling toy were listed below:

- There is a need for more advanced design of virtual environment for children.
- Size of the objects should be parallel to real life.
- There is a need for more attractiveness of graphics, toys and animations for children.
- There is a need for more realistic animations and graphics.
- There is a need for animations and graphics suitable for children

Content: Based on the responses of 7 of 18 teachers, there is a need for using a variety of plush toys or background cards than the offered ones. For instance, a teacher stated:

> *For instance, the smart toy can be enhanced by adding different environments and different animals* (ECT11_NA).
>
> *Mesela ortam falan dediniz ya belki daha farklı ortamlar, daha farklı hayvanlar devreye sokulabilir. Ortamlar ve hayvan çeşitleri zenginleştirilebilir* (ECT11_NA).

Another teacher said:

> *Child created the story by using only 4 figures but his/her attention can be taken if he/she has a chance to use different objects in the second story. Let's think broader. Different stories including forest, north pole or a different country can be provided rather than providing stories including only forest or night environment. You can also add child figures to this toy. Child can play with these figures by thinking as if he/she is in the role of that figure. Then, he/she can use that figure as his/her friend. If the numbers of the objects increase, the child get focused more easily. It can also be more advantegous situation for you* (ECT14_NA).
>
> *4 tane figürle bir hikaye oluşturuyor tamam ama ikinci hikayede çocuk daha farklı şeyler de kullanabilirse bu onun ilgisini daha çok arttırır. Biraz daha geniş düşünelim. Bütün hikayelerin bir ormanda ya da gece gündüzde geçmesinden ziyade. birinde ormanda geçsin, birinde işte kuzey kutbunda, birinde başka bir ülkede. Buraya normal çocuk figürleri falan da koyabilirsiniz. O zaman kendisi çocukmuş gibi düşünür, direkt onunla oynar. Daha sonra arkadaş olarak bunu alır. Daha sonra ne söylemesini istiyorsa bunu alır. Figür ne kadar*

> *çoğalırsa çocuk o kadar çok ilgiye odaklanır. Bu sizin için de avantaj olabilir* (ECT14_NA).

In addition, 5 of 18 teachers stated that there is a need for dynamic content rather than showing only pictures. A teacher explained this as follow:

> *Are these objects in the virtual environment movable? They should be. When a child puts the toy, he/she tells the story: "the polar bear goes to the snowman and says hello to him. Then the polar bear becomes aware of the house of snowman and gets into that house". The child can make the story varied. The movable objects take more attention of children* (ECT10_NA).
>
> *Peki bunlar hareket ediyor mu? Etmiyor değil mi, orada donup kalıyor. Etse daha iyi olur tabi ki. Bunu koyunca geldi ama çocuk diyor ki mesela hikayede "kutup ayısı gider kardan adamın yanına, kardan adama merhaba der. Sonra bakar ki orada kardan adamın evi varmış. Buzdan evin içine girer". Çocuk kendisi hikayesini çeşitlendirebilir. Objelerin hareket etmesi çocuğun çok daha fazla ilgisini çeker, eğer hareket edebiliyorsa* (ECT10_NA).

Besides, 4 of 18 teachers pointed out that there is a need for using animations in virtual content. A teacher's view for this expectation was as follow:

> *A child can choose the rain option and add raining animation to his/her story. On the other hand, a wind sound or weathercock animation can be included with the desire of the child. The smart toy can be improved with this kind of animations* (ECT16_NA).
>
> *Mesela yağmurlu bir gün olmasını ister bugünün. Orada yağmur seçeneğini seçip, yağmur yağdırabilir hikayesinde. Ya da bir rüzgar sesi, rüzgar gülü animasyonu olabilir o an ekranda. Böyle animasyonlar olabilir, daha da geliştirilebilir* (ECT16_NA).

Lastly, need for adding background music and need for warm narrations suitable for children were the other expactations as to the content and stated by only 2 teachers as well.

In summary, teachers' expectations as to content of the smart storytelling toy were listed below:

- There is a need for using a variety of plush toys or background cards than the offered ones.
- There is a need for dynamic content rather than showing only pictures.
- There is a need for using animations in virtual content.
- There is a need for adding background music.
- There is a need for warm narrations suitable for children.

Interaction: According to 5 of 18 teachers, there is a necessity of recording child's voice while storytelling. For instance, a teacher stated:

> *There can be a microphone connected to the smart toy while a child tells his/her story. We can turn computer to the child feeling as a person and the toy records the child's voice while telling his/her story* (ECT13_NA).
>
> *Hatta hikaye okurken, hikaye canlandırırken, materyal olarak böyle güzel bir mikrofon bile olabilir. Çocuk eline mikrofon alır, bilgisayarı da çeviririz çocuklara doğru. O orada bir birey olur, hikayesini anlatır ve sistem sesini kaydeder* (ECT13_NA).

Need for allowing children to change the virtual environment with their desires and need for making computer screen touchable were the other expectations as to the interaction and stated by only 2 teachers as well.

In summary, teachers' expectations as to interaction of the smart storytelling toy were listed below:

- There is a necessity of recording child's voice while storytelling.
- There is a need for allowing children to change the virtual environment with their desires.
- There is a need for making computer screen touchable.

Educational Use: Based on the responses of 12 of 18 teachers, they expect using the smart toy for giving several concepts like numbers, colors, geometric shapes and location. For instance, a teacher stated:

> *You can give the color concept. For instance, let's say as "near of the red bird, yellow closet and which shelf of the closet". "Can you show me the thing in the shelf below or above. Hence, you can give several concepts with this toy* (ECT5_NA).
>
> *Renk kavramını verebilirsiniz. İşte dersiniz ki kırmızı kuşun yanı, sarı dolap, sarı dolabın hangi rafında. Alttaki rafında veya üstteki rafındaki şeyi gösterebilir misin? Hani verebileceğiniz birçok şey var burada* (ECT5_NA).

Another teacher said:

> *You can also give geometric shapes and numbers. There is no necessity of using only animals. You can give different concepts such as opposite, hot and cold. Let's think like: "The weather is very hot and Ayse comes to Ali and suggests something to make him refresh". This idea can come from the children* (ECT11_NA).
>
> *Geometrik şekilleri getirebilir, sayılar gelebilir. İlla hayvanlarla da olması gerekmiyor bu işin. Vermemiz gereken kavramlar olabilir. İşte zıt kavramlar ve sıcak soğuk gibi. Örneğin, hava çok sıcak ve Ali bunaldıysa Ayşe gelip ona birşey önerebilir, onu serinletecek. O fikir çocuklardan gelebilir* (ECT11_NA).

In addition, 11 of 18 teachers stated that the smart toy can be used in language development activities. For instance, a teacher expressed:

> *It is important that children can build their independent sentences, say something original and use different words. That is, they can create original products and say original things* (ECT8_NA).
>
> *Çocuğun bağımsız olarak cümle kurabilmesi en basitinden, karşı verilen cevaba göre yeni birşey söyleyebilmesi, farklı kelimeler kullanabilmesi önemli. İşte özgün ürünler ortaya koyar, özgün şeyler söyler* (ECT8_NA).

Besides, 10 of 18 teachers emphasized that the smart toy can be used in cognitive activities. A teacher's view for this expectation was as follow:

> *This toy can develop children's problem solving skills as a cognitive activity. They can compare the features of events, watch the events and ordering the events by time. You can give several cognitive activities in accordance with the content. If you want to use this toy in cognitive domain, you need to consider children's developmental needs* (ECT9_NA).
>
> *Problem çözme yeteneğini geliştirebilir bilişsel açıdan. Olayların özelliklerini karşılaştırabilir, olayları gözlemleyebilir, oluş sırasına göre sıralar. Pek çok şey olabilir aslında. Bu, içerikle ilgili aslında. Eğer bunu bilişsel alanda yürütmek istiyorsanız, çocukların bu dönemdeki gelişim düzeyleri göz önüne alınarak yapılabilir* (ECT9_NA).

Besides, 7 of 18 teachers expected that the smart toy can be used in storytelling activities. For example, a teacher stated:

> *For instance, I start a new story by saying the first sentence of it. "A polar bear is coming from the pole". Then, children can add new sentences to the story one by one. This exists in the goal and objectives of the curriculum. So, it can be used for that purpose* (ECT18_NA).
>
> *Mesela ben bir hikayeye başlıyorum, bir cümle söylüyorum. "Kutup ayısı kutuplardan geliyor" diye bir cümle söylüyorum. Ondan sonra sırayla kendileri cümleler katıyorlar. Bu bizim amaç ve kazanımlarımızda var. Ona yönelik kullanılabilir* (ECT18_NA).

Besides, 6 of 18 teachers expressed that the smart toy can be used for giving social skills. A teacher explained this as follow:

> *This toy can be used for correcting misbehaviors. A child can watch something including correct, wrong and expected behaviors from the smart toy and he/she can change of it. "What would you do if you were on the same situation" can be asked to the children in smart toy play and he/she can see and apply his/her choice* (ECT9_NA).
>
> *Yanlış davranışları düzenlemek için kullanılabilir. Orada birşeyi izler, olumsuz bir durum vardır ya da olumlu, olması gereken bir durum*

> *vardır. Onu değiştirebilir, aynı sahneyi "sen olsaydın ne yapardın" şeklinde değiştirebilir belki. Onu görebilir, orada uygulayabilir. Uygulama şansı verir bu çocuğa. Bu geldi ilk olarak aklıma. "Sen olsaydın" yapılabilir* (ECT9_NA).

Besides, 3 of 18 teachers pointed out that the smart toy can be used for giving daily life skills. For instance, a teacher stated:

> *It can give information about daily life of the child. For example, a shopping center card can be provided to the child. "How do you act when you go to a shopping center?" Parents have a big problem about the behaviors of their children in a shopping center because children want everything in that center. A story about what children do in a shopping center can be presented in the smart toy. So, these background cards can be adapted to the several environments* (ECT10_NA).
>
> *Günlük yaşantısıyla ilgili de bilgi verilebilir. Mesela bir alışveriş merkezi kartı olur. "Sen alışveriş merkezine gittiğinde nasıl davranıyorsun?". En çok velilerin alışveriş merkezi sıkıntısı var. Çocuk gittiğinde alışveriş merkezinde gördüğü herşeyi istiyor. "Gittiğinde ne yapıyorsun?" diye bir hikaye anlatabilir. Bu kartlar her ortam için uyarlanabilir yani* (ECT10_NA).

3 teachers also mentioned about the expectation of using the smart toy for showing different animals, their living areas and features. A teacher's view for this educational use expectation was as follow:

> *For instance, there are animals in a farm. When a child puts an animal which shouldn't be in the farm, the toy can give a feedback like "Do you think that this animal can be in this farm?"* (ECT8_NA).
>
> *Mesela çiftlikle ilgili, çiftlikte hayvanlar vardır. Çiftlikte olmayacak bir hayvanı koyduğunda, yönerge veriyor ya mesela, "sence bu hayvan çiftlikte olabilir mi?" gibi bir dönütle cevap verebilir* (ECT8_NA).

Moreover, 3 of 18 teachers stated that the smart toy can be used in seasons activities. For example, a teacher said:

> *A smart toy about seasons can be used. The difference between spring and autumn can be given in that toy. It can also be related with suitable clothes for different seasons* (ECT3_NA).
>
> *Mevsimlerle ilgili olabilir. İlkbahar, sonbahar ve aradaki farklar verilebilir. Giyinmeleriyle ilgili olabilir. Hangi mevsim hangi kıyafetleri giymeliyiz gibi* (ECT3_NA).

Lastly, use for traffic activities was the other educational use expectation from the smart toy and stated by only 2 teachers as well.

In summary, teachers' expectations as to educational use of the smart storytelling toy were listed below:

- Using the smart toy for giving several concepts like numbers, colors, geometric shapes and location
- Using in language development activities
- Using in cognitive activities
- Using in storytelling activities
- Using for giving social skills
- Using for giving daily life skills
- Using for showing different animals, their living areas and features
- Using in seasons activities
- Using for traffic activities

In conclusion, it can be inferred from the findings as to the expectations of teachers toward the smart toy play that teachers believe the importance of smart toys for children in preschool settings if these toys can be improved both pedagogically and technically.

4.1.1.2.2 Benefits of the Smart Toy Play

According to 15 of 18 teachers, the smart toy takes attention of children. For instance, a teacher stated:

> *Toys are nice. Attention is mostly taken to the toys. This is a very nice and different system* (ECT5_NA).
>
> *Oyuncaklar güzel. Dikkat daha çok oyuncaklara çekiyor kendini. Bu çok güzel bir sistem, çok değişik ve çok güzel bir sistem* (ECT5_NA).

Additionally, 8 of 18 teachers emphasized that immersing children into the activity was another benefit of the smart toy play. A teacher explained this as follow:

> *Child is involved in the toy play and immersed in the activity. He/she watches from the toy, makes the characters talk and thinks about what he/she tells* (ECT2_NA).
>
> *Çocuk bunda olaya dahil oluyor hatta kendisi içine giriyor. Orada hem izliyor hem konuşturuyor hem de ne söyleyeceğini düşünüyor* (ECT2_NA).

Besides, 7 of 18 teachers mentioned about good interaction between touchable objects and virtual environment. For example, a teacher said:

> *This is an interesting and beautiful toy because it is different than the others that I have ever seen before. In the first story, I thought that children don't do anything but then, I noticed that children's attention is important. They listen to the story and put the related rabbit. When the narrator tells to put the rabbit, they can replace turtle with rabbit and watch the story from the computer* (ECT10_NA).
>
> *Gayet güzel yani daha önce görmediğim için bana çok farklı geldi, ilginç olmuş. İlkinde hani çocuk hiçbirşey yapmıyor gibi gelmişti bana ama orada da biraz çocuğun dikkati var. Çocuk dikkatli bir şekilde dinliyor ve gerekli olan tavşanı koyuyor. Tavşanı koy dediğinde hemen kaplumbağayla yer değiştiriyor ve hikayeyi bilgisayardan izliyor* (ECT10_NA).

Besides, 6 of 18 teachers pointed out that the smart toy supports creativity of children. A teacher's view for this benefit was as follow:

> *This is a very different toy than the other usual toys because child puts any object whatever he/she desires. It is very interesting and improves their creativity* (ECT6_NA).

> *Alışılagelmiş hazır kullanılan şeylerden çok daha farklı. İster bunu koyuyor, sonra mesela kutuba bir tane koyun koyuyor. İlginç birşey. Bence güzel, kendi yaratıcılığını geliştirebiliyor* (ECT6_NA).

Moreover, 6 of 18 teachers expressed that the smart toy allows children to construct their own process. For instance, a teacher stated:

> *This smart toy allows children to join the activity enthusiastically and immerses them into the event actively. So, a child constructs the process individually. Hence, it is suitable for the constructivist view. We can get target skills of children by using this smart toy which is consistent with the constructivist view. Since the child constructs individually, he/she respects his/her product more* (ECT7_NA).

> *Öğrencilerin daha ilgiyle takip etmelerini sağlar. Kendisini birebir işin içine sokar aktif şekilde. Dolayısıyla kendisi yapılandıracak süreci. Yani yapılandırmacı anlayışın o anlamda uygun olduğunu düşiünüyorum. Dolayısıyla onunla hedeflediğimiz herşeyi öğrenciden bununla alabiliriz. Kendisi yapılandırdığı için kendi ürününü daha çok sahiplenir* (ECT7_NA).

Furthermore, 5 of 18 teachers stated that the smart toy has an advantage of toy and card use rather than mouse and keyboard use. For example, a teacher said:

> *Everything is visual in other systems. Yes, you use mouse in that systems but I think that touching is an advantage for children. This smart toy provides an effective and nice material for children since they can see other kind of toys everywhere* (ECT17_NA).

> *Diğer sistemlerde herşey görsel. Evet fare kullanıyorsun ama buna dokunmak çocuk için bir artı bence. Bunu işin içine koymak daha hoş olacak. O sürekli heryerde karşılaştığı birşey. Akıllı oyuncağın işin içine girmesi bence daha etkili olacak birşey* (ECT17_NA).

Lastly, improving hand skills of children was the other benefit of the smart toy and stated by 4 teachers.

In conclusion, taking attention of children, immersing children into the activity, good interaction between touchable objects and virtual environment, supporting creativity of children, allowing children to construct their own process, toy and card use rather than mouse and keyboard use and improving hand skills of children were the benefits of the smart toy play. It can be inferred from these findings that the smart toy has several advantages, such as effective children-smart toy interaction and improving several skills of children.

4.1.1.2.3 Problems of the Smart Toy

Based on the responses of 9 of 18 teachers, sizes of the virtual objects are inconsistent with their real life sizes. For example, a teacher stated:

> *Sizes of the animals are not consistent. Sheep is very big while bear is very small compared with sheep. Sizes of the animals should be close to their life sizes* (ECT7_NA).
>
> *Hayvanların boyutları mesela çok dengeli değil. Koyun çok büyük, ayı küçük kalmış onun yanında. Bu boyutlar gerçeğe uygun olursa daha iyi olabilir* (ECT7_NA).

In addition, 6 of 18 teachers pointed out that there are difficulties of individual smart toy play of children at classroom settings. A teacher explained this as follow:

> *This smart toy can be used but there can also be a problem when children want to play with it individually. The objects included in this toy are not sufficient for 25 children existing in the classroom. There are hyperactive and impatient children at classroom* (ECT17_NA).
>
> *Bu kullanılabilir. Belki şunda sıkıntı olabilir. Mesela çocuklar karşılıklı yapmak isteyecektir. 25 kişilik bir sınıfta, sadece şöyle birşey o çocuklara yetmeyecektir. Sırada beklerken biraz sıkıntımız oluyor. Hareketli çocuklar, sabırsız bekleyen çocuklar var* (ECT17_NA).

Besides, 5 of 18 teachers emphasized that the smart toy is lack of dynamic content. A teacher’s view for this problem was as follow:

> *When a child puts the rabbit in the first story, the rabbit does not talk. The rabbit should be active and dynamic. Graphics should also be attractive and dynamic* (ECT9_NA).
>
> *İlk hikayede mesela tavşanı koyduğumuzda tavşan konuşmuyor. Ona daha hareket kazandırılabilir belki. Grafikler daha ilgi çekici ve hareketli olabilir* (ECT9_NA).

Finally, limited content for children was the other problem of the smart toy and stated by 4 teachers. For example, a teacher stated:

> *You can present a farm's different environments, such as night, day time, spring, winter and summer. You need to enrich the content very much. For example, a rabbit comes at night and asks some questions like how it feels* (ECT1_NA).
>
> *Bu çiftliğin mesela gecesi, gündüzü, baharı, kışı, yazı olsa iyi olur. Çok zenginleştirmek gerekiyor bunu etkin şekilde kullanmak istiyorsak. Gece tavşan gelir mesela bunun üzerine sorular sorulabilir. Örneğin, tavşan kendini nasıl hissediyordur diye sorulabilir* (ECT1_NA).

In conclusion, based on the teachers' responses, inconsistency of sizes of the virtual objects with their real life sizes, difficulties of individual smart toy play of children at classroom, lack of dynamic content and limited content for children were the problems of smart toy play. It can be reached from these findings that teachers emphasize the problems in both smart toy play and its content.

4.1.1.2.4 Teachers' Strategies as to the Smart Toy Play

According to 10 of 18 teachers leading collaborative smart toy play can be a strategy for using the smart toy at the classroom. For instance, a teacher stated:

> *For example, a child can take a role of the rabbit. Collaborative play with 2 or 3 children can eliminate the disadvantage of poor interaction. Every child can tell something about the story in smart toy play* (ECT8_NA).
>
> *Mesela sen sadece tavşan rolündesin. Ben dedim ya etkileşim zayıf diye, şunu mesela 2 ya da 3 çocuğa oynatırsanız etkileşimin zayıflığını ekarte ediyor. Her çocuk işte, o ona göre birşey söyleyecek falan* (ECT8_NA).

Another teacher explained this as follow:

> *Children can produce their own stories one by one in a collaborative group study by using projector in smart toy play* (ECT10_NA).

Sınıfta mesela bu kullanılarak projeksiyonla birlikte çocuklar sırayla gelip işte bir hikaye yazılabilir hep birlikte (ECT10_NA).

In addition, 7 of 18 teachers emphasized that teacher guides children in smart toy play. For instance, a teacher said:

There should be a teacher guiding children in smart toy play. "Let's open the story. Kids, what is this? Turtle. How does this turtle make a sound? Let's open the story related with this turtle". They turned on the computers. It is very easy for children to do this activity if the classroom is not too crowded (ECT4_NA).

Başlarında bir öğretmen olacak, grup 10 kişi olmalı maksimum. "Evet hikayeyi açıyoruz, bu nedir çocuklar? Kaplumbağa. Bu nasıl ses çıkartır? Aaaa bununla ilgili bir hikaye var, hadi bakalım açın". Açtılar bilgisayarlarını. Çok basit bunu yaptırmak. sınıf ortamı uygunsa ve sayı çok fazla yoksa bunu yaptırmak gayet verimli birşey (ECT4_NA).

Lastly, individual smart toy play as free time activity was the other strategy of smart toy play and stated by only 2 teachers.

In conclusion, leading collaborative smart toy play, guiding children in smart toy play and individual smart toy play as free time activity were the smart toy play strategies mentioned by teachers. It can be commented from these findings that teachers believe in collaboration and guidance in smart toy play at classroom settings.

As a result of this section including the findings of research question 2, teachers had positive views about integrating the smart toy into preschool settings. They also declared that the content, visual design and interaction components of the smart toy need to be improved. Moreover, teachers emphasized the integration of the smart toy into several educational activities by following specific strategies. Lastly, teachers mentioned not only advantages of the smart toy for children but also the problems which can occur while playing with it.

4.2 Phase 2 (Design Phase)

In the design phase, six focus group meetings were carried out with four early childhood teachers to design the smart toy. The phases of determining tentative objectives, determining the story and its components, preparing the storyboard and deciding the final objectives were accomplished as the results of these focus group meetings. These phases were explained below in detailed.

4.2.1 Determining Tentative Objectives

Early childhood teachers decided to prepare tentative objectives to be used in the story of smart toy. They gave importance to goals and objectives for any material used in preschool education. For instance, a teacher stressed:

> *We consider the toys coming to our school. Which developmental areas are focused and what educational content of these toys are the important questions that we look for. We don't buy any toy which doesn't serve for specific goals and objectives. We also write goals and objectives to the toys developed at school* (ECT3_D).
>
> *Biz zaten bize gelen oyuncaklara bakıyoruz. Hangi gelişim alanlarına yönelik, neleri kapsıyor, neleri verebiliyoruz. Amaçsız kazanımsız birşey almıyoruz ki zaten. Kendi yaptığımız, okulda böyle yaptığımız oyuncaklar oluyor onlara bile amaç kazanım yazmaya çalışıyoruz* (ECT3_D).

Additionally, teachers believed that several objectives of different developmental areas, such as cognitive, language, social emotional, motor and personal care need to be included in the smart toy. For instance, a teacher stated:

> *For example, we spend a lot of money for toys providing only one concept like shape or color. If this smart toy can be used for several purposes then it becomes valuable. Cognitive, social and personal care objectives can be presented via this toy* (ECT3_D).
>
> *Mesela biz o kadar para veriyoruz ve çoğu oyuncak tek kavrama yönelik ya şekille alakalı ya da renklerle alakalı oluyor. Ama bu çok amaçlı birşey olduğu zaman değer yani. Bilişsel, duygusal, özbakım becerilerinin hepsi akıllı oyuncakla verilebilir* (ECT3_D).

While teachers stated that several objectives of all developmental areas can be given in the smart toy, they firstly emphasized on giving cognitive skills. This was also consistent with the findings in the needs analysis phase because the majority of teachers emphasized on using smart toy for giving concepts and cognitive skills. For instance, a teacher explained this as follow:

> *Colors, numbers and shapes can be given with this toy and it can also be developed more* (ECT1_D).
>
> *Renkler, sayılar şekiller bu oyuncakla verilebilir, geliştirilebilir* (ECT1_D).

Another teacher expressed:

> *For example, let's write cognitive domain firstly. What will this toy contribute in terms of children's cognitive developmental needs? We can proceed one by one starting from cognitive domain* (ECT3_D).
>
> *Mesela öncelikle bilişsel alanı yazalım. Çocuğun bilişsel alanda hangi gelişimine yönelik nelere yardımcı olacak oyuncak? Öyle tek tek gidelim* (ECT3_D).

Moreover, pattern activities were declared by all of the teachers. They wanted to include the objectives related with pattern activities in the smart toy. For instance, a teacher said:

> *There is no any toy including pattern activity. Children can put the toys in a specific order. Pattern is included in our program and we use it. Although pattern has existed for 6 years, nobody knows what the pattern is* (ECT1_D).
>
> *Örüntülü hiçbir oyuncak yok. Belirli sıraya göre oyuncakları düzer. Örüntü bizde var ve biz bunu kullanıyoruz. Hiçbir oyuncakta da yok. Kimse bilmiyor örüntünün ne olduğunu. Örüntü 6 yıldır var.* (ECT1_D).

Although teachers preferred to see very detailed pattern activity in the smart toy, it was not easy and practicable because of the smart toy's content including several concepts and objectives. The developer in the focus group meeting explained this as follow:

> *It would be easy to develop the toy if we give only pattern activity. However, including several toys and different concepts such as colors and numbers can make the detailed pattern activity presentation difficult* (developer).
>
> *Sadece örüntüyü versek bu projede daha kolay yapılabilir ama bu oyuncaklar, renkler, sayılar da girince örüntüyü çok detaylı vermek sıkıntı olabilir* (developer).

Personal care objectives were also mentioned by teachers to use in the smart toy. For instance, a teacher pointed out:

> *The smart toy can embrace 3 years old children by giving personal care skills* (ECT3_D).
>
> *Öz bakım becerileriyle oyuncak 3 yaş çocuklarını da kapsar* (ECT3_D).

Another teacher stated:

> *There are limited numbers of games for 3 years old children. This is a problem because producers target 6 years old children in general* (ECT2_D).
>
> *3 yaşa göre zaten oyunlar çok az. Öyle bir sıkıntı da var aslında. Genelde 6 yaş yapabiliyor diye 6 yaşa yöneliyorlar ama 3 yaş da oyun yönünden sıkıntılı. Onlara yönelik çok fazla oyun yok* (ECT2_D).

Although teachers agreed that several objectives of different developmental areas can be given in the smart toy, the context was restricted as cognitive and personal care skills to design the smart toy for 36 – 72 months old children. For that purpose, tentative objectives and their indicators for cognitive and personal care developmental areas were determined based on the national preschool curriculum. These objectives and their indicators were presented below (see Appendix M for the original Turkish version):

- Cognitive Skills

  Objective 1: Gives attention to object/situation/event.

    Indicator: Focuses on object/situation/event that require attention.

  Objective 2: Makes predictions about object/situation/event.

    Indicator: Tells the prediction by combining clues.

  Objective 3: Counts objects.

    Indicator 1: Counts forward/backward by ones.

    Indicator 2: Tells the number of objects counted.

  Objective 4: Observes objects or material.

    Indicator 1: Tells the name of object/material.

    Indicator 2: Tells the color of object/material.

    Indicator 3: Tells the shape of object/material.

  Objective 5: Match objects or materials by their properties.

    Indicator 1: Match objects/materials one to one.

    Indicator 2: Distinguish objects/materials by color and match them.

    Indicator 3: Distinguish objects/materials by shape and match them.

    Indicator 4: Distinguish objects/materials by size and match them.

  Objective 6: Group objects or materials by their properties.

    Indicator 1: Group objects/materials by color.

    Indicator 2: Group objects/materials by shape.

    Indicator 3: Group objects/materials by size.

  Objective 7: Compare the properties of objects or materials.

    Indicator 1: Distinguish objects/materials by color and compare them.

    Indicator 2: Distinguish objects/materials by shape and compare them

    Indicator 3: Distinguish objects/materials by size and compare them.

  Objective 8: Order objects or materials by their properties.

    Indicator: Order objects/materials by size.

  Objective 9: Follow the location related instructions in space.

    Indicator: Put object to the right place based on the instruction.

Objective 10: Recognizes geometric shapes.

Indicator 1: Tells the name of geometric shapes.

Indicator 2: Tells the property of geometric shapes.

Indicator 3: Indicates objects similar to geometric shapes.

Objective 11: Recognizes the symbols used in daily life.

Indicator: Indicates the appropriate symbol in the explanations given.

Objective 12: Create a pattern with objects.

Indicator 1: Create a pattern with objects by looking at the model.

Indicator 2: Tells the missing item left in a pattern.

Indicator 3: Complete the missing item left in a pattern.

- Personal Care Skills

Objective 1: Apply the cleaning rules on the body.

Indicator 1: Brushes the hair.

Indicator 2: Brushes teeth.

Indicator 3: Washes hands/face.

Objective 2: Does dressing related tasks.

Indicator 1: Takes off clothes.

Indicator 2: Puts on clothes.

Objective 3: Makes the necessary arrangements in the living area.

Indicator 1: Uses stuff in the house/school clean and carefully.

Indicator 2: Organizes stuff in the house/school.

Indicator 3: Hang stuff in the house/school.

Indicator 4: Place stuff in the house/school.

Objective 4: Feeds self adequately and balanced.

Indicator 1: Tries to eat at meal time.

Indicator 2: Avoids foods and drinks affecting health adversely.

Objective 5: Uses tools and equipment which are need for daily life skills.

Indicator 1: Uses appropriate tools and equipment during feeding.

Indicator 2: Use materials related to body cleaning.

4.2.2 Determining the Story and Its Components

After determining tentative objectives to be given in the smart toy, focus group meetings continued to create the story. Teachers decided to give a story about an environment in which children spend times in their daily routines. Hence, several ideas such as giving school, house or park environments emerged from teachers. For instance, a teacher stated:

> *There can be a girl. There can also be rooms of a house. Colors can be given with slipper that a child wears. The child can wear the red slipper and go to the kitchen. Stuff in the kitchen can be given in the toy and it also involves little age group* (ECT3_D).
>
> *Bir kız olabilir. Evin bölümleri olabilir mesela. Renkler verilir, terlik giyiliyor ona göre. Kırmızı terliğini giydi, mutfağı gezdi. Mutfakta hangi eşyalar var, bardak, tabak. Bu küçük yaş grubunu da kapsar* (ECT3_D).

Another teacher stressed:

> *There can be background cards showing every room. The child can see the room by putting the related background card. Narrator can tell the story by saying "the child woke up and then went to the kitchen or bathroom". This story can also include little age group children* (ECT4_D).
>
> *Her odayı anlatan bir kart olsun. Çocuk o anda ne yapıldığını kendisi kartı koyup görebilir. Çocuk uyanmış diye hikayeyi anlatan kişi anlatsın. Ondan sonra, evet uyandıktan sonra mutfağa geçti ya da banyoya geçti, sonra ne yaptı. O zaman küçük yaşımızı da kapsar* (ECT4_D).

Rooms of a house was the agreed topic of teachers for the story. They also emphasized that using a child character in the story is important for children to identify them with the character. A 5 years old girl was selected as the character to be used in the story. For example, a teacher explained this as follow:

> *Using a character who is at the same age with the child playing with the smart toy can be suitable* (ECT2_D).

> *Kendi yaş grubunda karakterin kullanılması uygun olabilir* (ECT2_D).

In addition, teachers decided that the story day should be a rest day of children because the story needs to consider school environment in case of weekday. It can be inferred from teachers' ideas that story needs to be realistic and consistent with real life. For instance, a teacher's view for this idea was as follow:

> *Since we show the rooms to the children, the day should be a holiday. We don't send children to school because we also need to show school in case of including school environment* (ECT3_D).
>
> *Biz odayı gezdireceğiz ya, bir tatil sabahı falan anlatmak lazım o zaman. Okula falan göndermeyiz çünkü odaları nasıl gezdireceğiz okula gidecekse, okulu da gezdirmek lazım* (ECT3_D).

Teachers also pointed out that the story starts with giving personal care skills and continues with giving cognitive skills. For example, a teacher expressed:

> *First of all, the child wakes up and goes to the bathroom. We can start with personal care* (ECT3_D).
>
> *İlk olarak sabah yatağından kalkacak, banyoya gidecek. Öz bakımdan başlayabiliriz* (ECT3_D).

Another teacher said:

> *The child brushes the hair and teeth, washes face, and puts on clothes and shoes* (ECT1_D).
>
> *Saçını tarar, dişini fırçalar, yüzünü yıkar, giysilerini giyer, ayakkabılarını giyer* (ECT1_D).

For the concept of color, teachers were on agreement about giving three primary colors such as red, blue and yellow. For example, a teacher stated:

> *We can use primary colors like red, yellow and blue because these colors are mostly given at preschool* (ECT3_D).

> *Kırmızı, sarı ve mavi olan ana renkleri kullanabiliriz çünkü bu renklerden daha çok bahsediyoruz okulda* (ECT3_D).

For the narration and voice of the child character, teachers emphasized on using warm and familiar sounds for children. Therefore, teachers decided to use the voice of a woman for narration and a real 5 years old girl voice for the sound of the character. For instance, a teacher stressed:

> *It is important that narration and vocalizing should be sincere and warm. A woman voice can be used because children feel good when hear a woman voice. A real 5 years old girl must vocalize the character in the story* (ECT1_D).

> *Konuşmaların ve seslendirmelerin samimi ve sıcak olması önemli. Bayan sesi kullanılabilir çünkü çocuklar kendilerine daha yakın hissediyorlar. Ayşe'nin seslendirmesini de aynı yaştaki bir kız çocuğu yapmalı* (ECT1_D).

Based on the ideas and statements of the teachers, first draft of the story was produced. The draft was presented below (see appendix N for the original Turkish version):

Smart toy story / First draft / 13.12.2012

It was a sunny Sunday. Ayse woke up with the rising of sun.

- Good morning. My name is Ayse. I am 5 years old. And you? (Child puts one of the cards ranging from 1 to 10 onto the reader)

- Thank you.

- I am very happy because today is weekend holiday. I will spend the day with my family and you. Would you like to help me in doing several tasks?

- First of all, I will wash my hands and face and brush my hair in bathroom.

Put the picture of bathroom for that (Child puts the bathroom card onto the reader)

Would you put soap for washing her hands and face? (Child puts the soap toy onto the reader)

Would you put comb for brushing her hair? (Child puts comb toy onto the reader)

- Let's have breakfast together.

Put the picture of kitchen for that (Child puts the kitchen card onto the reader)

What should Ayse eat for healthy and balanced nutrition?

Would you help Ayse by using cards? (positive: milk, eggs, honey and cheese; negative: sugar, chips and coke)

P.s: If child puts one of the negative cards, the feedback like "No, I don't eat/drink because I get sick if I do" is given

What should Ayse do now?

P.s: There should be a small time break

Put the picture of bathroom (Child puts the bathroom card onto the reader)

P.s: "Try again" feedback is given in case of putting cards other than bathroom card

- Would you give me tootbrush for brushing my teeth?

Put the toothbrush (Child puts the toothbrush toy onto the reader)

- Thank you
- Would you like to play with me?

Put the picture of game room (Child puts the game room card onto the reader)

- Would you help me place my toys to my cupboard newly bought?
- Would you put the toys in red color to the top of the shelf?

(Child puts red colored car, bear, baby and ball toys to the top of the shelf)

- Would you put the toys in blue color to the middle of the shelf?

(Child puts blue colored car, bear, baby and ball toys to the middle of the shelf)

- Would you put the toys in yellow color to the bottom of the shelf?

(Child puts yellow colored car, bear, baby and ball toys to the middle of the shelf)

- Would you like to play on my game carpet now?

P.s: There are square, rectangle, triangle and circle shapes on the game carpet

- Can you show me the big triangle? (Child puts the big triangle toy onto the reader)
- Can you show me the small square? (Child puts the small square toy onto the reader)
- Can you show me the big rectangle? (Child puts the big rectangle toy onto the reader)
- Can you show me the small circle? (Child puts the small circle toy onto the reader)

- Can you show me the small triangle? (Child puts the small triangle toy onto the reader)
- Can you show me the big square? (Child puts the big square toy onto the reader)
- Can you show me the small rectangle? (Child puts the small rectangle toy onto the reader)
- Can you show me the big circle? (Child puts the big circle toy onto the reader)
- Would you like to count the objects in my room together?
- How many carpets are there in my room? (Child puts the card showing number 1 onto the reader)
- Can you count the numbers of shapes of the carpet in my room? (Child puts the card showing number 8 onto the reader)
- How many triangle shapes are there on the carpet? (Child puts the card showing number 2 onto the reader)
- How many cars are there in my room? (Child puts the card showing number 3 onto the reader)
- How many yellow colored toy are there? (Child puts the card showing number 4 onto the reader)

Although story was mainly created in the first draft, there were also several deficiencies. First of all, which dialogues will be vocalized by which character was not clear. On the other hand, statements or narrations in the story were not totally polite. Teachers emphasized that all statements should be warm and polite to children to make them feel comfortable. Additionally, the pattern part of the story was not added in the first draft. Moreover, the story was not completely clear about giving personal care skills and cognitive skills. Furthermore, the feedback showing the finish of the play was absent in the first draft. Teachers emphasized that a finishing feedback should be given at the end of the play. Teachers also pointed out that all objects in the smart toy need to be familiar for children. For that reason, they decided to use the name of "hand" for the RFID reader. According to them, a hand picture can be put onto the reader and hand can be used in the story rather than calling as reader or anything else. Based on these reviews, second draft of the story was created as a result of the focus group meetings. The second draft was presented below (see Appendix O for the original Turkish version):

Smart toy story / Second draft / 20.12.2012

1) Ayse gains personal care skills

Narrator: It was a sunny Sunday. Ayse woke up with the rising of sun.

Ayse: Good morning. My name is Ayşe. I am 5 years old. And you? (Child puts one of the cards ranging from 1 to 10 onto the reader)

Ayse: Thank you

Ayse: I am very happy because today is weekend holiday. I will spend the day with my family and you. Would you like to help me in doing several tasks?

Ayse: First of all, I will wash my hands and face and brush my hair in bathroom

Narrator: You should put the bathroom picture onto the hand (Child puts the bathroom card on to the reader)

Narrator: Would you put soap onto the hand for washing her hands and face? (Child puts the soap toy onto the reader)

Ayse: Thank you

Narrator: Would you put comb picture onto the hand for brushing her hair? (Child puts the comb toy onto the reader)

Ayse: Thank you

Ayse: Let's have breakfast together

Narrator: You should put the kitchen picture onto the hand (Child puts the kitchen card onto the reader)

Narrator: What should Ayse eat for healthy and balanced nutrition?

Narrator: Would you help Ayse by using cards? (positive: milk, eggs, honey and cheese; negative: sugar, chips and coke)

P.s: If child puts one of the negative cards, the feedback like "No, I don't eat/drink because I get sick if I do" is given

Narrator: What should Ayse do now?

P.s: There should be a small time break

Narrator: You should put the bathroom picture onto the hand (Child puts the bathroom card onto the reader)

P.s: "Try again" feedback is given in case of putting cards other than bathroom card

Ayse: Would you give me tootbrush for brushing my teeth?

You should put the toothbrush onto the hand (Child puts the toothbrush toy onto the reader)

Ayse: Thank you

2) Ayse gains cognitive skills and learns concepts

Ayse: Would you like to play with me?

Narrator: You should put the game room picture onto the hand (Child puts the game room card onto the reader)

Ayse: Would you help me place my toys to my cupboard newly bought?

Ayse: Would you put the toys in red color to the top of the shelf?

(Child puts the red colored car, bear, baby and ball toys to the top of the shelf)

Ayse: Would you put the toys in blue color to the middle of the shelf?

(Child puts the blue colored car, bear, baby and ball toys to the middle of the shelf)

Ayse: Would you put the toys in yellow color to the bottom of the shelf?

(Child puts the yellow colored car, bear, baby and ball toys to the middle of the shelf)

Ayse: Would you like to play on my game carpet now?

P.s: There are square, rectangle, triangle and circle shapes on the game carpet

Ayse: Can you show me the big triangle? (Child puts the big triangle toy onto the reader)

Ayse: Can you show me the small square? (Child puts the small square toy onto the reader)

Ayse: Can you show me the big rectangle? (Child puts the big rectangle toy onto the reader)

Ayse: Can you show me the small circle? (Child puts the small circle toy onto the reader)

Ayse: Can you show me the small triangle? (Child puts the small triangle toy onto the reader)

Ayse: Can you show me the big square? (Child puts the big square toy onto the reader)

Ayse: Can you show me the small rectangle? (Child puts the small rectangle toy onto the reader)

Ayse: Can you show me the big circle? (Child puts the big circle toy onto the reader)

Ayse: Would you like to count the objects in my room together?

Ayse: How many carpets are there in my room? (Child puts the card showing number 1 onto the reader)

Ayse: Can you count the numbers of shapes of the carpet in my room? (Child puts the card showing number 8 onto the reader)

Ayse: How many triangle shapes are there on the carpet? (Child puts the card showing number 2 onto the reader)

Ayse: How many cars are there in my room? (Child puts the card showing number 3 onto the reader)

Ayse: How many yellow colored toy are there? (Child puts the card showing number 4 onto the reader)

Ayse: Would you like to play pattern game now?

Narrator: You should put pattern picture onto the hand for starting the game.

Ayse: Yes, we can start the game now

Ayse: You should put the missing object left in the pattern in the first row onto the hand

Ayse: Good, you are perfect

Ayse: You should put the missing object left in the pattern in the second row onto the hand

Ayse: You should put the missing object left in the pattern in the third row onto the hand

Ayse: I thank you for playing with me

4.2.3 Preparing the StoryBoard

Before preparing the storyboard, the second draft of the story was reviewed in focus group meetings. Although, size and geometic shapes were given together in cognitive skills part of the story, teachers decided to give only geometric shapes. The reason of this change was based on the view that giving size and geometric shapes at the same activity can make children confused. For instance, a teacher stated:

> *The focus should be on the geometric shapes rather than combining shapes with size concepts in the same activity because children can perceive only one concept easily* (ECT2_D).
>
> *Büyüklük ve küçüklük gibi kavramlarla birlikte geometrik şekilleri aynı anda vermektense, çocukların algılayabileceği şekilde sadece şekiller üzerine odaklanmak daha iyi olabilir* (ECT2_D).

Numbers was another concept mentioned in the story; however, teachers and the developer participated in the meetings reached an agreement on excluding number concept from the story. The reason of this exclusion was mostly based on preventing children to become bored while playing with a great numbers of the plush toys and cards used in the smart toy. Therefore, the concept of numbers in the cognitive skills part was excluded from the story and it was not covered in the storyboard. Another point that teachers mentioned was about improving the sincerity and familiarity of the smart toy with the children. Therefore, teachers decided to use 5 years old girl's voice mostly rather than using a woman narrator. They stated that this can enhance interaction between the character and the child player by improving identification of child with the character in the smart toy. Based on these reviews and notes, storyboard consistent with the second draft story and teachers' feedbacks was prepared. The storyboard was presented in Table 4.1 (see Appendix P for the original Turkish version):

Table 4.1 Storyboard of the smart toy

Scene 1	
Scenario	Voice 1 is played. The woman narrating needs to appear on the screen with speaking animation. There needs to be house and sun cards. When the child playing with the smart toy puts the house card onto the hand, the third scene is appeared. If the child puts the sun card, the first scene about get information is appeared.
Voice	A young woman narrates this: Voice 1: Hello, welcome to Ayse's toy house. If you want to play with the toy immediately, you should put the house card onto the hand. If you want to get information how to play with the toy, you should put the sun card onto the hand.

Table 4.1 (continued)

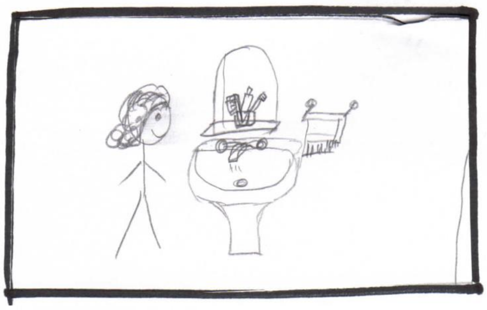
Scene 2	 
Scenario	If the child puts the bathroom and kitchen cards onto the hand correctly, the related scenes are appeared. The woman continues to her narration. If the child puts the bear toy correctly, the woman holding the bear toy appeared on the scene. While voice 2a is played, the animation about how to put cards or toys onto the hand is shown. If the child puts the wrong card or toy for bathroom card, voice 2b is played. While voice 2b is played, the animation about putting the bathroom card correctly is shown. If the child puts the wrong card or toy for kitchen card, voice 2c is played. While voice 2c is played, the animation about putting the kitchen card correctly is shown. If the child puts the wrong card or toy for bear toy, voice 2d is played. While voice 2d is played, the animation about putting the bear toy correctly is shown. Voice 2e is played. After voice 2e, the main scene of the smart toy is appeared.

Table 4.1 (continued)

Voice	The same young woman narrates this: Voice 2: a) You will learn how to play with the toy in this scene. You should listen to Ayse carefully while playing with the toy and as you see in the scene, you should put the related toy or card onto the hand. Let’s do a practice together. Firstly, would you put the bathroom card onto the hand? If the child puts correctly: Congrats, you put the bathroom card onto the reader and we are in bathroom now. b) If the child puts a wrong card: Unfortunately, you put the wrong card. Now, you should find the bathroom card and put it onto the hand. Now, would you put the kitchen card onto the hand? If the child puts correctly: Congrats, you put the kitchen card onto the reader and we are in kitchen now. c) If the child puts a wrong card: Unfortunately, you put the wrong card. Now, you should find the kitchen card and put it onto the hand. Lastly, would you put bear onto the hand? If the child puts correctly: Congrats, you put the bear toy onto the reader and I am holding the bear toy now. d) If the child does not put the correct toy: Unfortunately, that is not correct. Now, you should find the bear toy and put it onto the hand. e) You learned how to play with the toy. Now, you can start to play with the toy.
Scene 3	

Table 4.1 (continued)

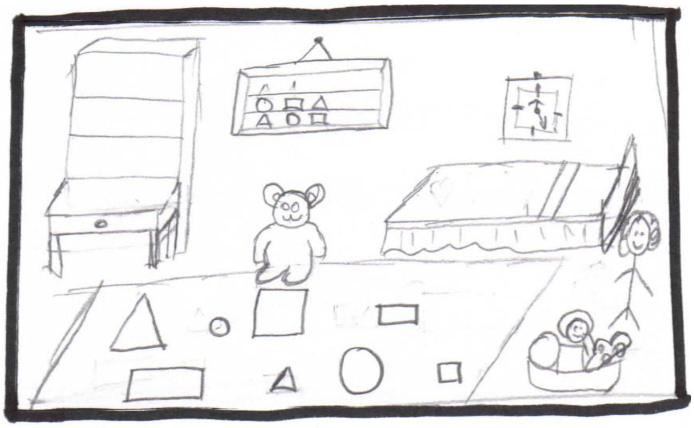
Scenario	Sun rises slowly and brightenes the day. Then, door gets bigger on the scene and is opened slowly. Then Ayse's room is appeared on the scene.
Scene 4	
Scenario	Ayse's room; toys on a bed, a desk, a carpet, a pattern frame hung on wall, a clock hung on wall and a toy basket. There is also a cupboard having 3 shelves for placing toy, bear, baby and ball toys. Ayse narrates voice 3a. After finishing the narration, scene 5 is appeared if the child puts the bathroom card. If the child does not put the right card or he/she does not put anything for 5-6 seconds, voice 3b is played.
Voice	Voice 3: (After this, all narrations will be done from a 5 years old girl) a) Ayse: Good morning. My name is Ayse. I am 5 years old. I am very happy because today is weekend holiday. I will spend the day at home with my family and you. Would you like to help me in doing several tasks? First of all, I will wash my hands and face and brush my hair in bathroom. Now, please put the bathroom card onto the hand and let's go to the bathroom. b) Would you put the bathroom card onto the hand for going to the bathroom?

Table 4.1 (continued)

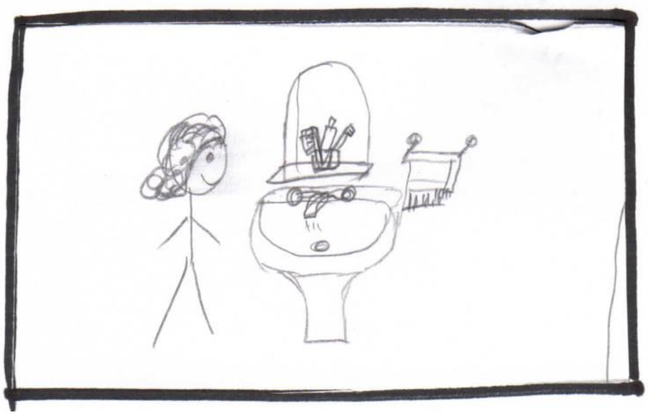
Scene 5	
Scenario	There are washstand and mirror hung on wall. There is a box including toothpaste, toothbrush and comb on top of the washstand. Additionally, there is a soap dish on the washstand. There is also a towel hung on the towel stand. Ayse goes to the bathroom. She is in front of the washstand. She opens the tap and water flows. Voice 4a is played. If the child puts correctly, voice 4b is played. If he/she does not, voice 4c is played. After the child puts soap toy onto the hand, Ayse's hands become foamy and Ayse wipes her hands with the towel. Voice 4d is played. If the child puts correctly, voice 4e is played. Ayse brushes her hair after the child puts the comb toy onto the hand. If the child puts the wrong object, voice 4f is played. Voice 4g is played. There is a time break lasting 3-4 seconds. If the child puts the kitchen card onto the hand, scene 6 is appeared. If the child does not put the kitchen card or anything else in 3-4 seconds, voice 4h is played.

Table 4.1 (continued)

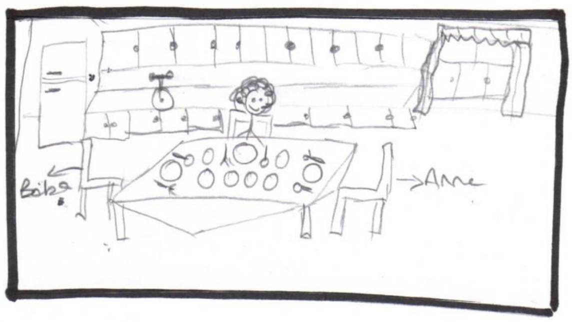
Voice	Voice 4: a) Ayse: Would you put the soap onto the hand to soap my hands? b) If the child puts correctly: Thank you c) If the child puts a wrong card or toy: You should put the soap onto the hand to soap my hands d) Ayse: Would you put the comb onto the hand to brush my hair? e) If the child puts correctly: Well done f) If the child puts a wrong card or toy: You should put the comb onto the hand to brush my hair. g) Ayse: Let’s go to the kitchen to have breakfast. h) If the child does not put the kitchen card: Would you put the kitchen card onto the hand to go to the kitchen?
Scene 6	
Scenario	Kitchen table is on the foregound of the kitchen scene. There are also kitchen cupboard, refrigerator, and other stuff in the kitchen. Mom and dad is sitting on the chairs of the kitchen table. Ayse is sitting between her mom and dad. There are milk box, eggs, honey, cheese, chips and coke on the table. Ayse goes to the kitchen and sits on the chair. Voice 5a is played. Voice 5b is played. If the child does not put the correct card or anything else in 4-5 seconds, voice 5c is played. If the child puts one of the cards of milk, eggs, honey and cheese, voice 5d is played. If the child puts the chips card, voice 5e is played. If the child puts the coke card, voice 5f is played. It is expected from the child to put milk, eggs, honey and cheese cards. For example, if the child does not put anything for 3-4 seconds after putting the milk card, voice 5g is played. If the child does not put anything, voice 5g is played until all healthy foods are completed. After putting all healthy foods, such as milk, eggs, honey and cheese, voice 5h is played. Voice 5i is played. If the child puts the bathroom card, scene 7 is appeared. If the child does not put the correct card, voice 5j is played. If the child does not put anything in 4-5 seconds, voice 5k is played.

Table 4.1 (continued)

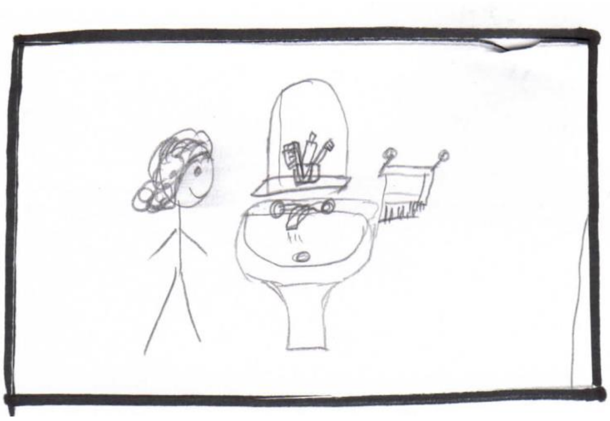
Voice	Voice 5: a) Ayse: Good morning mom, good morning dad. b) Ayse: What should I eat for healthy and balanced nutrition? c) If the child does not put the correct card: Would you put one of the cards showing foods or drinks onto the hand? d) Ayse: Perfect. It is a healthy food. e) If the child puts the chips card: I'm sorry, I can't eat, it is an unhealthy food. f) If the child puts the coke card: I'm sorry, I can't drink, it is an unhealthy food. g) Is there any other food that I can eat or drink at breakfast? Would you put it onto the hand? h) Perfect. Milk, eggs, honey and cheese are the heatlthy foods that I can eat or drink at breakfast. i) Ayse: What should I do after finishing my breakfast? Would you help me? j) Ayse: We need to go somewhere else after finishing breakfast. k) Ayse: Now, please put the bathroom card onto the hand and let's go to the bathroom again.
Scene 7	
Scenario	Ayse comes to the bathroom and voice 6a is played. If the child does not put anything for 5 seconds then voice 6b is played. If the child puts a wrong object, voice 6c is played. If the child puts tootbrush onto the hand, voice 6d is played. An animation about brushing teeth is shown. Voice 6e is played. If the child puts the room card onto the hand, scene 8 is appeared. If the child puts the wrong card or does not put anything for 5-6 seconds, voice 6f is played.

Table 4.1 (continued)

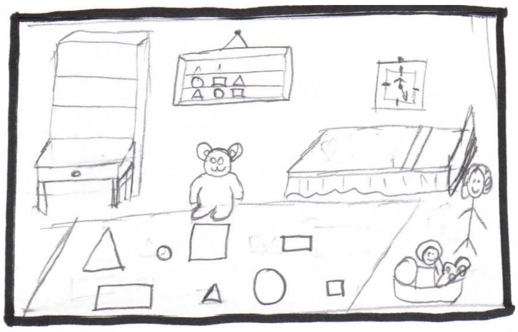
Voice	Voice 6: a) Ayse: Would you give me the tootbrush for brushing my teeth? b) Would you put the toothbrush onto the hand. c) If the child puts a wrong object: I can’t brush my teeth with this. You need to put the toothbrush. d) Ayse: Thank you. e) Ayse: Would you like to play with me? Please, put the room card onto the hand and let’s play in my room. f) If the child puts a wrong object: Would you put the room card onto the hand to go to my room?
Scene 8	
Scenario	Voice 7a is played. The child tries to put car, bear, baby and ball toys in red, blue and yellow colors to the shelves in the cupboard. The child needs to put red colored toys on the top shelf, blue colored toys on the middle shelf and yellow colored toys on the bottom shelf. Voice 7b is played. If the child puts a toy in blue or yellow colored, voice 7c is played. If the child does not put anything for 5-6 seconds, voice 7d is played. If the child completes all red colored toys, voice 7e is played. If the child puts the wrong object, the correct toy does not place on the shelf and a negative sound is given. If the child puts the correct toy, the toy is placed and a positive sound is given. Voice 7f is played. If the child puts a toy in red or yellow colored, voice 7g is played. If the child does not put anything for 5-6 seconds, voice 7h is played. If the child completes all blue colored toys, voice 7i is played. Voice 7j is played. If the child puts a toy in red or blue colored, voice 7k is played. If the child does not put anything for 5-6 seconds, voice 7l is played. If the child completes all yellow colored toys, voice 7m is played.

Table 4.1 (continued)

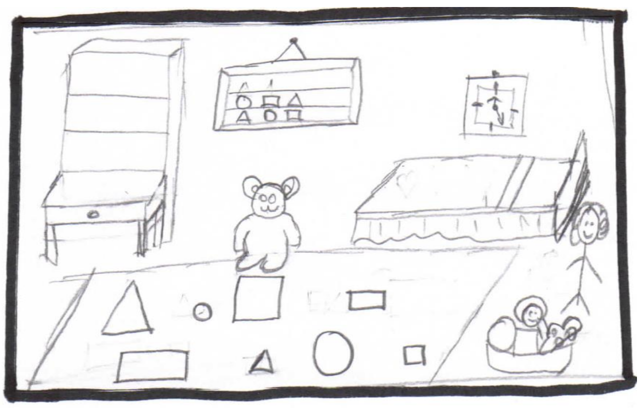
Voice	Voice 7: a) Would you help me place my newly bought toys to the cupboard? b) Would you put the toys in red color to the top shelf? c) You need to put the red colored toys firstly. d) You didn’t finish putting all red colored toys. Go on, please. e) You are perfect, you put all red colored toys to the top shelf. f) Would you put the blue colored toys to the middle shelf? g) You need to put the blue colored toys firstly. h) You didn’t finish putting all blue colored toys. Go on, please. i) You are perfect, you put all blue colored toys to the middle shelf. j) Would you put the yellow colored toys to the bottom shelf? k) You need to put the yellow colored toys firstly. l) You didn’t finish putting all yellow colored toys. Go on, please. m) You are perfect, you put all yellow colored toys to the bottom shelf.
Scene 9	

Table 4.1 (continued)

Scenario	There is a game of shapes in this part. Some objects which are similar to specific geometic shapes are highlighted to the child and the child tries to put the correct geometric shape toy onto the hand. Voice 8a is played. Then, voice 8b is played. While voice 8b is played, the ball object in the room is highlighted. If the child puts the circle toy onto the hand, voice 8c is played. If the child puts a wrong toy or card, voice 8d is played. If the child also does not put anything for 5-6 seconds, voice 8e is played. Voice 8f is played. While voice 8f is played, the clock hung on the wall is highlighted. If the child puts square toy onto the hand, voice 8g is played. If the child puts a wrong toy or card, voice 8h is played. If the child also does not put anything for 5-6 seconds, voice 8i is played. Voice 8j is played. While voice 8j is played, the top two shelves of the cupboard is highlighted. If the child puts the rectangle toy onto the hand, voice 8k is played. If the child puts a wrong toy or card, voice 8l is played. If the child also does not put anything for 5-6 seconds, voice 8m is played. Voice 8n is played. While voice 8n is played, an object similar to triangle is highlighted. If the child puts triangle toy onto the hand, voice 8o is played. If the child puts a wrong toy or card, voice 8p is played. If the child also does not put anything for 5-6 seconds, voice 8r is played. Voice 8s is played. Then, voice 8t is played. Scene 10 is appeared. If the child does not put pattern card or does not put anything for 6-7 seconds, voice 8u is played.

Table 4.1 (continued)

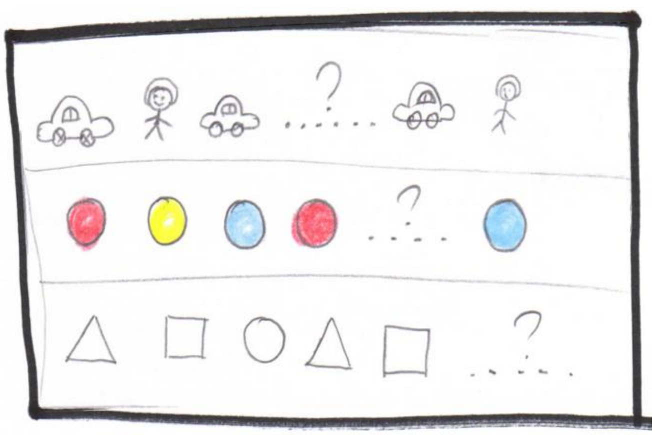
Voice	Voice 8: a) Now, we will play shapes game. You will find the geometric shapes of the toys which are highlighted in the room. Let’s start. b) Which shape does this look like? (for the ball object) c) Yes, you are right. This is a circle. d) No, that’s not true. You should try again. e) Would you put the shape which looks like the object highlighted onto the hand? f) Which shape does this look like? (for the clock hung on the wall) g) Yes, you are right. This is a square. h) No, that’s not true. You should try again. i) Would you put the shape which looks like the object highlighted onto the hand? j) Which shape does this look like? (for the top two shelves of the cupboard) k) Yes, you are right. This is a rectangle. l) No, that’s not true. You should try again. m) Would you put the shape which looks like the object highlighted onto the hand? n) Which shape does this look like? (for the object similar to triangle) o) Yes, you are right. This is a triangle. p) No, that’s not true. You should try again. r) Would you put the shape which looks like the object highlighted onto the hand? s) Oleeyy, you found all shapes. t) Now, let’s play a pattern game together. You should put the pattern card onto the hand. u) Would you put the pattern card onto the hand for playing pattern game?
Scene 10	

Table 4.1 (continued)

Scenario	When the pattern card is put, the pattern scene is appeared. First of all, the scene above is appeared. While the focus is on the top row of the pattern, this row is bright. Brightness passes to other rows in accordance with the focus. First row: red car, red bear, red car, ?, red car, red bear (missing object: red bear) Second row: red ball, yellow ball, blue ball, red ball, ?, blue ball (missing object: yellow ball) Third row: triangle, square, circle, triangle, square, ? (missing object: circle) Voice 9a is played. Then, voice 9b is played. If the child puts the red colored bear toy, voice 9c is played. If the child puts a wrong card or toy, voice 9d is played. Voice 9e is played. If the child puts the yellow colored ball toy, voice 9f is played. If the child puts a wrong card or toy, voice 9g is played. Voice 9h is played. If the child puts the circle toy, voice 9i is played. If the child puts a wrong card or toy, voice 9j is played. Voice 9k is played after finishing all rows.
Voice	Voice 9: a) Now, we will play a pattern game. b) Would you put the missing object left in the pattern in the first row onto the hand? c) Yes, you are perfect. d) Unfortunately, that’s not true. You should try again. e) Would you put the missing object left in the pattern in the second row onto the hand? f) Yes, you are perfect. g) Unfortunately, that’s not true. You should try again. h) Would you put the missing object left in the pattern in the third row onto the hand? i) Yes, you are perfect. j) Unfortunately, that’s not true. You should try again. k) You are perfect, that’s it. You solved all patterns. I thank you for playing with me.

4.2.4 Determining the Final Objectives

After preparing the storyboard, the final objectives were determined. These objectives which were based on the storyboard were presented below:

- Cognitive Skills
    - *Objective 1:* Gives attention to object/situation/event.
        - *Indicator:* Focuses on object/situation/event that require attention.
    - *Objective 2:* Observes objects or material.
        - *Indicator 1:* Tells the name of object/material.
        - *Indicator 2:* Tells the color of object/material.
        - *Indicator 3:* Tells the shape of object/material.
    - *Objective 3:* Group objects or materials by their properties.
        - *Indicator:* Group objects/materials by color.
    - *Objective 4:* Follow the location related instructions in space.
        - *Indicator:* Put object to the right place based on the instruction.
    - *Objective 5:* Recognizes geometric shapes.
        - *Indicator 1:* Tells the name of geometric shapes.
        - *Indicator 2:* Indicates objects similar to geometric shapes.
    - *Objective 6:* Recognizes the symbols used in daily life.
        - *Indicator:* Indicates the appropriate symbol in the explanations given.
    - *Objective 7:* Create a pattern with objects.
        - *Indicator 1:* Create a pattern with objects by looking at the model.
        - *Indicator 2:* Tells the missing item left in a pattern.
        - *Indicator 3:* Complete the missing item left in a pattern.
- Personal Care Skills
    - *Objective 1:* Apply the cleaning rules on the body.
        - *Indicator 1:* Brushes the hair.
        - *Indicator 2:* Brushes teeth.
        - *Indicator 3:* Washes hands/face.

Objective 2: Feeds self adequately and balanced.

Indicator 1: Tries to eat at meal time.

Indicator 2: Avoids foods and drinks affecting health adversely.

Objective 3: Uses tools and equipment which are need for daily life skills.

Indicator 1: Uses appropriate tools and equipment during feeding.

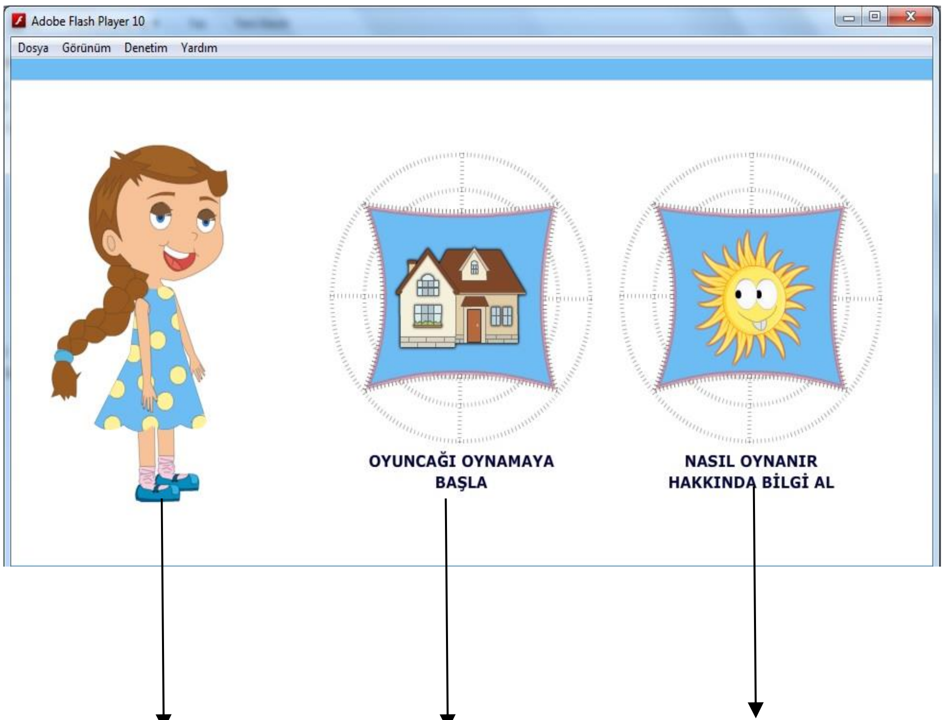
Indicator 2: Use materials related to body cleaning.

4.3 Phase 3 (Development Phase)

In the development phase of the smart toy, several sub phases were also accomplished. The first prototype of the smart toy was developed based on the storyboard which was created in the design phase. Formative evaluations were carried out with preschool children, early childhood teachers and scholars who were expert in the areas, such as instructional technology and early childhood education. After taking the results of the formative evaluation, the second prototype of the smart toy was developed based on the necessary revisions emerged from the feedbacks of the participants in the formative evaluation. A new formative evaluation was also conducted with scholars to evaluate the second prototype. After getting the feedbacks from the scholars, the final version of the smart toy was developed. The whole development process was explained below in detailed:

4.3.1 Development of the First Prototype

Based on the storyboard prepared in the design phase, there were five main scenes, namely introduction, bathroom, kitchen, child room, and pattern. These scenes were developed in Adobe Flash program by considering the details mentioned in the storyboard. The screenshots of these scenes were shown below:



The character of "Ayse" "Start to play the toy" "Get information about how to play"

Figure 4.1 Screenshot of introduction scene

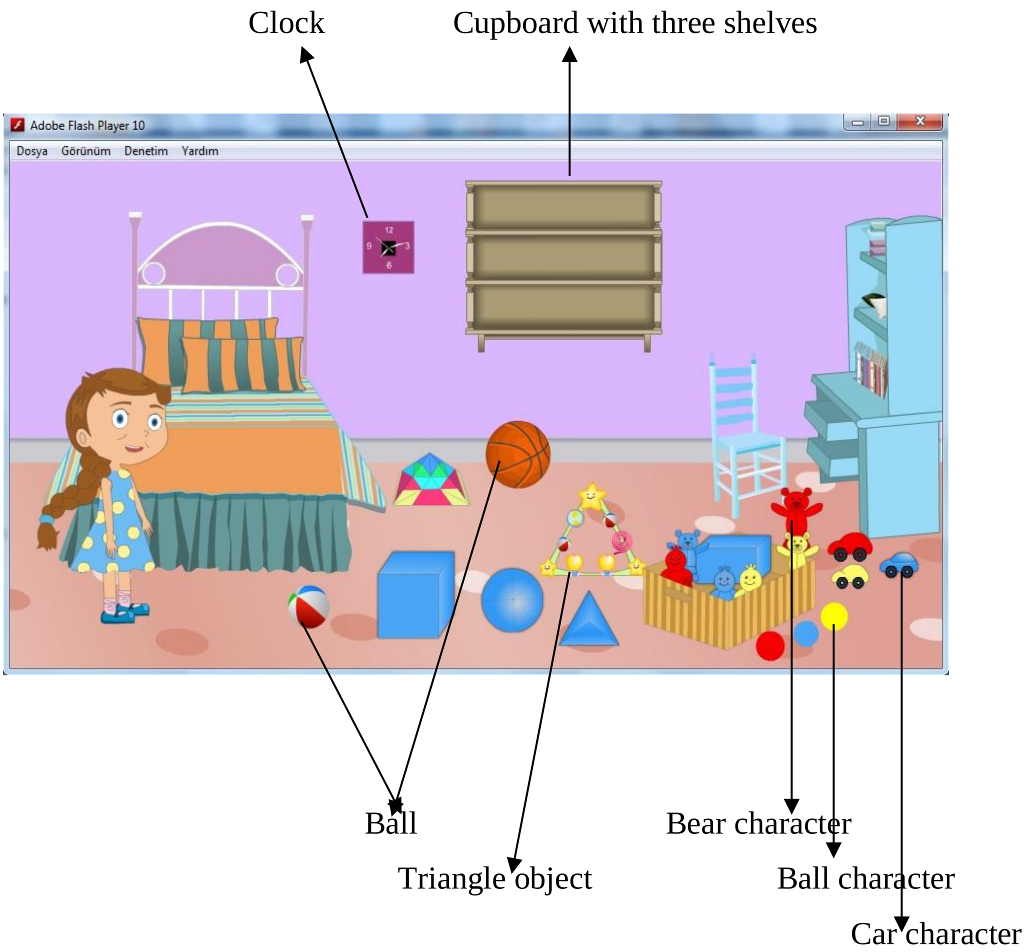


Figure 4.2 Screenshot of child's room scene

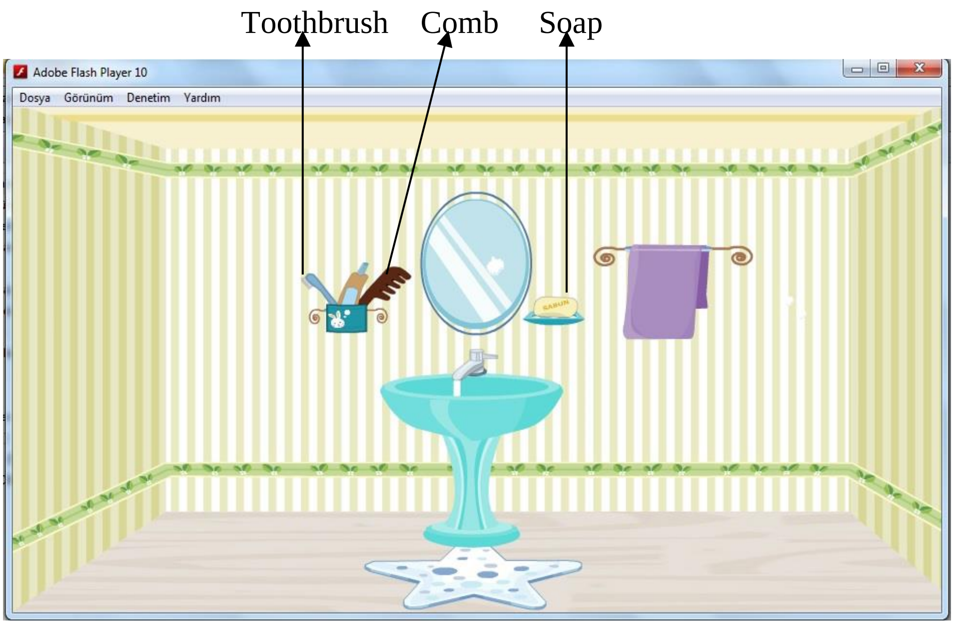


Figure 4.3 Screenshot of bathroom scene

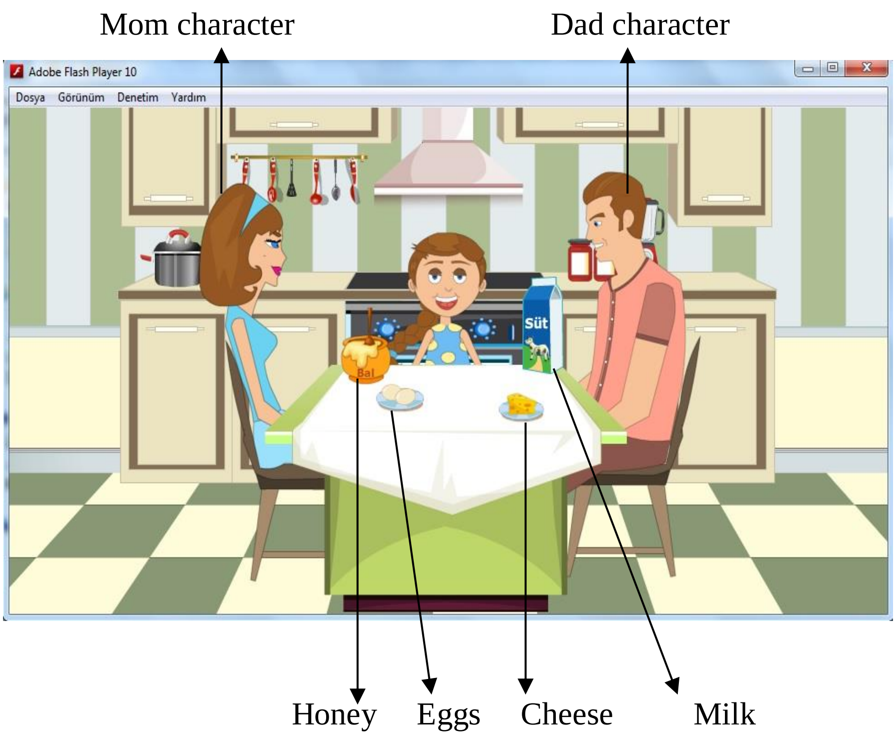
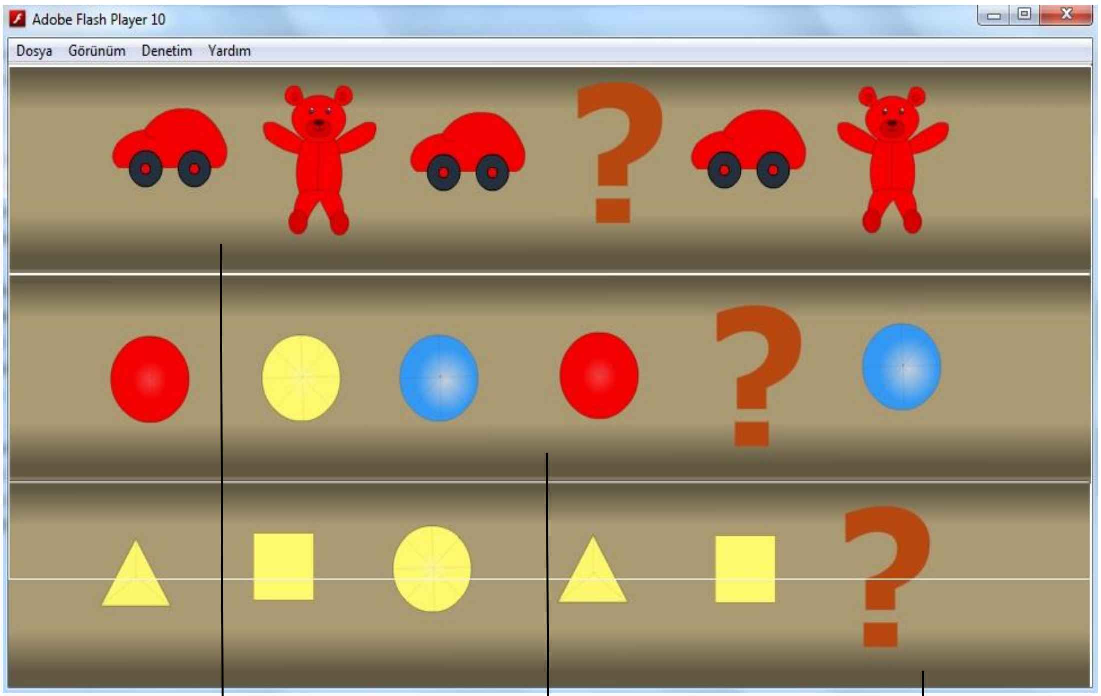


Figure 4.4 Screenshot of kitchen scene



Same color and different shape pattern
with 2 different objects

Different color and same shape pattern

Same color and different shape pattern
with 3 different objects

Figure 4.5 Screenshot of pattern scene

After developing the virtual content in Adobe Flash program, plush toys and background cards with RFID tags were bought and adapted to the virtual environment of the smart toy. RFID tags were placed into the each toy and the codes produced by tags were used in programming of the smart toy. Toys which were suitable for the characters developed in the virtual content were presented below:

Figure 4.6 Plush toys equipped with RFID tags

RFID cards which were used with plush toys were also bought and the pictures of scenes or objects used as cards in the smart toy were sticked on the cards. Since each card had a unique RFID code, these codes were used in programming of the smart toy. Cards used in the smart toy were presented below:

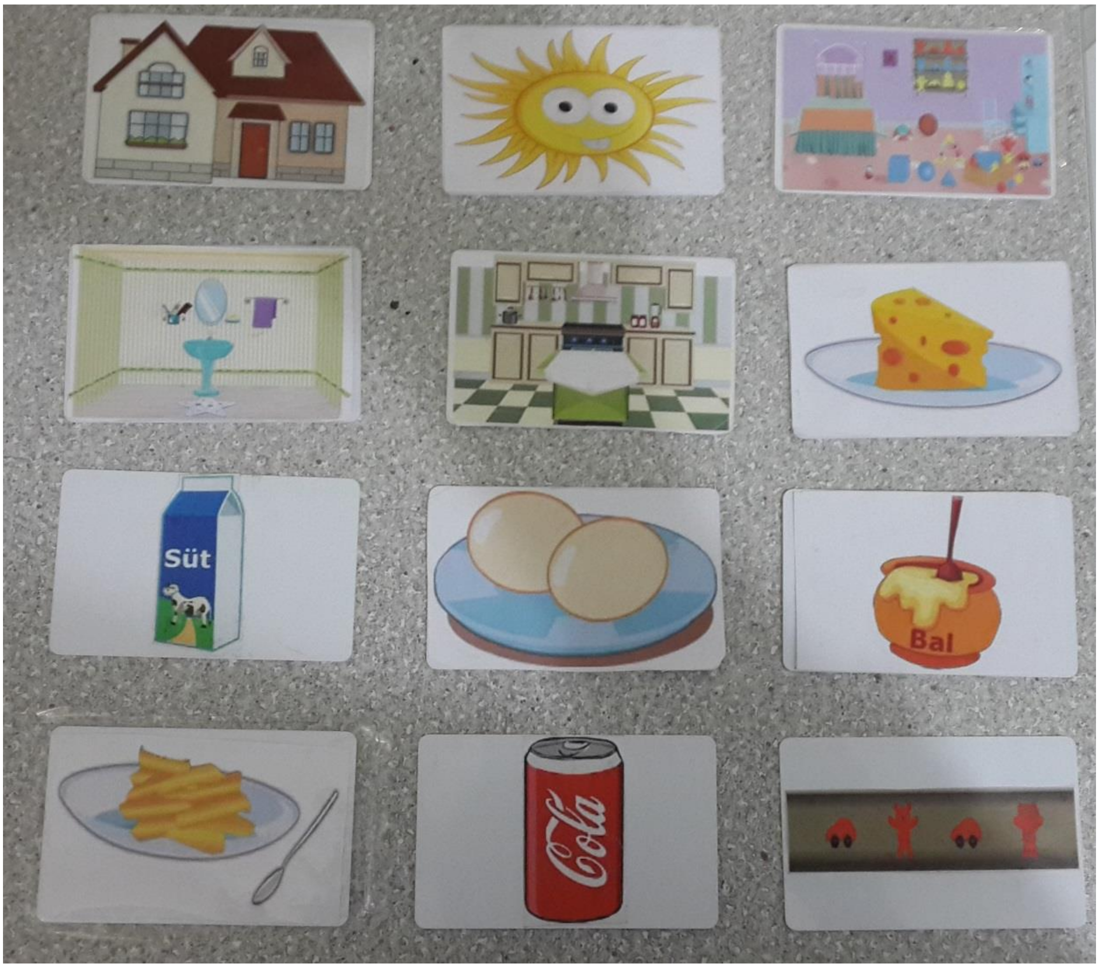


Figure 4.7 RFID cards stucked with the pictures of objects

RFID reader was a tool connecting plush toys and cards to the virtual content via RFID tags. Based on the storyboard in the design phase, RFID reader was named as "hand" to make the object familiar with children. Therefore, a hand picture was stucked on the reader and presented below:

Figure 4.8 RFID reader stucked with the picture of hand

4.3.2 Formative Evaluation of the First Prototype with Preschool Children

After developing the first prototype of the smart toy, a formative evaluation was carried out with preschool children by means of observation method. The content of the smart toy was based on two main skills, namely personal care skills and cognitive skills. In personal care skills, there were two main scenes which were bathroom and kitchen scenes. On the other hand, cognitive skills included two main scenes, namely child's room and pattern scene. Based on these scenes in content of the smart toy, several tasks were created to observe children while playing (see Appendix F for the observation sheet). 5 male and 2 female children participated in the sessions individually. The findings based on the themes emerged from the observation notes were explained below in detailed:

4.3.2.1 Content

The first prototype of the smart toy was developed based on two parts; personal care and cognitive part. Table 4.2 summarized each child's duration of the smart toy play in terms of personal care and cognitive parts.

Table 4.2 Duration of the first prototype play of children

Child	Gender	Age	Duration for The Part of Personal Care Skills (minutes)	Duration for The Part of Cognitive Skills (minutes)	Total Time For The first prototype play (minutes)
C1_FE1	Male	38 months old	4,20	9	13,20
C2_FE1	Female	40 months old	4,15	8,30	12,45
C3_FE1	Male	55 months old	4,20	6	10,20
C4_FE1	Male	56 months old	4,10	9,30	13,40
C5_FE1	Male	62 months old	3,30	6,45	10,15
C6_FE1	Female	69 months old	5	5,30	10,30
C7_FE1	Male	45 months old	4,20	7,40	12

The average duration of the first prototype play was 11.7 minutes. According to table, it can be said that play time of the first prototype decreased with age. For instance, children between 36 and 48 months old completed playing with the smart toy more than 12 minutes, while children older than 60 months old completed less than 11 minutes. This was totally related with the content of the toy. Based on the observation notes, the youngest group of children struggled with the part aiming at giving cognitive skills. Pattern scene, especially, was the hardest and time consuming part of the smart toy for the youngest children. For instance, completing only pattern activity scene lasted 4 minutes while finishing all cognitive parts, including placing colored objects to their right places, finding the suitable geometric shapes and pattern activity lasted 9 minutes. So, it can be inferred from this finding that the pattern activity took nearly half of the play duration of the whole cognitive part. On the other hand, this youngest group of children was successful in doing all tasks in smart toy play. In light of these findings, it can be concluded that the content of the smart toy should be suitable for children with 36 months old – 72 months old. Younger children's backgrounds and their needs need to be taken into consideration to increase the success of the smart toy.

Another problem related with the content was about the help screen. Since this was the first prototype, "getting information about how to play" scene was not developed entirely. Hence, children couldn't use this part at the beginning of the prototype. Therefore, they had difficulties in putting an object or card onto the reader called as "hand" at the beginning of the play. This finding showed that "help" screen needs to be presented detailed before starting to play the actual content. It was important because "help" screen can improve the familiarity of children with the smart toy.

Another finding as to the content of the smart toy was about the numbers of plush toys and cards. Since there were several plush toys and cards that children had to use to proceed in smart toy play, they had difficulties in deciding the object as a plush toy or card to put onto the hand. Therefore, it was important to keep the numbers of plush toys and cards in a low level. Alternatively, plush toys and cards can be put in boxes and children can choose the related toy or card based on the content of the smart toy. That is, plush toys and cards should be given to children in an ordered way.

Another finding as to the content was related with the tasks children completed. According to the observation notes, all children completed the tasks of personal care skills easily. However, children aged 36 to 60 months had several difficulties in the scenes of cognitive skills. These children could not solve the patterns. On the contrary, some children could not understand which pattern needs to be solved first because 3 different patterns were shown in the same scene. Therefore, it was important to use only one pattern in each screen. Additionally, different pattern rows such as two objects with same color and different shape, and three objects with different color and same shape were presented in the same scene. This was also difficult for children in terms of clarity and comprehensibility. It was important to start from basic pattern and make them more difficult at later scenes. It can be inferred from this finding that the content needs to be clear and easy to understand for children.

The last finding as to the content was about the voices used in the smart toy. In some scenes, there was a time break after narrating the voice. This affected the flow of the play negatively because children had to wait for a while after completing a task. It can be concluded from this finding that time breaks should be small to prevent loss of children's concentration to the play. Additionally, reminding voices should be used in some scenes. For instance, in the kitchen scene, when children put a food card onto the hand, no voice was played until putting all correct cards. This also affected children's concentration negatively. Therefore, reminding voices should be narrated at some points to keep children in the flow of the play.

In summary, children's findings as to the content of the first prototype were listed below:

- Play time of the first prototype decreased with age.
- The youngest group of children struggled with the part aiming at giving cognitive skills.
- Pattern scene, especially, was the hardest and time consuming part of the smart toy for the youngest children.
- Since "getting information about how to play" scene was not ready, children had difficulties in putting object or card onto the reader called as "hand" at the beginning of the play.

- Since there were several plush toys and cards that children had to use to proceed in smart toy play, they had difficulties in deciding the object as a toy or card to put onto the hand.
- All children completed tasks of personal care skills easily. However, children aged 36 to 60 months had several difficulties in the scenes of cognitive skills.
- Different pattern rows such as two objects with same color and different shape, and three objects with different color and same shape were presented in the same scene. This was difficult for children in terms of clarity and comprehensibility.
- Time breaks after narrating the voice affected the flow of the play negatively because children had to wait for a while after completing a task.
- In kitchen scene, when children put a food card onto the hand, no any voice was played until putting all correct cards. Therefore, reminding voices need to be used in some scenes.

4.3.2.2 Visual Design

For the visual design theme, the design of both virtual content and physical toys were considered. The first visual design finding was related with the RFID tags placed into the toys. Since these tags were placed into the plush toys, it was important to correctly put the plush toy onto the reader called as hand. Since there was no any sign on the plush toy, children had difficulties on putting the plush toy onto the hand correctly. When they put in a wrong way, reader could not read the tag and the virtual character of the plush toy was not appeared on the screen. This was an important point because it affected the flow of the toy play negatively. To solve this problem, a sign can be sticked onto the plush toy and children get informed about putting the sign of the toy onto the reader. It can be inferred from this finding that the design of plush toys needs to be clear and affective for children.

The last visual design related finding was about the feature of toys. Plush toys were used in this smart toy and they were usable for children. Based on the observation notes, children could give some damage to plush toys if they did not have plush feature because they dropped the toys several times and grabbed them in a very hard way. Hence, using soft plush toys was an advantage in smart toys because these toys cannot be destroyed easily.

In summary, children’s findings as to the visual design of the first prototype were listed below:

- Since there was no any sign on the plush toy, children had difficulties on putting the toy onto the hand correctly.
- Children could give some damage to plush toys if they did not have plush feature because they dropped the toys several times and grabbed them in a very hard way.

4.3.2.3 Interaction

The first finding related with the interaction theme was about the interaction between the child playing with the toy and the teacher guiding the child in the play. All children participating to smart toy play sessions were guided by their teachers. Hence, teachers helped children when they had difficulties in understanding or following the scenes. It can be inferred from this finding that the guidance of teachers can increase the effectiveness of smart toy play of children at school.

The last finding as to the interaction theme was about the interaction between child and the avatar used in the toy. Avatar was a 5 years old girl character. Therefore, child playing with the smart toy built interaction with that character and did everything what character said. For instance, C5_FE1 answered the narration of the character while putting the desired toy or card onto the hand. It can be concluded from this finding that the character used in the virtual content of the smart toy needs to be designed as similar to a real young child. The character’s appearance and voice should be the same with real life.

In summary, children’s findings as to the interaction of the first prototype were listed below:

- All children participating to smart toy play sessions were guided by their teachers. Hence, teachers helped children when they had difficulties in understanding or following the scenes.
- Child playing with the smart toy built interaction with 5 years old virtual girl character (avatar) and did everything what the character said.

4.3.3 Formative Evaluation of the First Prototype with Early Childhood Teachers

Teachers' feedbacks as to the first prototype were obtained via semi structured interviews. Three early childhood teachers who also participated in the design phase of the study were included in this formative evaluation of the prototype. The findings based on the themes were presented below:

4.3.3.1 Content

Based on the results of interviews, teachers stated that the content and story of the toy were appropriate for children. Additionally, they emphasized that the personal care and cognitive objectives determined in the design phase were conveniently applied in the smart toy. For instance, a teacher stated:

> *Children can gain personal care skills in bathroom and kitchen scenes. Then, cognitive objectives related with colors, location and shapes were given in the room of child. This is very nice toy in terms of presenting the objectives* (ECT1_FE1).
>
> *Çocuklar banyo ve mutfak ekranlarında özbakım becerileini kazanabiliyorlar. Daha sonraki oda ekranında hem renk, hem yer-mekan hem de şekiller gibi bilişsel beceriler veriliyor. Becerileri vermesi açısından çok güzel olmuş* (ECT1_FE1).

Moreover, teachers agreed on the appropriateness of the content for children aged 36 – 72 months. For example, a teacher said:

> *We put this toy to the middle of the classroom. We take children one by one to put red colored toys or blue colored toys. This is a very beautiful toy especially for 3 years old children* (ECT2_FE1).
>
> *Biz bunu oynarken ortaya koyarız. Çocukları tek tek alırız, kırmızı oyuncakları sen, mavi oyuncakları sen koy diye. Özellikle 3 yaş için çok güzel olmuş* (ECT2_FE1).

Another teacher stated:

> *Pattern activity will be effective for children older than 3-4 years old* (ECT1_FE1).
>
> *Örüntü ekranı öellikle daha yüksek yaş grubundaki çocuklar için etkili olacaktır* (ECT1_FE1).

Another finding as to the content was about the navigation. Based on the responses of all teachers, there should be an option for teachers to jump to different scenes, such as bathroom, kitchen, child's room and pattern when desired. It can be reached from this finding that there should also be a nonlinear content in smart toy play. For instance, a teacher explained this as follow:

> *I need to pass to the scene about the concept of colors that I want to study as a teacher. If I want to give pattern to children, I need to jump to the scene of pattern activity directly* (ECT2_FE1).
>
> *Öğretmen olarak ben renklerle çalışmak istiyorum. Direkt ona geçebilmeliyim. O gün sadece örüntü çalışmak istiyorsam, direkt örüntü ekranına gidebilmeliyim* (ECT2_FE1).

According to the teachers, pattern scene including only 3 different patterns in the same screen was not adequate for children. Teachers wanted to see more and varied patterns. It can be inferred from this finding that the content presented in the smart toy needs to be adequate for children. In addition, children should reach different kind of examples in the content of the smart toy. For instance, a teacher expressed:

> *If we give more patterns to children, we can use patterns in different kind and a higher number. For example, we can ask the color of red in the first pattern, the color of yellow in the second pattern and the*

> *color of blue in the last pattern. So, different examples of a specific pattern can be given in that way* (ECT3_FE1).
>
> *Daha fazla örüntü verirsek hem örnekleri çoğaltmış oluruz hem de karışık vermiş oluruz. Örneğin bir önrüntüde önce kırmızıyı, sonra sarıyı, en son da maviyi sorabiliriz. Bu şekilde hepsinin örneği yapılmış olur* (ECT3_FE1).

In summary, early childhood teachers' findings as to the content of the first prototype were listed below:

- The content and story of the toy were appropriate for children.
- Personal care and cognitive objectives determined in the design phase were conveniently applied in the smart toy.
- Teachers agreed on the appropriateness of the content for children aged 36 to 72 months.
- There should be an option for teachers to jump to different scenes, such as bathroom, kitchen, child's room and pattern when desired.
- Pattern scene including only 3 different patterns in the same screen was not adequate for children. Teachers wanted to see more and varied patterns.

4.3.3.2 Visual Design

According to the teachers, the design of plush toys was suitable and usable for children. It can be reached from teachers' feedbacks that plushness can increase the durability of physical toys used in the smart toy. For example, a teacher stated:

> *Plush toys are nice. They are tough and children can not give damage to them easily* (ECT1_FE1).
>
> *Oyuncaklar güzel olmuş. Hem sağlam hem de çocuklar kolay kolay yıpratamazlar* (ECT1_FE1).

Based on the responses of teachers, the character and the voice narrated were not consistent in some scenes. While the voice of a woman was narrating, the character of 5 years old girl was shown on the screen. Hence, the design needs to be consistent and related visuals should be appeared in accordance with the voices used. On the other hand, while there was no voice narrated in the scene, the virtual girl character's mouth was animated. This was not correct in terms of visuality because the animation should be given in accordance with the narrations.

Another finding as to the visual design was about the similarity of smart toy design with computer games. According to one of the teachers, computer game like design in the virtual content of the smart toy was very nice for children. She emphasized that computer game like visual design used in this smart toy attracts attention of children easily.

Another finding related with visual design was about virtual mom and dad characters used in the kitchen scene. According to all teachers, these characters were so static. They stated that these characters should give a small reaction. It can be concluded from this finding that characters used in the virtual content of the smart toy need to be dynamic. For instance, a teacher stated:

> *Mom and dad stay passive. They should show a reaction somehow* (ECT2_FE1).
>
> *Anne, baba çok tepkisiz duruyor. Bunların bir şekilde tepki vermesi lazım* (ECT2_FE1).

Besides, one of the teachers pointed out that the tootbrush animation should be given while the character expressed brushing the teeth. It can be inferred from this finding that the animations should be consistent with the narration or verbal statements.

Another finding was about the design of geometric toys. Although children were expected to find the similar shapes such as circle, square, rectangle and triangle of the objects highlighted in the room of the child character, the geometry of plush toys were in 3-d like triangle prizm and cube. Hence, teachers reached an agreement on drawing the geometric shapes onto the cards and using these cards when highlighted objects appeared on the screen. It can be reached from this feedback of the teachers that visual design of the plush toys or cards should be consistent with the content of the smart toy to prevent misunderstanding of children.

The last finding as to the visual design was about the colors of the objects not emphasized in an activity of the smart toy. One of the teachers pointed out that the colors of the objects which are not emphasized in any activity should be different than the colors of the objects focused in the smart toy. It can be concluded from this statement that the visual design should not confuse children and the objects emphasized in the smart toy should easily be differentiated from other objects placing in the same environment.

In summary, teachers' findings as to the visual design of the first prototype were listed below:

- The design of plush toys was suitable and usable for children.
- The character and the voice narrated were not consistent in some scenes.
- While there was no voice narrated in the scene, the virtual girl character's mouth was animated. This was not correct in terms of visuality because the animation should be given in accordance with the narrations.
- Computer game like design in the virtual content of the smart toy was very nice for children.
- Virtual mom and dad characters shown at the kitchen scene were so static.
- Tootbrush animation should be given while the character expressed brushing the teeth.
- Teachers reached an agreement on drawing the geometric shapes onto the cards to prevent misunderstanding of children and use these cards when highlighted objects appeared on the screen.
- The colors of the objects which are not emphasized in any activity should be different than the colors of the objects focused in the smart toy.

4.3.3.3 Interaction

According to all interviewed teachers, the similarity between plush toys and their virtual images were very high. Hence, this created the interactive smart toy play for children. It can be reached from this statement that the virtual images of the physical toys need to be the same to create effective interactive environment in smart toy play.

In addition, two of the teachers stated that the feedbacks given after putting a wrong toy or card onto the reader was good and important. So, it can be concluded that feedbacks should be given after not only correct move but also wrong move in smart toy play. For instance, a teacher stated:

> *It is important to give feedback when a child puts a wrong food card* (ECT1_FE1).
>
> *Mutfakta yanlış olan besini koyduğunda yanlış olduğunu belirtmek güzel* (ECT1_FE1).

Besides, one of the teachers stated that when children put an object, its virtual image needs to be revealed appearantly. It can be concluded from this statement that a feedback needs to be given when a child puts a toy or card onto the reader. For example, the teacher stated:

> *It is important to show the virtual image of the object put clearly. For example, when a child puts the car, its visual image needs to be shown on the screen appearantly* (ECT3_FE1).
>
> *Oyuncakların her birini koyduğunda onu bir şekilde belli etmek iyi olurdu. Mesela arabayı koyduğunda onu ekranda göstermek güzel olurdu* (ECT3_FE1).

The last finding as to the interaction was about the directions given by the child character in the smart toy. One of the teachers expressed that using child character for giving feedbacks and directions rather than using voice over was good for interaction of the smart toy with the child playing with the toy. It can be concluded that virtual character needs to do narrations mostly rather than a voice over to improve one to one interaction level.

In summary, teachers' findings as to the interaction of the first prototype were listed below:

- The similarity between plush toys and their virtual images were very high.
- The feedbacks given after putting wrong toy or card onto the reader was good and important.
- When children put an object, its virtual image needs to be revealed appearantly.
- Using child character for giving feedbacks and directions rather than using voice over was good for interaction of the smart toy with the child playing with the toy.

4.3.4 Formative Evaluation of the First Prototype with Scholars

Scholars' feedbacks as to the first prototype were obtained via a focus group meeting. 3 scholars participated in this formative evaluation of the prototype. While two of them were from the field of instructional technology, one of them was from the field of early childhood education. The findings based on the themes were presented below:

4.3.4.1 Content

According to the scholars, story and content of the smart toy, in general, were suitable for children. One of the important points that one of the IT scholars mentioned was about the suitability of the content of the scenario with real life. Based on the response of the scholar, the content presented to children needs to be convenient with real life. It can be inferred from this finding that all objects included in the content should be consistent with real life. For instance, she stated:

> *When the child wakes up, the clock shows a specific time. After the child goes to different rooms and come back to her room, the clock needs to show a later time* (IT2_FE1).
>
> *Sabah uyandığında saat kaçsa, çocuk oyuncak içerisinde ilerleyip tekrar odasına geldiğinde saatin ilerlemiş olması gerekir* (IT2_FE1).

Another finding as to the content was about the pattern scene. According to the ECE scholar, the numbers and variety of the patterns were not adequate for children. He stated that since pattern activity includes different variations, some of them can be presented in the smart toy. He also declared that patterns should be presented from simple to complex and different variations should be presented in an order.

Another finding related with the content was about the structure of feedbacks given. The ECE scholar stated that using positive feedbacks rather than negative feedbacks can be more suitable for children. For instance, he expressed:

> *When a toy put, the color of that toy can be narrated. For example, when a child puts a blue colored toy instead of yellow colored toy, "this is a blue colored toy" feedback can be narrated.* (ECE1_FE1).
>
> *Her bir oyuncak konulduğunda, koyulan oyuncağın rengi de söylenebilir. Örneğin sarı yerine mavi oyuncak konulduğunda, "bu, mavi oyuncak" diye bir feedback verilebilir* (ECE1_FE1).

In addition, all of the scholars emphasized that feedbacks should be clear and easy to understand for children. They pointed out that feedback statements should be explanatory for the object or card put onto the reader. For instance, one of the IT scholars stressed:

> *A feedback like "You are perfect, milk is a useful food for my health" should be narrated. That is, when the child puts a food card, the name of that food needs to be said in the feedback given* (IT2_FE1).
>
> *"Harikasın, süt sağlığım için faydalı bir besin" gibi seslendirme verilmeli. Yani, her yiyeceği koyduktan sonra o yiyecekle ilgili geribildirim adı söylenerek verilmeli* (IT2_FE1).

Besides, one of the IT scholars stated that the child character can repeat the narration of instruction/direction in case the child playing with the smart toy misses that instruction. For example, the scholar explained this as follow:

> *The character used in the toy should repeat the narration of instruction when the player does not give any response for a while. If the child wants to listen to the instruction again or he/she misses that instruction, this repated narration can help the child* (IT1_FE1).
>
> *Bir süre yanıt gelmeyince, oyuncaktaki karakterin verdiği yönergeyi tekrar etmesi iyi olur. Çocuk tekrar dinlemek isterse ya da yapması gereken şeyi kaçırırsa bu tekrar yardımcı olabilir* (IT1_FE1).

Besides, all scholars declared that the smart toy should also provide unstructured content for children. Children or teachers using this smart toy should have a chance to go to any scene rather than following the structured content of the smart toy. They also emphasized that the guidance of teacher is important in using nonlinear structure of the smart toy. For example, an IT scholar stated:

> *This is a structured toy. There can also be added non structured part. This can be given to the use of teacher. Children can jump to any scene with the guidance of teacher* (IT1_FE1).
>
> *Belirli bir yapı bu. Bir de belirli olmayan bir yapı sunulabilir. Bu öğretmenin kullanımına verilebilir. Öğretmenin yönlendirmesiyle istenilen ekrana gidilebilir* (IT1_FE1).

In summary, scholars' findings as to the content of the first prototype were listed below:

- Story and content of the smart toy, in general, were suitable for children.
- Content presented to children needs to be convenient with real life.
- The numbers and variety of the patterns were not adequate for children.
- Patterns should be presented from simple to complex and different variations should be presented in an order.
- Using positive feedbacks rather than negative feedbacks can be more suitable for children.

- Feedbacks should be clear and easy to understand for children.
- Feedback statements should be explanatory for the object or card put onto the reader.
- The child character can repeat the narration of instruction/direction in case the child playing with the smart toy misses that instruction.
- Smart toy should also provide unstructured content for children.
- Children or teachers using this toy should have a chance to go to any scene rather than following the structured content of the smart toy.
- The guidance of teacher is important in using nonlinear structure of the smart toy.

4.3.4.2 Visual Design

Based on the responses of all scholars, the design of the plush toys of geometric shapes, such as square, rectangle, circle and triangle was not consistent with the shapes of the objects. Although desired shapes that children were required to put were circle, square, rectangle and triangle, the plush toys were designed as cube, sphere, rectangular prizm and triangular prizm. Scholars mentioned that the differences between real shapes and their virtual images can create a conceptual confusion for children. It can be concluded from this finding that the the plush toys and their visual images need to match entirely.

In addition, one of the IT scholars emphasized that the design of the child character in the smart toy was nice and attractive. He also pointed out that the design was consistent with the needs of young age group children. For example, he stated:

> *The design of the young girl character was nice and attractive and the design looked like the famous characters such as Dora and Pepe* (IT1_FE1).
>
> *Kız karakteri güzel çizilmiş. Dora ve Pepe gibi karakterlere benziyor. Çocukların ilgisini çekebilir* (IT1_FE1).

Moreover, all scholars agreed on the necessity of consistent design among different scenes. For instance, the ECE scholar said:

> *The child character disappears sometimes. When the screen appeared, the child character needs to be on the screen too* (ECE1_FE1).
>
> *Çocuk arada kayboluyor. Ekran geldiğinde çocuğun da ekranda gözükmesi lazım* (ECE1_FE1).

Furthermore, all scholars mentioned that the design of the smart toy should not distract the attention of children. For example, the ECE scholar stressed:

> *In the bathroom scene, tap should be closed when it is not used. Otherwise, it distracts attention very much* (ECE1_FE1).
>
> *Banyo sahnesinde, su kullanılmıyorken kapalı olsun. Aksi takdirde çok fazla dikkati dağıtıyor* (ECE1_FE1).

The last finding as to the visual design was about the consistency of animations or visuals with the content or instructions. All scholars mentioned about the importance of showing animations or visuals in accordance with the narrations. Additionally, they emphasized that animations or visuals should not mix with any other animations or visuals to prevent chaos in the scenes. For example, one of the IT scholars expressed:

> *After toothbrushing animation is finished, Ayse starts to speak. After finishing soaping her hands, she starts to brush her hair. That is, each process should be accomplished before proceeding any other process to prevent chaos* (IT2_FE1).
>
> *Diş fırçalama bittikten sonra Ayşe konuşmaya başlamalı ya da elini sabunlamayı bitirdikten sonra saçını taramaya geçmeli. Yani herbir süreç tamamlanmalı ve karışık olmamalı* (IT2_FE1).

In summary, scholars' findings as to the visual design of the first prototype were listed below:

- The design of the plush toys of geometric shapes, such as square, rectangle, circle and triangle was not consistent with the shapes of the objects.

- Differences between real shapes and their virtual images can create a conceptual confusion for children.
- Design of the child character in the smart toy was nice, attractive and consistent with the needs of young age group children.
- There is a necessity of consistent design among different scenes.
- Design of the smart toy should not distract the attention of children.
- There should be consistency of animations or visuals with the content, instructions and narrations.
- Animations or visuals should not mix with any other animations or visuals to prevent chaos in the scenes.

4.3.4.3 Interaction

According to the ECE scholar, children can feel the help of an adult while playing with the smart toy. It can be concluded that the guidance of teachers can be useful for effective play while playing with the smart toy especially at classroom environment.

In addition, one of the IT scholars stated that the child playing with the smart toy can easily identify himself/herself with the virtual character whose age is close to him/her. For instance, the scholar explained this as follow:

> *The character telling her name and age was nice for children because they can identify themselves with the character* (IT2_FE1).
>
> *Çocuğun adını ve yaşını söylemesi, kendini özdeşleştirmesi açısından güzel olmuş* (IT2_FE1).

Moreover, one of the IT scholars expressed that when the child puts a toy or card onto the reader, the previous voice narrated needs to be stopped and related visual or animation with its narration should be appeared. According to her, this was important for improving the interaction between child and the smart toy because flow of the play lasts continuously.

Furthermore, all scholars agreed that the unstructured play of this toy can enhance the collaborative play especially at classroom environment. According to them, this was important to create interactions, such as child-child and child-teacher.

Finally, the ECE scholar stated that when a child puts a toy or card onto the reader, a sign should be presented on the screen to enhance the interaction of the physical objects with the virtual environment. For example, he stated:

> *While putting toys to the shelves of the cupboard, a sign of a sound can be given to show the toy placed* (ECE1_FE1).
>
> *Oyuncakları rafa dizerken, her bir oyuncak konulduğunda onu işaret edecek bir ses verilebilir* (ECE1_FE1).

In summary, scholars' findings as to the interaction of the first prototype were listed below:

- Children can feel the help of an adult while playing with the smart toy.
- The child playing with the smart toy can easily identify himself/herself with the virtual character whose age is close to him/her.
- When the child puts a toy or card onto the reader, the previous voice narrated needs to be stopped and related visual or animation with its narration should be appeared.
- Unstructured play of the smart toy can enhance the collaborative play especially at classroom environment.
- When a child puts a toy or card onto the reader, a sign should be presented on the screen to enhance the interaction of the physical objects with the virtual environment.

4.3.5 Development of the Second Prototype

Based on the feedbacks of children, teachers and scholars in the formative evaluation of the first prototype, the second prototype was developed. Revisions and integrated features with screenshots were presented below:

- Since the voice of woman was played in this scene, Ayse's mouth was changed from animated to not animated (see Figure 4.9).
- As shown in Figure 4.9, the visual of woman character was added since she was narrating in the introduction scene.

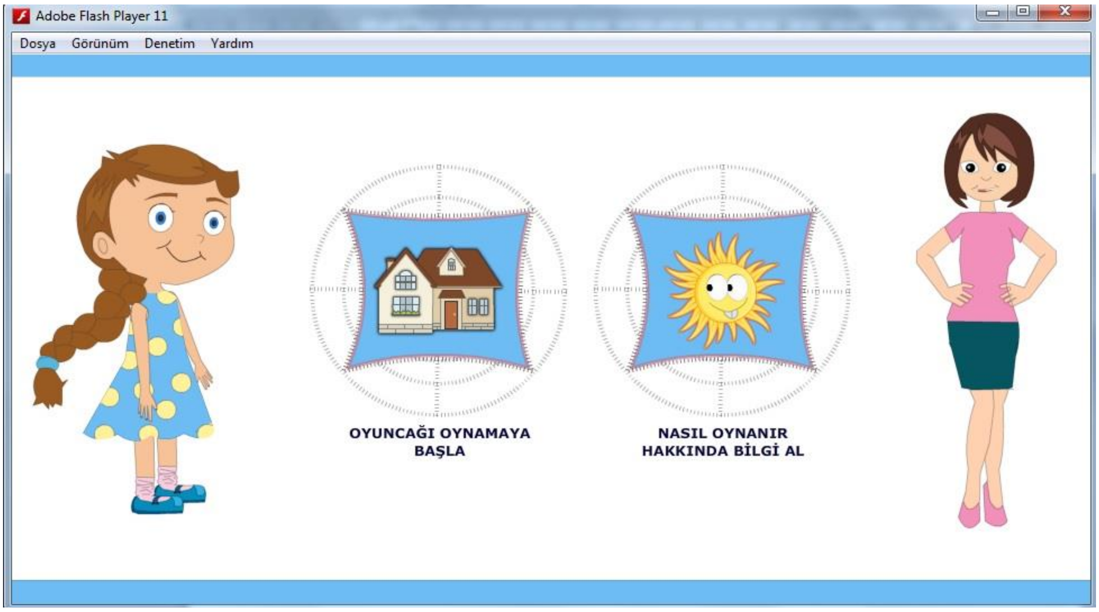


Figure 4.9 Screenshot of introduction scene in the second prototype

- "Get information about how to play" part was developed. A woman character showed how to play with the smart toy. She wanted the player to put the bathroom and kitchen cards to go to the related scenes. Additionally, she wanted the child to put the bear toy onto the reader to show the visual image of the toy (see Figure 4.10).

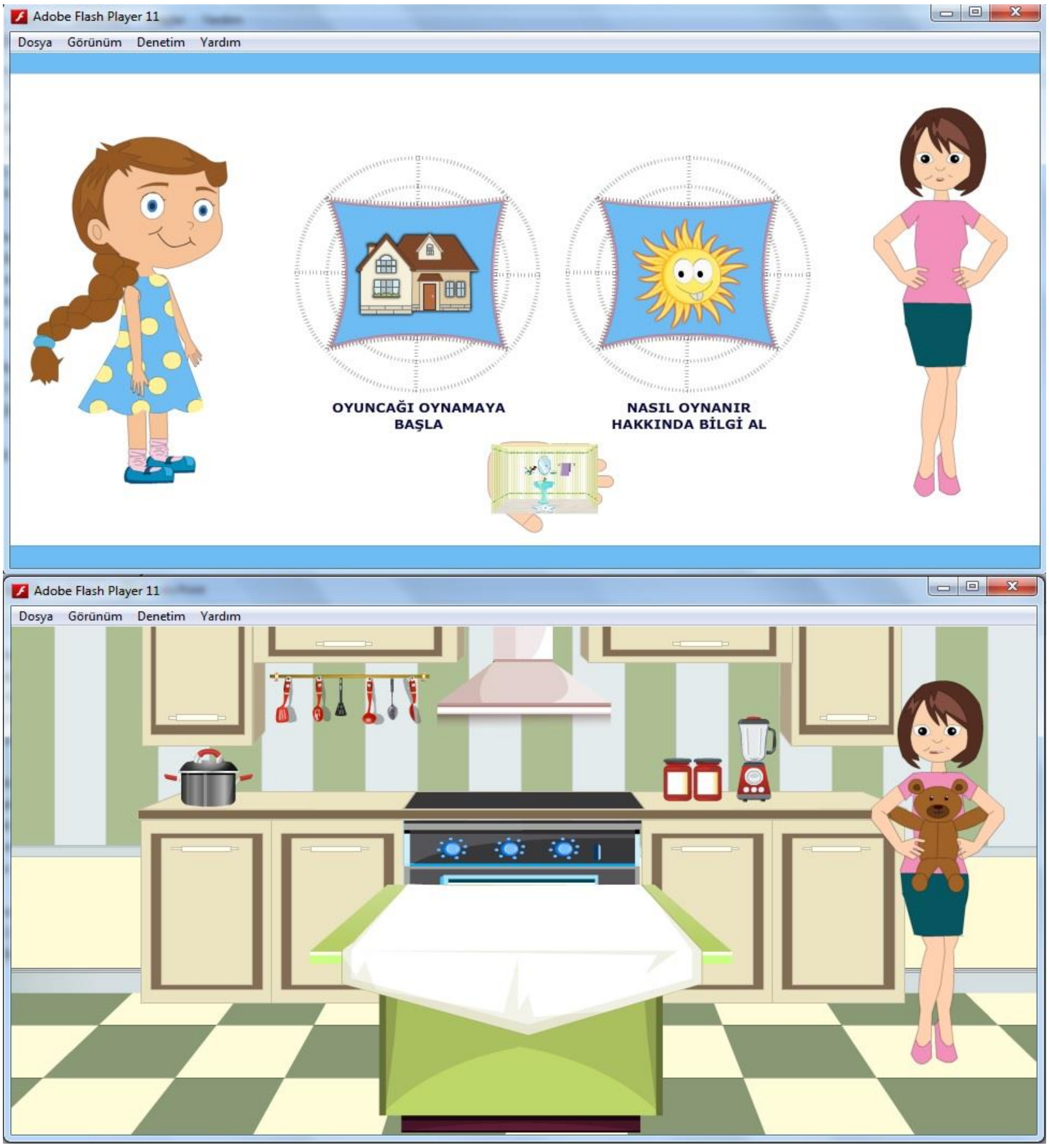


Figure 4.10 Screenshots of “get information about how to play” scene in the second prototype

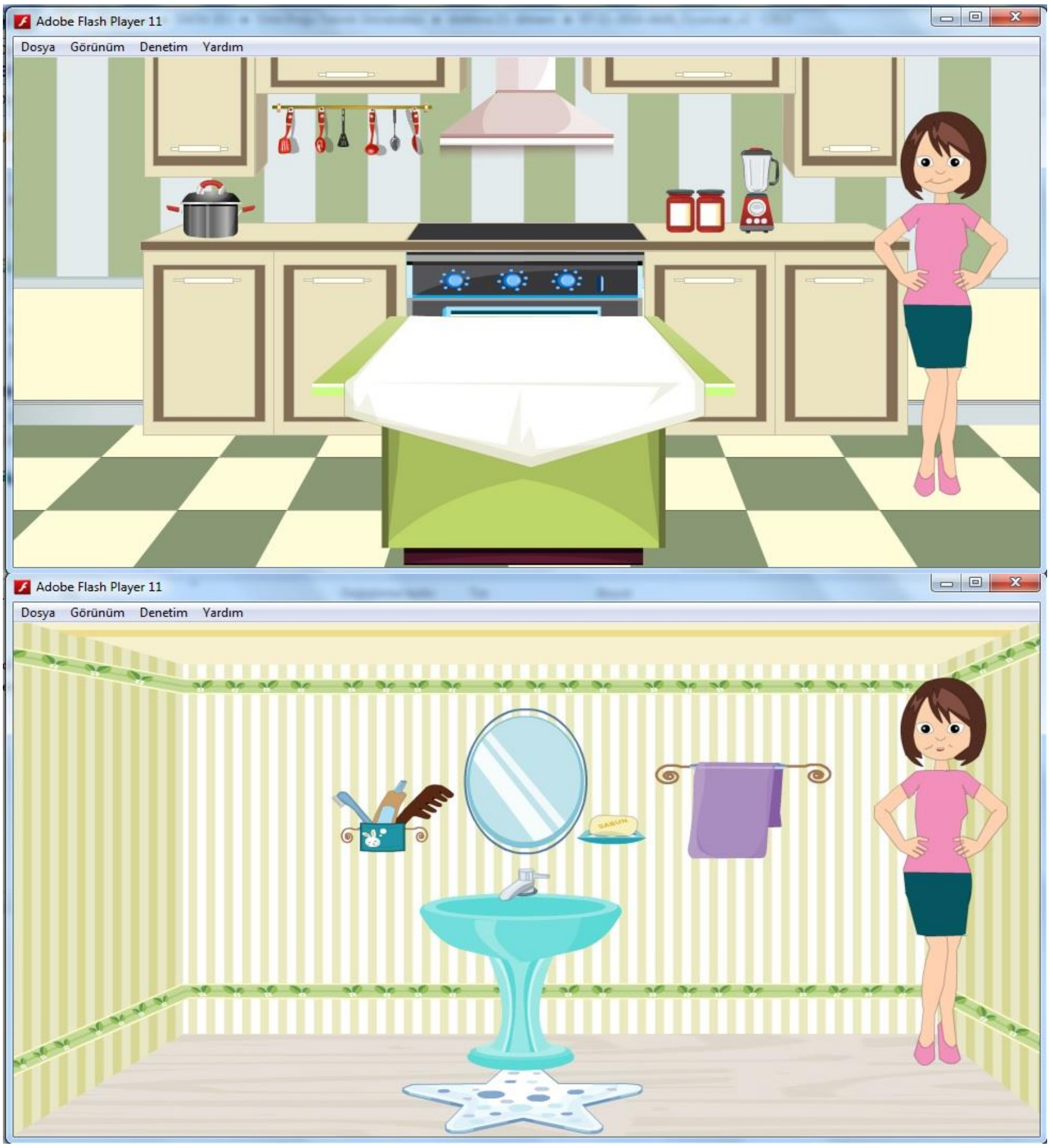


Figure 4.10 (continued)

- Ayse's mouth was synchronized with the narration of Ayse. When Ayse started to speak, her mouth was animated until she stopped speaking (see Figure 4.11).
- Clock hung on the wall showed time 7.30 (see Figure 4.11).

Figure 4.11 Screenshot of child’s room scene in the second prototype

- When bathroom scene appeared, the tap was closed (see Figure 4.12).
- As shown in Figure 4.12, when the bathroom scene appeared, Ayse also appeared in the bathroom.
- Ayse turned the tap on, washed her hands with the soap, turned the tap off and put the soap on the soap dish.
- The tap was closed while Ayse was brushing her hair (see Figure 4.12).
- Soap was on the soap dish while Ayse was brushing her hair (see Figure 4.12).

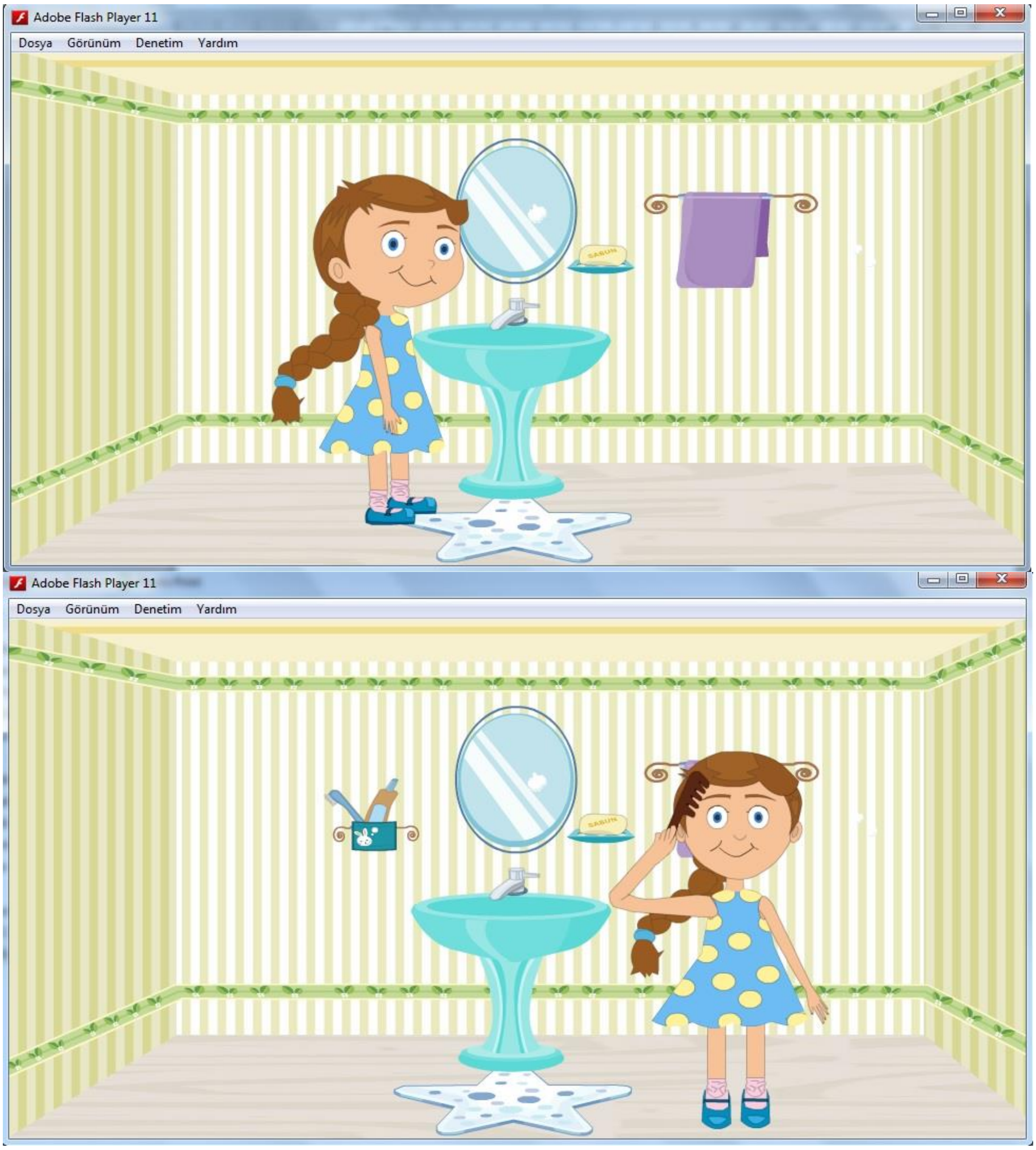


Figure 4.12 Screenshots of bathroom scene in the second prototype

- Mom and dad were very passive on this scene. They winked at least (see Figure 4.13).
- When a food card was put onto the reader, the feedback included the name of the food. For example, when a cheese card was put, the feedback like "You are perfect, cheese is a healty food" was narrated by Ayse.

- Narrations were not mixed with other narrations. When a new card put onto the reader, all other voices were stopped and the related voice of the food card put onto the reader was narrated.

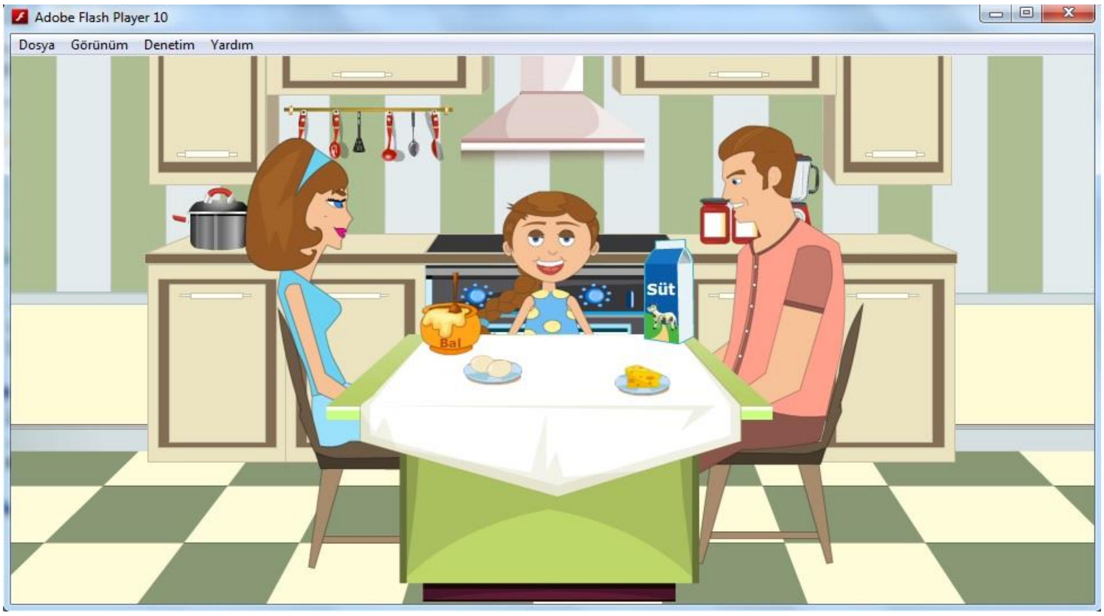


Figure 4.13 Screenshot of kitchen scene in the second prototype

- When bathroom scene appeared, Ayse also appeared in the bathroom (see Figure 4.14).
- As shown in Figure 4.14, the tap was closed.
- Brushing teeth animation was shown when the toothbrush was put onto the reader (see Figure 4.14).
- After finishing the brushing teeth animation, toothbrush was in the case hunged on the wall.

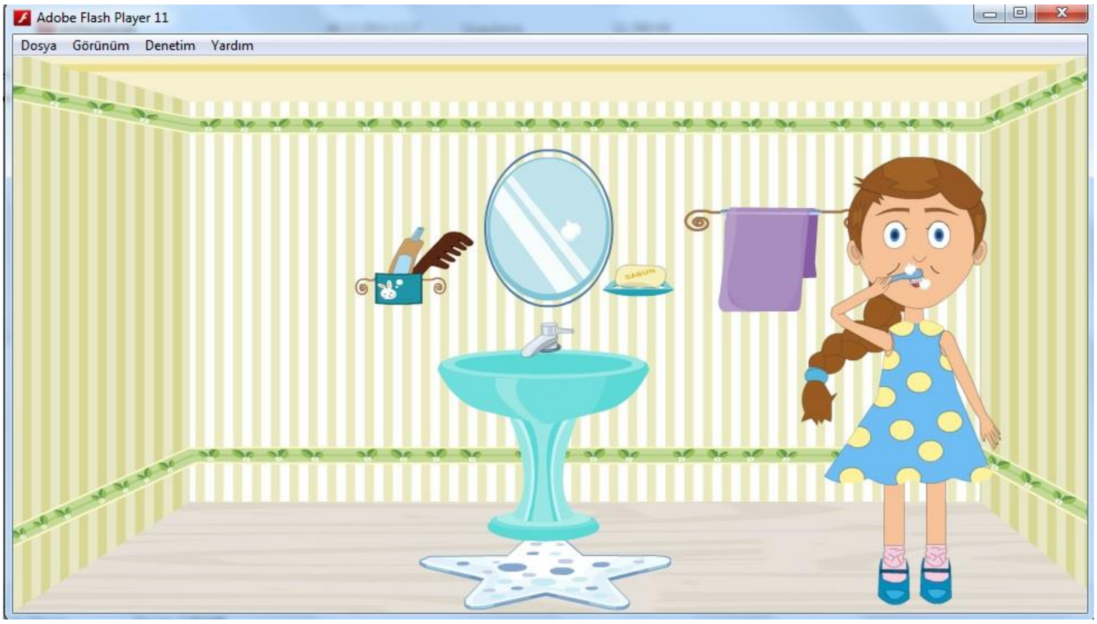


Figure 4.14 Brushing teeth related screenshot of bathroom scene in the second prototype

- Clock hung on the wall showed time 7.30 (see Figure 4.15).
- A feedback like a positive sound was given when each virtual toy was correctly placed on the shelf.
- When a wrong virtual toy placed on the shelf, explanatory feedback like "This is a blue colored toy, you should put the red colored toys firstly" was given.
- Plush toys were not be used for matching objects with similar shapes. The shapes of circle, rectangle, square and triangle were drawn on the cards.

Figure 4.15 Cognitive skills related screenshot of child's room scene in the second prototype

- Each pattern was presented on different screens (see Figure 4.16).
- Patterns on different screens were as follow (see Figure 4.16):
    - Screen 1: red car – red bear – red car - ? (correct answer: red bear)
    - Screen 2: red car – red bear – ? – red bear (correct answer: red car)
    - Screen 3: red ball – yellow ball – red ball - ? (correct answer: yellow ball)
    - Screen 4: ? – yellow ball – blue ball – yellow ball (correct answer: blue ball)
    - Screen 5: toothbrush – comb – ? - comb (correct answer: toothbrush)
    - Screen 6: red car – red bear – red car - ? – red car – red bear (correct answer: red bear)
    - Screen 7: red car – red bear – ? – red bear – red car – red bear (correct answer: red car)
    - Screen 8: red ball – yellow ball – blue ball – red ball - ? – blue ball (correct answer: yellow ball)

- Screen 9: red ball – yellow ball – blue ball – red ball – yellow ball – ? (correct answer: blue ball)
- Screen 10: toothbrush – ? – soap – toothbrush – comb – soap (correct answer: comb)

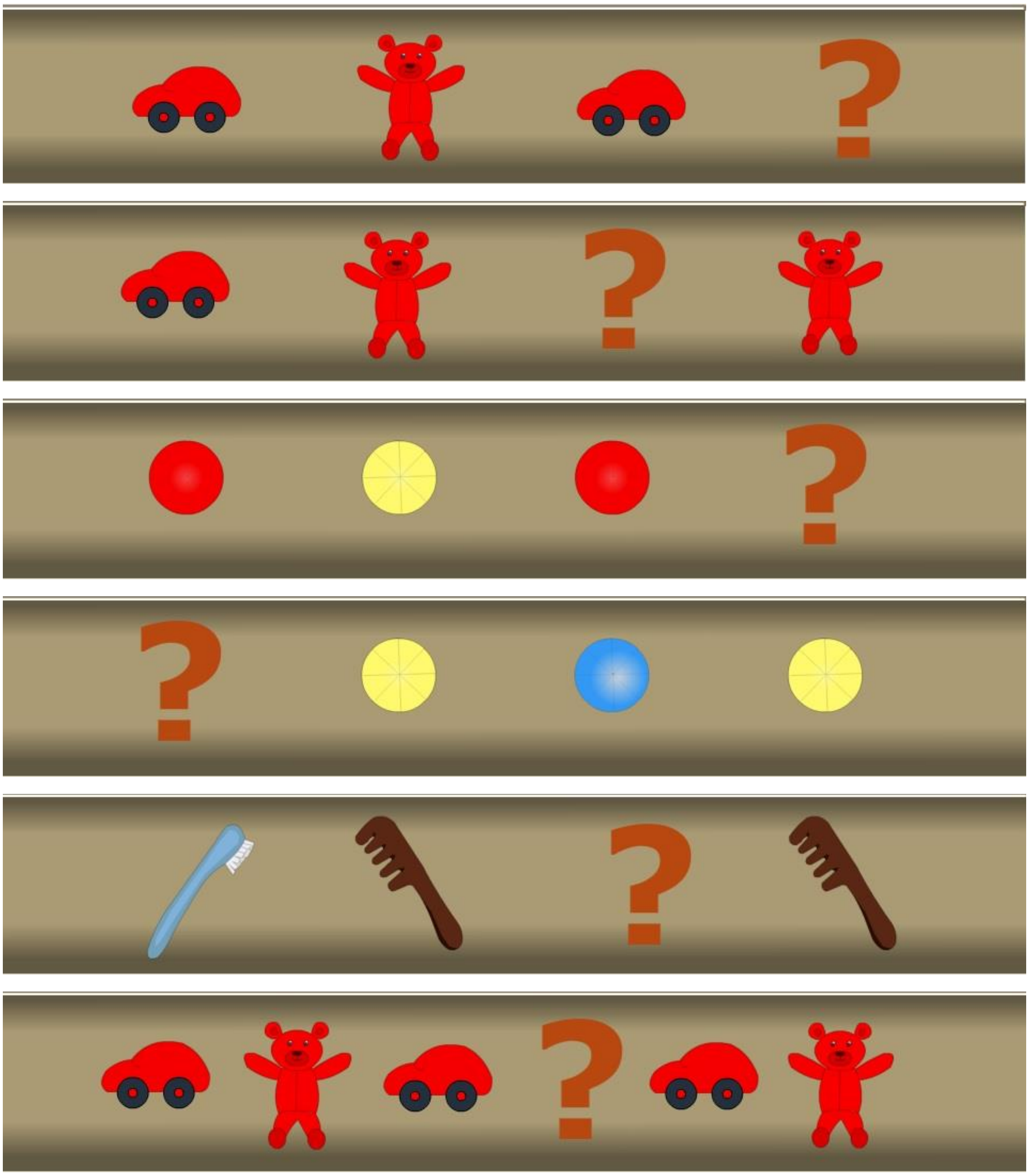


Figure 4.16 Screenshots of pattern scene in the second prototype

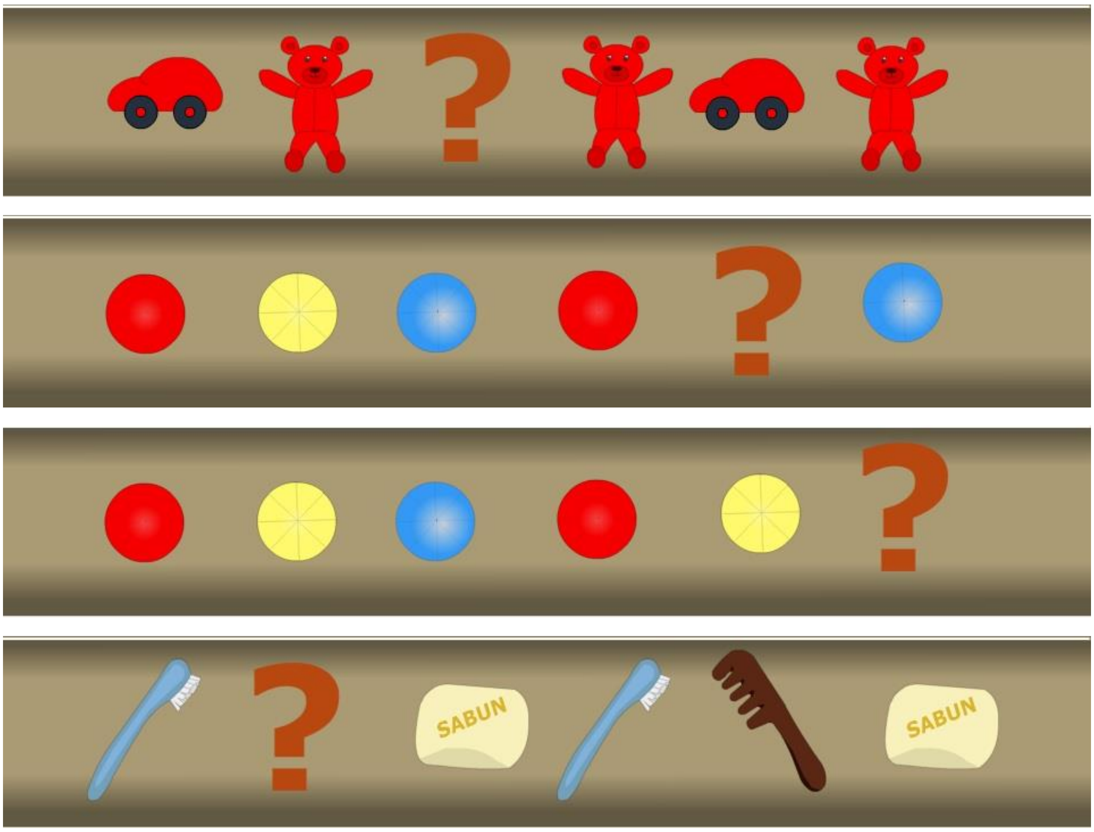


Figure 4.16 (continued)

4.3.6 Formative Evaluation of the Second Prototype with Scholars

Scholars' feedbacks as to the second prototype were obtained via a focus group meeting. The same 3 scholars who also joined the previous focus group meeting participated in this formative evaluation of the second prototype. In addition, a semi structured interview was carried out with an additional ECE scholar in this phase to get more feedbacks. The interview instrument which was used for getting feedbacks of the teachers as to the first prototype was applied. The findings based on the themes were presented below:

4.3.6.1 Content

According to all scholars, it was important to seperate smart toy play to different modules. They emphasized that there should be an option to jump to any scene by putting the related card onto the reader. They also pointed out that teachers or adults can use these cards to change the scene by considering children's needs. For instance, an IT scholar stated:

> *3 different modules, such as patterns, personal care skills and cognitive skills can be presented by using cards. This helps teachers start to play with the smart toy from any scene that they desired* (IT1_FE2).
>
> *Örüntüler, yaşam becerileri ve bilişsel beceriler olmak üzere 3 farklı modül kartlarla verilebilir. Bu şekilde öğretmen istediği bölümden başlayabilir* (IT1_FE2).

Additionally, an ECE scholar stressed that negative feedbacks should not be used mostly. On the contrary, he stated that correct put of the object should be reinforced and explanatory feedbacks narrating the name or shape of the object should be used mostly. For example, he explained this as follow:

> *When child puts the yellow colored car, a feedback like "this is a yellow colored car" should be given instead of a negative feedback* (ECE1_FE2).
>
> *Çocuk yanlış olarak sarı arabayı koyduğunda, "yanlış yaptın" demek yerine, "bu bir sarı araba" gibi açıklayıcı geribildirim vermek daha doğru olur* (ECE1_FE2).

Moreover, two of the scholars attended to the focus group meeting stated that finishing scene of the smart toy should be presented clearly and children should be informed about what they accomplished at the end of the smart toy play. For instance, an IT scholar expressed:

> *After finishing the pattern activity, a new screen showing the woman character and Ayse should be appeared. Ayse should show her happiness since she accomplished all tasks* (IT2_FE2).

> *Örüntü aktivitesi bittikten sonra yeni bir ekran gelmeli. Ekranda oyuncağın en başında yer alan kadın ve Ayşe'nin görüntüleri olmalı. Ayşe oyuncağı oynamayı bitirdiğine dair sevinç hareketi yapmalı* (IT2_FE2).

Furthermore, the interviewed ECE scholar mentioned that background music can be used to attract attention of children. He also stated that background music can be changed by the child playing with the smart toy and different musics can be given in different scenes.

Finally, the interviewed ECE scholar emphasized that explicit instructions need to be used in the smart toy. He explained this as follow:

> *In the pattern screen, a child can not know which toy should be put. Hence, an explicit instruction like "you can put the correct toy on the missing place by choosing from the box" should be given* (ECE2_FE2).
>
> *Örüntü ekranında, çocuk hangi oyuncağı koyacağını tam olarak bilmeyebilir. Burada "boş olan yere doğru oyuncağı yandaki sepetten seçerek koyabilirsin" gibi açıklayıcı bir yönerge verilebilir* (ECE2_FE2).

In summary, scholars' findings as to the content of the second prototype were listed below:

- It was important to seperate smart toy play to different modules.
- There should be an option to jump to any scene by putting the related card onto the reader. Teachers or adults can use these cards to change the scene by considering children's needs.
- Negative feedbacks should not be used mostly.
- Correct put of the object should be reinforced and explanatory feedbacks narrating the name or shape of the object should be used mostly.
- Finishing scene of the smart toy should be presented clearly and children should be informed about what they accomplished at the end of the smart toy play.
- Background music can be used to attract attention of children.

- Background music can be changed by the child playing with the smart toy and different musics can be given in different scenes.
- Explicit instructions need to be used in the smart toy.

4.3.6.2 Visual Design

According to almost all scholars, correct or positive visuals or animations should be shown at the middle of the screen since the focus is mostly on the middle of the screen. For example, an ECE scholar stated:

> *In the kitchen scene, healty foods should be put forward and presented at the middle of the screen* (ECE2_FE2).
>
> *Mutfak sahnesinde, faydalı olan besinler ekranın daha ortasında ve göz önünde olmalıdır* (ECE2_FE2).

In addition, an ECE scholar emphasized that more animations should be used when a child puts the correct toy or card. It can be inferred from this statement that animations can be used as positive feedbacks in smart toy play.

Moreover, all scholars liked the coherence of animations with the instuctions and content. They declared that the objective related animations should be presented on time when a child puts related toy or card.

Furthermore, an ECE scholar pointed out that game like visual design should be presented in the virtual content. For instance, the scholar's view for this explanation was as follow:

> *There should be a game like visual design in smart toy. For example, when a child solved each pattern, a bar loading slowly can be shown at the right corner of the screen. This helps children feel themselves in a game environment* (ECE2_FE2).
>
> *Oyun benzeri bir tasarım olmalıdır. Örneğin örüntü oyununda, her bir örüntü çözüldükçe ekranın sağ altında dolan bir bar gösterilebilir ve çocuk kendini oyun içinde hissedebilir* (ECE2_FE2).

In summary, scholars' findings as to the visual design of the second prototype were listed below:

- Correct or positive visuals or animations should be shown at the middle of the screen since the focus is mostly on the middle of the screen.
- More animations should be used when a child puts the correct toy or card.
- Objective related animations should be presented on time when a child puts related toy or card.
- Game like visual design should be presented in the virtual content.

4.3.6.3 Interaction

Based on the responses of almost all scholars, back and forward options need to be added to the smart toy to improve the interaction between the player and the smart toy. For example, an IT scholar stated:

> *Forward and back transitions can be provided among screens by placing forward and back arrows onto the cards* (IT2_FE2).
>
> *İleri ve geri oklar kartların üzerine yerleştirilebilir. Bu sayede ekranlar arasında ileri ve geri geçişler de yapılabilir* (IT2_FE2).

Additionally, almost all scholars stressed that the guidance of an adult can be helpful for children in an interactive play of smart toy with other children.

In summary, scholars' findings as to the interaction of the second prototype were listed below:

- Back and forward options need to be added to the smart toy to improve the interaction between the player and the smart toy.

- The guidance of an adult can be helpful for children in an interactive play of smart toy with other children.

4.3.7 Development of the Final Version of the Smart Toy

Based on the feedbacks of the scholars in the formative evaluation of the second prototype, the final version of the smart toy was developed. Revisions and integrated features were presented below:

- Forward, back, personal care skills, patterns and Ayse’s room cards were prepared especially for teachers to navigate among screens easily and quickly (see Figure 4.17).

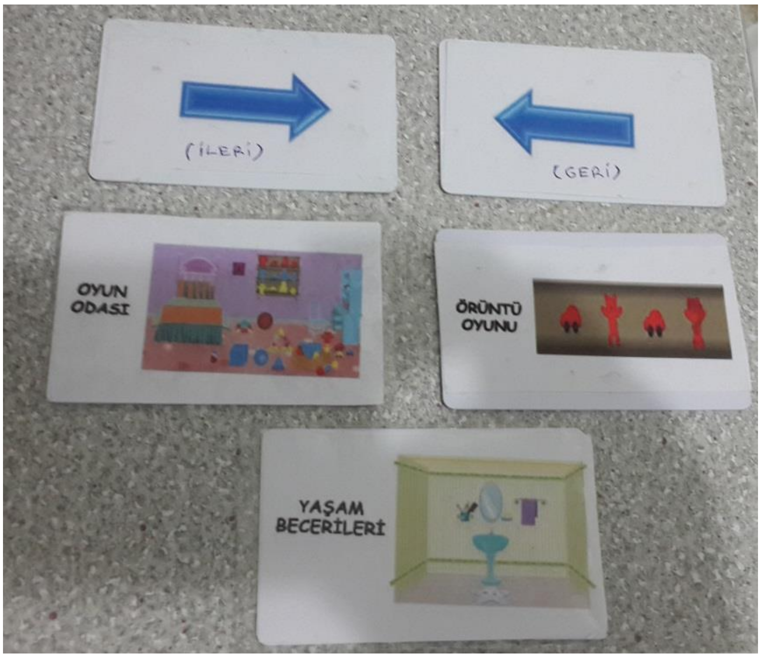


Figure 4.17 Cards prepared for the final version of the smart toy

- Ending scene including the visual of woman character narrating and Ayse was developed (see figure 4.18). The aim of this scene was to explain that the smart toy play was accomplished. Ayse was happy since she finished all tasks in the smart toy.

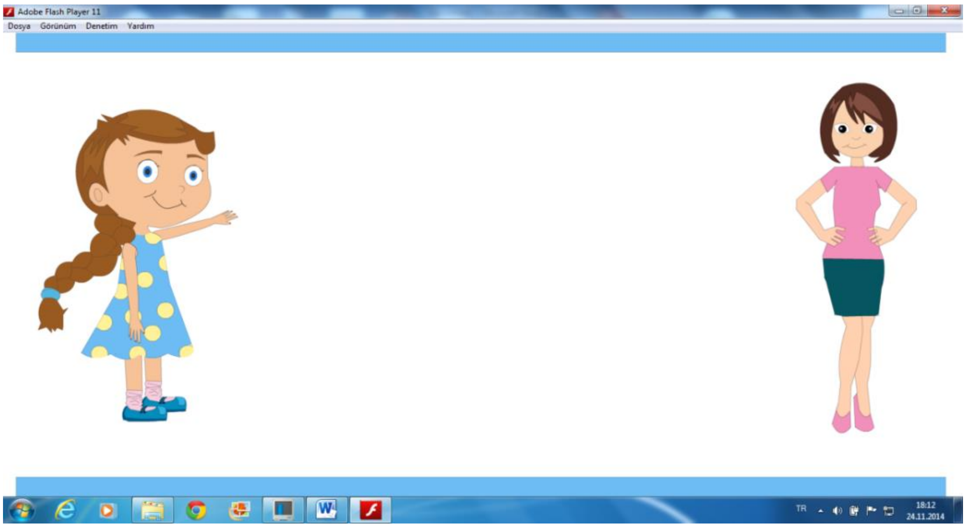


Figure 4.18 Final scene of the smart toy

- Narrations which were not interrupted when a new object put were revised and all small deficiencies affecting the flow of the play negatively were corrected.

4.3.8 Design Principles

4.3.8.1 Research Question 3

What are the design principles when designing a smart toy to support curriculum related objectives?

To answer the third research question, the findings of the design and development phases were mainly considered. At the end of the development phase, design principles emerged. Although the design and development phases of the study caused the design principles of smart toys, the finalized and refined principles were presented at the end of the evaluation phase. That is, the finalized principles including the findings of all phases emerged after finishing all phases.

The design principles appearing at the end of design and development phases were shown below in accordance with related themes.

4.3.8.1.1 Content

- Smart toys supporting specific goals and objectives should be used in preschool education.
- Smart toys should be designed for giving multiple tasks rather than providing a single and simple task.
- Content of the smart toy should be suitable for children with 36 months old – 72 months old.
- Story of the toy should be realistic and consistent with real life.
- Sounds or narrations should be warm and familiar for children. If an adult voice is used, a woman narrator should be preferred generally.
- Instructions, directions, or narrations should mostly be performed by a virtual young child character to improve identification of child (player) with the character in the smart toy.
- "Help" screen should be presented detailed before starting to play the actual content of the smart toy.
- High numbers of plush toys or cards should not be included in the smart toy to prevent loss of focus and concentration of children.
- Each screen of the virtual content of the smart toy should be designed as clear and easily understandable by children.
- Time intervals among narrations should be small to prevent loss of children's concentration to the play.
- Reminders should be used at some points of the virtual content of smart toy to keep children in the flow of the play.
- Content should be presented in a nonlinear and flexible way.
- Rich and varied content should be presented in smart toy.
- Content and scenario of smart toy should be consistent with real life.
- Positive feedbacks should be used more than giving negative feedbacks.
- Feedbacks should be clear, explanatory and easy to understand for children.

- Instructions or directions used in the virtual content of smart toy should lead children to focus on the play and prevent loss of children's concentration.
- Unstructured content should be provided to children as an alternative option.
- The final scene of smart toy should be presented clearly and children should be informed about what they accomplished at the end of smart toy play.
- Background music should be used as optional to attract attention of children.
- Instructions or directions should be explicit and easily understandable.

4.3.8.1.2 Visual Design

- Smart toys should be designed in accordance with the needs of 36 – 72 months old children.
- The main characters or avatars that are at the close age with young children should be used.
- Design and use of plush toys should be clear and affective for children.
- Soft plush toys should be used because these toys cannot be destroyed easily.
- Design should be consistent and related visuals should be appeared in accordance with the voices used.
- The virtual part of smart toy should be designed in a similar way to computer games for young children. That is, computer game like design should be taken into account.
- Characters used in the virtual content of the smart toy should be dynamic.
- Animations should be consistent with narrations or verbal statements.
- Visual design of plush toys should be consistent with content, goal and objectives.
- Visual design should not confuse children and the virtual objects focused in the smart toy should easily be differentiated from other objects.
- Design of characters or objects should be nice and attractive for children.
- There should be a consistency in the design among different scenes.

- Correct / positive / desired visuals or animations should be shown at the middle of the screen since the focus is mostly on there.
- Animastions should be preferred as positive feedbacks in smart toy play.
- Objective related animations should be presented on time when a child puts related toy or card.

4.3.8.1.3 Interaction

- Guidance of teachers should be given to increase the effectiveness of smart toy play of children at school.
- Character used in the virtual content of the toy should be designed as similar to a real young child's appearance and voice.
- Virtual images of plush toys should match entirely to create effective interactive environment in smart toy play.
- Feedbacks should be given after not only correct move but also wrong move in smart toy play.
- A feedback should be given immediately when a child puts a toy or card onto the reader.
- Virtual character or avatar should do narrations mostly rather than a voice over to improve one to one interaction level.
- Smart toy should enable children to play collaboratively.
- Smart toy should be easily controllable to improve the interaction between player and smart toy.

4.4 Phase 4 (Evaluation Phase)

4.4.1 Summative Evaluation of the Smart Toy with Children

4.4.1.1 Research Question 4

What are the usability issues of smart toys?

To answer the fourth research question, a usability test of the smart toy was carried out with 10 children. Observation method was used to get data from the children playing with the smart toy. An observation sheet including several smart toy based tasks was created (see Appendix G). Tasks were separated into mainly four scenes: Introduction, Personal care skills, Cognitive skills in Ayse's room and Pattern skills. Although pattern activity was included in the cognitive skills part, it was decided to put pattern scene as a different part because of its wide content.

In introduction scene, there were 2 tasks, such as putting the sun card to go to "get information about the smart toy" scene and putting the house card to go to Ayse's room. In addition, in the scene of personal care skills, there were 10 tasks, such as putting the bathroom card to go to the bathroom scene, putting the soap toy, putting the comb toy, putting the kitchen card to go to the kitchen scene, putting the cheese card, putting the honey card, putting the milk card, putting the eggs card, putting the bathroom card to go to the bathroom scene and putting the toothbrush toy. On the other hand, in the scene of cognitive skills in Ayse's room, there were 17 tasks, such as putting Ayse's room card to go to the room scene, putting the red bear toy, putting the red baby toy, putting the red car toy, putting the red ball toy, putting the blue bear toy, putting the blue baby toy, putting the blue car toy, putting the blue ball toy, putting the yellow bear toy, putting the yellow baby toy, putting the yellow car toy, putting the yellow ball toy, putting the circle card, putting the square card, putting the rectangle card and putting the triangle card. Finally, in the pattern scene, there were 11 tasks, such as putting the pattern card, putting the red bear toy, putting the red car toy, putting the yellow ball, putting the blue ball, putting the toothbrush, putting the red bear toy, putting the red car toy, putting the yellow ball toy, putting the blue ball toy and putting the comb toy. Based on these tasks related with different scenes, children were observed if they did the tasks or not. Detailed comments were also noted. Observation sheet also included the duration of play in terms of different scenes.

Usability testing was applied individually and each child was accompanied by his/her teacher during the smart toy play. The researcher gave information about how to play with the toy to the teachers before the sessions. Teachers also introduced the smart toy to each child before starting of each play session. Detailed results of the usability testing were presented below:

4.4.1.1.1 Children Behaviors

In Table 4.3 below, the findings of usability testing in terms of duration of different scenes were shown. The tests lasted approximately 154.40 min. (mean 15.44 min.). The maximum value of total play time was 27.50 min. for C1_SE, while the minimum value was 10.25 min. for C5_SE. Based on the findings, since 4 of 10 children did not prefer to go to “get information about how to play with the smart toy”, durations of introduction scene for C1_SE, C5_SE, C9_SE, C10_SE were 1, 0.15, 0.30 and 0.30 minutes. Findings also showed that duration for the scene of personal care skills was similar for nearly all children except C1_SE. It can be inferred from this finding that almost all children were successful at completing the part of pesonal care skills and they showed a close performance in finishing the part of personal care skills in similar time periods. On the other hand, based on the findings, children showed a negative performance in finishing the scene of cognitive skills in Ayse’s room in terms of their ages. Older ages completed the scene of cognitive skills in Ayse’s room shorter time than younger ages. For example, the average duration of 3 years old children (children whose age are between 36 – 48 months) was approximately 7 minutes, while the average duration of 5 years old children (children whose age are between 60 – 72 months) was approximately 4.1 minutes. The same situation was also valid for the pattern scene. As seen from Table 4.3, older ages finished the pattern activity shorter time than younger ages. It can be concluded from these findings that young age group of children, especially 3 years old children, spent higher effort than older age group of children to do cognitive related tasks.

Table 4.3 Quantitative findings as to the usability of the smart toy

Child	**Gender**	**Age**	**Duration for Introduction Scene (minutes)**	**Duration for the Scene of Personal Care Skills (minutes)**	**Duration for the Scene of Cognitive skills in Ayse's room (minutes)**	**Duration for Pattern Scene (minutes)**
C1_SE	Male	38 months old	1	9.50	9.10	7.50
C2_SE	Female	41 months old	3.40	3.30	6.50	8
C3_SE	Female	47 months old	2	4.30	5.35	5.25
C4_SE	Female	50 months old	2.05	4	4.40	4
C5_SE	Male	54 months old	0.15	3.05	3.20	3.45
C6_SE	Female	61 months old	2	2.55	4.30	3.10
C7_SE	Male	69 months old	2	4.30	5.50	4.30
C8_SE	Female	69 months old	2.10	2.50	3.30	3
C9_SE	Male	69 months old	0.30	4.40	4	2.20
C10_SE	Female	69 months old	0.30	4.15	3.40	3.20

In Table 4.4 below, children's reactions as to the simple questions such as, "Did you like the toy?" and "Would you like to play with the toy again?" were presented. All children liked the smart toy. On the other hand, 4 of 10 children didn't want to play with the smart toy again. This was probably because they didn't want to play with the toy second time immediately after playing with it.

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

Child	Gender	Age	Did you Like the toy?	Would you like to play with the toy again?
C1_SE	Male	38 months old	Yes	No
C2_SE	Female	41 months old	Yes	No
C3_SE	Female	47 months old	Yes	Yes
C4_SE	Female	50 months old	Yes	Yes
C5_SE	Male	54 months old	Yes	Yes
C6_SE	Female	61 months old	Yes	Yes
C7_SE	Male	69 months old	Yes	No
C8_SE	Female	69 months old	Yes	Yes
C9_SE	Male	69 months old	Yes	No
C10_SE	Female	69 months old	Yes	Yes

4.4.1.1.2 Problems of Children Playing with the Smart Toy

Based on the observation notes, almost all children had difficulties in deciding to put toy or card onto the reader. For example, since children put only cards until the task of putting soap toy in the scene of personal care skills, they tried to find the soap card firstly and then put the soap toy onto the reader with the guidance of teacher accompanying. It can be inferred from this finding that the instructions need to be very clear and lead children to put the correct item onto the reader. In addition, the findings revealed that children aged 36 – 48 months got help from the teachers for almost all tasks. Their concentration was relatively low than older age children and teachers accompanying provided guidance during the smart toy play. On the other hand, children aged 48 – 72 months completed several tasks without the help of their teachers. Another problem was about the pattern scene. Since young age group of children, especially 3 years old children, had not familiar with the concept of pattern, they couldn’t solve the patterns without a help from the teachers. On the other hand, almost all 5 years old children were successful at solving the patterns without getting any help. However, 4 children in 50, 54, 61 and 69 months needed a help especially in the patterns with 3 different colors and same shapes. The last problem was about the pattern card. Almost all children had difficulties in finding the pattern card narrated by Ayse. It can be inferred from this finding that the visuals in cards need to be explicit for children and simple and clear visuals need to be used on the cards.

4.4.1.1.3 Positive Activities of Children Playing with the Smart Toy

Based on the observation notes, the majority of children played with the smart toy enthusiastically. Plush toys were attractive for all children. Additionally, all children played with the smart toy without interrupting the play. Narrations were understood by children easily and they did all tasks in different scenes. 5 years old children, in general, finished all tasks in the smart toy in a short time. Interaction of children with the smart toy was also successful. For example, some children spoke to the girl character, Ayse, while listening to her and putting the related toy or card onto the reader.

As a result of this section including the findings of research question 4, children enjoyed playing with the smart toy. In addition, most of them wanted to play with the toy again. Moreover, plush toys were attractive for all children. Furthermore, narrations were understood by children easily and they did all tasks in different scenes. On the other hand, having difficulties in deciding to put toy or card onto the reader, slower performance of 36 – 48 months old children in completing the cognitive tasks than the older age group of children and having difficulties in finding the pattern card were the problems that children encountered during the smart toy play.

4.4.2 Summative Evaluation of the Smart Toy with Early Childhood Teachers

4.4.2.1 Research Question 5

What are early childhood teachers' opinions about the design and use of smart toy?

To answer the fifth research question, semi-structured interviews were carried out with 6 early childhood teachers. Seven main themes emerged to understand early childhood teachers' opinions toward the design and use of smart toy. These themes were:

- Content
- Visual Design
- Interaction
- Teachers' Strategies as to Smart Toy Play
- Educational Use of Smart Toy
- Advantages of Smart Toy Play
- Problems of Smart Toy Play

These themes were explained in detailed in the following section.

4.4.2.1.1 Content

According to all teachers, there was a need for advanced levels of the content. For instance, a teacher stated:

> *Toy was good for 4 years old children but the pattern part can be made complicated or summation and subtraction parts can be added* (ECT3_SE).
>
> *4 yaşa göre iyiydi ama büyük yaşa göre belki örüntü biraz zorlaştırılabilir veya toplama, çıkarma eklenebilir* (ECT3_SE).

Another teacher said:

3 years old children play with the toy by thinking and learning but it does not take attention of older children after second play. Toy must become more complex. For example, you can offer different levels going from simple to hard in content of the toy (ECT1_SE).

Aynı şey üzerinden daha karmaşık hale getirilebilir yani. 3 yaş düşünerek, öğrenerek yapar ama dediğim gibi benimkilerin 2. den sonra daha ilgisini çekmez bunlar, biraz daha hani karışık olması lazım. Ya da mesela ilk başlangıç seviyesi. Hani oyunlarda atlıyorsun yani, atlata atlata götürebilirsin. Basitten zora doğru gidebilir (ECT1_SE).

On the other hand, 5 of 6 teachers stressed that the content was appropriate for preschool education. For instance, a teacher explained this as follow:

The content was good because it was suitable for the age group characteristics of children. It was also appropriate for preschool education (ECT3_SE).

O da gayet iyiydi. Yaş özelliklerine hitap etti, gayet iyiydi. Okul öncesine uygundu (ECT3_SE).

In addition, 4 of 6 teachers mentioned the suitability of voices and narrations for children. For instance, a teacher's view for this finding was as follow:

Children listen to the sounds attentively. Since sounds were also clear and easily understandable, children liked sounds and narrations (ECT4_SE).

Çocuklar çok severek dinledi. Ses de netti, gayet anlaşılırdı. Çocukların hoşuna gitti zaten (ECT4_SE).

Besides, 2 of 6 teachers agreed on the appropriate use of right and wrong feedbacks. For example, a teacher stated:

I really liked the use of not only right feedbacks but also wrong feedbacks. For example, the feedback like; "coke is not an healthy drink at breakfast" was very good (ECT2_SE).

Doğru bildirimler zaten iyi olur da, yanlış bildirimleri de ben çok beğendim. Mesela kahvaltıda kola sağlıklı bir yiyecek değildir diyor. Bu çok iyiydi (ECT2_SE).

Lastly, appropriateness of the story with real life was the other finding as to the content of the smart toy and stated by only 2 teachers as well.

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

- There was a need for advanced levels of the content.
- The content was appropriate for preschool education.
- Voices and narrations were suitable for children.
- Right and wrong feedbacks were appropriately used.
- The story was appropriate to real life.

In conclusion, it can be inferred that teachers found the content of the smart toy useful for children. They also indicated that enhancement was still needed for the content.

4.4.2.1.2 Visual Design

Based on the responses of all teachers, colors of plush toys and virtual objects were suitable for children. For instance, a teacher stated:

> *Colors are nice and suitable for children because they are not complicated, very bright and soft* (ECT1_SE).
>
> *Renkler güzel yani. Çok karmaşık değil, çok parlak değil, çok yumuşak değil. Uygun yani bence renkleri* (ECT1_SE).

Additionally, all of the teachers pointed out that drawings of virtual characters and objects were suitable for children. For instance, a teacher stressed:

> *Drawings took attention of children. They also liked the characters and wanted to play with the toy again* (ECT3_SE).
>
> *Çizimler de çocukların dikkatini çekti. Hatta karakterleri sevdiler, tekrar oynamak istediler* (ECT3_SE).

Moreover, 2 of 6 teachers agreed on the advantage of using soft, tangible and attractive plush toys. For example, a teacher expressed:

> *Plush toys are so nice because they are soft rather than being fathery. Tangible, soft and colored features of plush toys took attention of children* (ECT1_SE).
>
> *Peluş oyuncaklar gayet iyi. Peluş olması bence daha iyi. Yumuşak olması, şu kumaş iyi bence, tüylüdense. Çocukların tutabileceği boyutta, yumuşak, dikkatlerini çekecek renkte. Bence iyi. Renk ayırımı da güzel* (ECT1_SE).

Furthermore, 2 of 6 teachers emphasized that there is a need for using bigger cards. For example, a teacher explained this as follow:

> *Cards can be bigger because some children had difficulties in finding the right card* (ECT3_SE).
>
> *Kartlar biraz daha büyük olabilir diye düşünüyorum çünkü bulmakta biraz zorlandılar* (ECT3_SE).

Lastly, need for suitable contrast between foreground and background was the other finding as to the visual design of the toy and stated by only one teacher. She explained this as follow:

> *I think that wallpaper should not be that complex. Kitchen seems a bit messy because of the complex background. It would be nice if the background is pure and simple to clearly focus on the kitchen* (ECT1_SE).
>
> *Duvar kağıdı bu kadar karışık olmayabilir bence. Mutfak biraz karışık, hani arkaplanın daha düz olması açısından. Düz olursa daha iyi olur. Arka da göze çarpıyor ön de göze çarpıyor bence. Mutfak seçme açısından biraz daha karışık* duruyor (ECT1_SE).

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

- Colors of plush toys and virtual objects were suitable for children.
- Drawings of virtual characters and objects were suitable for children.
- Using soft, tangible and attractive plush toys was useful for children.
- There is a need for using bigger cards.
- There is a need for suitable contrast between foreground and background of the virtual interface.

In conclusion, it can be inferred that visual design of the smart toy was attractive for children. However, some improvements can still be considered for the design in terms of virtual and physical objects.

4.4.2.1.3 Interaction

2 of 6 teachers mentioned about the appropriate interaction between toys and their virtual images. For instance, a teacher stated:

> *Since plush toys and their virtual images were so compatible, children did not have any difficulty about that* (ECT5_SE).
>
> *Tasarlanan oyuncaklarla bilgisayarın ekranında görünen oyuncaklar çok uyumluydu, o konuda hiç sıkıntı yaşanmadı* (ECT5_SE).

Additionally, a teacher declared that there was a problem of choosing toy or card to put at the beginning of the play. She explained this as follow:

> *I guided children who could not know to choose toy or card to put at the beginnig of the play* (ECT1_SE).
>
> *İlk etapta bazı çocuklar için kartta mı oyuncakta mı olduğunu ben yönlendirdim çünkü hemen bulamadılar* (ECT1_SE).

Lastly, a teacher pointed out that younger children focused on putting toys or cards to hear the sound. She explained this as follow:

> *The most important thing for children is to put the plush toy or background card onto the machine and hear "diit" sound* (ECT1_SE).
>
> *Çocuklarda en önemli olan şey bunu alayım, makinenin üstüne tutayım, "dııt" etsin* (ECT1_SE).

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

- There was an appropriate interaction between toys and their virtual images.
- There was a problem of choosing toy or card to put at the beginning of the play.
- Younger children focused on putting toys or cards to hear the sound.

In conclusion, interaction between the smart toy and children was effective. However, there were also some problems, such as understanding the smart toy system easily at the beginning of smart toy play and including younger children to complete smart toy based activities rather than interacting only with multimedia components.

4.4.2.1.4 Teachers' Strategies as to Smart Toy Play

Based on the responses of all teachers, each child put one toy or card in collaborative smart toy play. For instance, a teacher stated:

> *Each child did an activity while playing with the smart toy. For example, a child put the right toy in the pattern activity. They can play collaboratively. One child did the tasks in kitchen part and another child did the tasks in bathroom part. There was no problem related with playing collaboratively* (ECT6_SE).
>
> *Herkes bir tane etkinliği yaptı. Örüntünün birini geldi işte ne eksikse onu koydu. Grupla da oynanabiliyor. Grupla da bir sıkıntı yok. Mutfak bölümünü ayrı biri yaptı, banyo bölümünü ayrı biri yaptı. Hiçbir sıkıntı olmuyor* (ECT6_SE).

In addition, 5 of 6 teachers stated that they used projector or television in collaborative play. For example, a teacher's view for this statement was as follow:

> *I used projector while playing with the toy. When Ayse narrated the tasks, I called a child to do the related task. I also gave chances to children to put toys several times* (ECT2_SE).
>
> *Ben açtım ekrana yansıttım. Ayşe komutları verdikçe isim söyledim, gel sen yap diye. Ya da her çocuğa 2-3 sefer okutması için fırsat verdim* (ECT2_SE).

Moreover, 5 of 6 teachers emphasized the guidance of teacher in smart toy play. For instance, a teacher expressed:

> *Teacher should lead children to individual smart toy play by helping them. Teacher guidance is a requirement* (ECT5_SE).

> *Öğretmenin bireysel çalıştırıp, başında da beklemesi gerekiyor. Öğretmenin rehberliği olması lazım* (ECT5_SE).

Lastly, preferring to use in small groups for effective smart toy play was the other strategy of teachers as to smart toy play and stated by 3 teachers as well. For instance, a teacher stressed:

> *Children can play with the smart toy not only individually but also collaboratively. If this toy is applied to small groups rather than big groups including 20 children, then it would become successful* (ECT1_SE).
>
> *Her seferinde tek tek kullanılır, 3'lü de kullanılır, grup da kullanılır ama küçük gruplarda daha başarılı olacağını düşünüyorum. Benim gibi 20 kişilik grup değil de, 3 kişilik bir gruba bunu koyup oturttursan kendileri aralarında oynarlar* (ECT1_SE).

In conclusion, putting a toy or card in collaborative smart toy play, using projector or television in collaborative play, the guidance of teacher in smart toy play and preferring to use in small groups for effective smart toy play were the smart toy play strategies mentioned by teachers. It can be inferred from these findings that teachers emphasize on collaborative smart toy play at preschool classrooms.

4.4.2.1.5 Educational Use of Smart Toy

According to all teachers, smart toy can be used for assessment and evaluation. For example, a teacher stated:

> *This toy can be used in assessment and evaluation of especially geometric shapes. We skip something in crowded classrooms sometimes. Teacher can assess and evaluate what children learned via the activities presented in this smart toy* (ECT4_SE).
>
> *Ölçme ve değerlendirmede kullanılır. Özellikle şekilleri öğrenmesi değerlendirilebilir. Bizim bazen çok kalabalık sınıflarımız oluyor. Bazı şeyleri atlayabiliyoruz. Bu oyunlarla çocuğun neyi öğrenip öğrenmediğini öğretmen daha rahat yakalayabilir* (ECT4_SE).

Additionally, 3 of 6 teachers pointed out that smart toy can be used for teaching and learning. For example, a teacher explained this as follow:

> *I think that this toy is mostly for teaching because of instructive feedbacks* (ECT2_SE).
>
> *Bence daha çok öğretme amaçlı bir oyuncak çünkü geribildirimleri genelde öğretmeye yönelik* (ECT2_SE).

Moreover, 3 of 6 teachers emphasized that smart toy can also be used for reinforcement. For instance, a teacher stated:

> *I use this smart toy as a material reinforcing the learned things with the help of real concepts and objects* (ECT3_SE).
>
> *Öğrettikten sonra gerçek kavramlarla, gerçek nesnelerle, biraz daha pekiştirici olarak kullanırım* (ECT3_SE).

Lastly, using as an alternative and supportive material in preschool education was the other way of educational use of smart toy and stated by 3 teachers as well. For example, a teacher said:

> *This toy provides a different activity for teachers. They have a chance to give the concepts or activities by using this smart toy in addition to giving the same concepts with papers, real toys and objects.This toy can be used for the purpose of reinforcement* (ECT2_SE).
>
> *Farklı bir etkinlik olur öğretmen için. Bir de bunu elektronik ortamda vermiş olur. Zaten bunun verdiğini biz kağıt üstünde, gerçek oyuncaklarla, nesnelerle veriyoruz. Bu da pekiştirme amaçlı olabilir* (ECT2_SE).

In conclusion, using for assessment and evaluation, using for teaching and learning, using for reinforcement and using as an alternative and supportive material were the areas that teacher preferred to use in preschool education. It can be reached from these findings that teachers see the smart toy for not only a supporting tool but also a material which can be used in teaching, learning and evaluation activities.

4.4.2.1.6 Advantages of Smart Toy Play

According to all teachers, smart toy took attention of children. For example, a teacher stated:

> *This toy took attention of children. For example, it was nice and exciting for children to find the comb toy* (ECT6_SE).
>
> *Çocukların çok dikkatini çekti, çok hoşuna gitti bire bir ordan oyuncağı bulmak. Çocuk tarağı bulduğunda heyecan yapıyor* (ECT6_SE).

Additionally, all of the teachers emphasized that smart toy is suitable for individual play. For instance, a teacher explained this as follow:

> *It is not necessary to play with this toy only at school. I think that it can also be useful for individual play at home. You can watch the child while he/she is playing with the toy. Since the instructions of the toy is so clear and easily understandable, children can also play with this toy at home without getting any help* (ECT2_SE).
>
> *İlla okulda olmasına gerek yok. Bana kalırsa hatta evde daha kullanışlı gibi geldi bana. Mesela takıyorsun, oyuncakları döküyorsun, oturuyorsun, sen izliyorsun, çocuğun yapıyor. Mantıklı geldi bana bunu evde uygulamak. Çünkü komutları açık. Elin üstüne okut diyor, şunu getir okut. Komutta çocukların anlamayacağı bir durum yok. Sıkıntı olmadığı için de evde de çok rahat uygulanabilir, müdahalesiz uygulanabilir bence* (ECT2_SE).

Besides, 5 of 6 teachers declared that smart toy is mostly suitable for 3 and 4 years old children. On the other hand, 5 of 6 teachers emphasized that smart toy helps teacher in giving several concepts. For example, a teacher expressed:

> *This toy can be improved. All concepts included in the preschool curriculum can be presented via smart toy. For example, opposite concepts, time concepts and concepts related with emotions can be given via this smart toy* (ECT5_SE).
>
> *Geliştirilebilir. Kavramlar arttırılabilir. Zıt kavramları alabiliriz. Materyaller geliştirilebilir. Zaman kavramı, zıt kavramlar,*

duygularım bu oyuncak ile verilebilir. Okul öcesi müfredatında yer alan tüm kavramlar verilebilir (ECT5_SE).

Besides, 5 of 6 teachers agreed on the authenticity of the smart toy. For instance, a teacher's view for this advantage was as follow:

> *This toy is different from other toys especially computer games. Touching to real objects and feeling them appeal children more than the computer games requiring only mouse moves. Hence, this toy is more effective in learning because learning by living is very important for children* (ECT4_SE).

> *Diğer oyuncaklarda böyle bir materyal yok, özellikle bilgisayarlı oyunlarda. Dokunarak, yaşayarak, hissederek, onları değdirerek daha hoşlarına gidiyor. Ötekilerde sadece fare ile hareket ettir, onu oraya taşı var. Bunlar daha etkili olur. Öğrenmede zaten bu çok önemli, yaşayarak öğrenme* (ECT4_SE).

Besides, 5 of 6 teachers stressed that smart toy improves motivation of children. For example, a teacher said:

> *Children had fun very much while playing with this toy. They were very excited while waiting for playing. They had also self confidence because they already knew the tasks presented in the toy. That is, this toy improved the motivation of children* (ECT5_SE).

> *Çocuklar çok eğlendiler bunu oynarken. Sırada çok heyecanla beklediler. Bir de bildiklerinin üzerine gidildiği için, kendilerine güven vardı, onun da etkisi vardı. Motivasyonlarını arttırdı* (ECT5_SE).

Moreover, 4 of 6 teachers emphasized on the easiness for teacher in showing patterns via the smart toy. For instance, a teacher stated:

> *I teach patterns easily by using this smart toy. This toy makes my job in teaching pattern concept easier than presenting by using papers. This toy provides retention by using real objects such as car and bear toys* (ECT1_SE).

> *Bunda daha kolay anlatırım örüntüyü. Şu, örüntüde benim işimi çok kolaylaştırır. Kağıtta bakmaktansa bununla hemen verebilirim. Araba,*

ayıcık gibi oyuncakları kullandığımdan daha akılda kalıcı olur (ECT1_SE).

Furthermore, 3 of 6 teachers declared that smart toy makes teacher's job easier. For instance, a teacher explained this as follow:

> *This kind of material helps teacher in clssroom management because it attracts attention of children* (ECT6_SE).
>
> *Bu tarz materyaller öğretmeni de rahatlatır çünkü ilgisini çekiyor çocukların. Sınıf kontrolü daha fazla sağlandığı için daha rahat olur* (ECT6_SE).

Lastly, helping children in quick and easy learning was the other advantage of smart toy and stated by 2 teachers as well. For example, a teacher stated:

> *Children can learn with this toy easier than learning from papers because smart toy is more attractive* (ECT1_SE).
>
> *Öğrenci açısından da daha kolay öğrenir çünkü kağıttan öğretiyoruz ya da oyuncaklardan öğretiyoruz ama bu daha dikkat çekici olur* (ECT1_SE).

In conclusion, based on the teachers' responses, taking attention of children, suitability for individual play, suitability for 3 and 4 years old children, helping teacher in giving several concepts, the authenticity, improving motivation of children, the easiness for teacher in showing patterns, making teacher's job easier and helping children in quick and easy learning were the advantages of smart toy play. It can be inferred from these findings that the smart toy play has several advantages for not only children but also teachers.

4.4.2.1.7 Problems of Smart Toy Play

Based on the responses of all teachers, novelty effect is one of the problems of smart toy. For example, a teacher stated:

Children can play with this smart toy for one or two times and they become bored at later play sessions since the toy provides the same activities in each play (ECT3_SE).

Çocuklar 1-2 kere oynayabilir, daha sonrasında belki sıkılabilirler, sürekli aynı şeyler olduğu için (ECT3_SE).

In addition, 4 of 6 teachers emphasized that the structure of smart toy is simple for children. For instance, a teacher explained this as follow:

This smart toy was so simple for 5 and 6 years old children. For example, putting toys or cards took attention of children at the beginning and then, they solved the patterns easily and quickly. Afer finishing playing with the toy, they asked me whether the harder version was presented (ECT2_SE).

Çok basit oldu. 5, 6 yaş grubu. Çok basit geldi. Örüntü mesela. Hemen yaptılar, hiç zorlanmadılar. İlk başta bunu okutmak ilgilerini çekti, çok pür dikkatlerdi, onu okutabilecek miyim diye. Sonra "öğretmenim bu çok kolaymış, daha zoru gelmeyecek mi?" dediler (ECT2_SE).

Lastly, the problem of one to one play of children with smart toy at crowded classrooms was the other problem and stated by 3 teachers as well. For example, a teacher stressed:

My classroom is crowded because there are 20 children. I can try to lead children to play with the toy one to one but I can't control children at that situation (ECT1_SE).

Benim grubum kalabalık, 20 kişi. Bire bir oynatabilirdim ama bu sefer ben sınıfta o kontrolü sağlayamazdım (ECT1_SE).

In conclusion, based on the teachers' responses, novelty effect, simplicity of the content especially for older age group of children and difficulties of one to one play at crowded classrooms were the problems of smart toy play. It can be commented on these findings that teachers emphasize the problems in both smart toy play and its content.

As a result of this section including the findings of research question 5, teachers had motivations to use the smart toy in preschool settings. Although they liked the content, visual design and interaction components of the smart toy, they also emphasized that these components need to be improved to provide effective smart toy play and sustain playability of the smart toy for a long time.

4.5 Phase 5 (Refining Design Principles)

The finalized and refined principles emerged after finishing all analysis, design, development and evaluation phases. These design principles were presented below in accordance with related themes.

4.5.1 Content

- A variety of plush toys or cards should be included in smart toy play.
- Dynamic content should be presented rather than showing only pictures.
- Smart toys supporting specific goals and objectives should be used in preschool education.
- Smart toys should be designed for giving multiple tasks rather than providing a single and simple task.
- Content of the smart toy should be suitable for children with 36 months old – 72 months old.
- Story of the toy should be realistic and consistent with real life.
- Sounds or narrations should be warm and familiar for children. If an adult voice is used, a woman narrator should be preferred generally.
- Instructions, directions, or narrations should mostly be performed by a virtual young child character to improve identification of child (player) with the character in the smart toy.
- “Help” screen should be presented detailed before starting to play the actual content of the smart toy.

- High numbers of plush toys or cards should not be included in the smart toy to prevent loss of focus and concentration of children.
- Each screen of the virtual content of the smart toy should be designed as clear and easily understandable by children.
- Time intervals among narrations should be small to prevent loss of children's concentration to the play.
- Reminders should be used at some points of the virtual content of smart toy to keep children in the flow of the play.
- Content should be presented in a nonlinear and flexible way.
- Rich and varied content should be presented in smart toy.
- Content and scenario of smart toy should be consistent with real life.
- Positive feedbacks should be used more than giving negative feedbacks.
- Feedbacks should be clear, explanatory and easy to understand for children.
- Instructions or directions used in the virtual content of smart toy should lead children to focus on the play and prevent loss of children's concentration.
- Unstructured content should be provided to children as an alternative option.
- The final scene of smart toy should be presented clearly and children should be informed about what they accomplished at the end of smart toy play.
- Background music should be used as optional to attract attention of children.
- Instructions or directions should be explicit and easily understandable.
- Different levels going from simple to hard should be presented in the content of smart toy.

4.5.2 Visual Design

- Size of both plush and virtual objects should be parallel to real life
- There should be realistic animations and graphics.
- Smart toys should be designed in accordance with the needs of 36 – 72 months old children.

- The main characters or avatars that are at the close age with young children should be used.
- Design and use of plush toys should be clear and affective for children.
- Soft plush toys should be used because these toys cannot be destroyed easily.
- Design should be consistent and related visuals should be appeared in accordance with the voices used.
- The virtual part of smart toy should be designed in a similar way to computer games for young children. That is, computer game like design should be taken into account.
- Characters used in the virtual content of the smart toy should be dynamic.
- Animations should be consistent with narrations or verbal statements.
- Visual design of plush toys should be consistent with content, goal and objectives.
- Visual design should not confuse children and the virtual objects focused in the smart toy should easily be differentiated from other objects.
- Design of characters or objects should be nice and attractive for children.
- There should be a consistency in the design among different scenes.
- Correct / positive / desired visuals or animations should be shown at the middle of the screen since the focus is mostly on there.
- Animations should be preferred as positive feedbacks in smart toy play.
- Objective related animations should be presented on time when a child puts related toy or card.
- Explicit, simple and clear visuals should be put on the cards to notice and differentiate from other cards easily.
- Bigger cards should be used.
- There should be a suitable contrast between foreground and background of the scenes in virtual environment.

4.5.3 Interaction

- Children's voices should be recorded in smart toys for using storytelling activities.
- The virtual environment should be interactive and children should change the environment with their desires.
- Guidance of teachers should be given to increase the effectiveness of smart toy play of children at school.
- Character used in the virtual content of the toy should be designed as similar to a real young child's appearance and voice.
- Virtual images of plush toys should match entirely to create effective interactive environment in smart toy play.
- Feedbacks should be given after not only correct move but also wrong move in smart toy play.
- A feedback should be given immediately when a child puts a toy or card onto the reader.
- Virtual character or avatar should do narrations mostly rather than a voice over to improve one to one interaction level.
- Smart toy should enable children to play collaboratively.
- Smart toy should be easily controllable to improve the interaction between player and smart toy.

CHAPTER 5

DISCUSSION AND CONCLUSION

The main purpose of this study was to design, develop and use of smart toys for preschool children from age 36 months to 72 months. Since design and development research was the main research design of the study, it was performed throughout several phases, namely, analysis, design, development, evaluation and finalizing design principles. The findings of research questions were presented in accordance with the results gathered in these main phases. This chapter evaluated the findings by considering the research questions.

5.1 Technology Use of Early Childhood Teachers

Semi-structured interviews were carried out to understand early childhood teachers' opinions toward technology and technology use in early educational settings. Based on the findings, computers were the most used technologies in preschool settings. Similar to this finding, Towns (2010) found that early childhood teachers are agreed on using computers in classrooms. On the other hand, projector, overhead projector and TV were the other used technologies in early educational settings. For specific characteristics of technology, visuality and audio were the most emphasized characteristics of technology. It can be inferred from these findings that teachers use different kind of technologies in preschool education.

According to the findings, teachers preferred to use technology mostly in storytelling and language activities. Similar to this finding, Marsh et al. (2005) stated that new technologies have been used in language and literacy activities by the majority of early childhood educators. Findings revealed that technology has also been used in math and cognitive activities by early childhood teachers. This finding reaffirmed that teachers have a desire to improve cognitive skills of children by including computers into activities (Yurt & Cevher-Kalburan, 2011). Listening music activity was also stated by teachers to use technology for. Similarly, Yurt and Cevher-Kalburan (2011) emphasized that computers are mostly included into music activities by early childhood teachers. Findings also showed that teachers use technology in science and nature activities, teaching several concepts, presenting educational cartoons, animations, art activities and documentaries. It can be reached from these findings that early childhood teachers use technology/computers for a variety of educational activities.

For the advantages of technology, the majority of teachers stated that technology takes attention of children. Similarly, Gok et al. (2011) found that information technologies positively affect interest and attention levels of children when these technologies are used appropriately. Additionally, the contribution of technology to visual and permanent learning was also stated by the majority of teachers. Similar to this finding, Marsh et al. (2005) pointed out that involving new technologies into curriculum related activities supports desires of children towards learning. Improving cognitive skills was another advantage of technology use for children. This is similar to Tsitouridou and Vryzas's (2004) statement that the majority of teachers believe the importance of computer use to enhance cognitive development of children. Moreover, addressing many senses of children and considering individual differences were stated by teachers as advantages of technology use for children. Teachers also emphasized that technology use improves psychomotor skills of children. In parallel to this finding, Tsitouridou and Vryzas (2004) declared that teachers accept the support of computer use to psychomotor development of children. Improving motivation was another advantage of technology use for children. Similarly, Marsh et al. (2005) stressed that new technologies improve motivation of children toward learning activities. Furthermore, teachers stated that technology use adapts children easily to future, improves curiosity and enhances hand-eye coordination of them. Findings also showed that technology use improves self confidence of children.

Similarly, Blackwell et al. (2014) mentioned about the importance of confidence in technology use. Lastly, allowing learning by doing, rehearsal larning, helping children transfer their knowledge to real life and improving creativity of children were the other advantages of technology use for children. It can be concluded from these findings that technology use has several advantages for children from the view of early childhood teachers.

For the potential disadvantages of technology for children, the majority of teachers stated that technology prevents socializing. This is similar to Wood, Specht, Willoughby and Mueller's (2008) finding that computers may prevent social development of children. Preventing social play and spending excessive amount of time were other disadvantages of technology use for children. Marsh et al. (2005) mentioned the worries about the time children spend on technology related activities. Facing with undesired things, creating psychological problems, uncontrolled use, causing health problems, speech problems and becoming addict were the other findings as to the potential disadvantages of technology use for children. It can be concluded from these findings that early childhood teachers are aware of the threats which can be caused by inappropriate technology use.

Turkish preschool curriculum in terms of technology use was another thematic finding of semi-structured interviews with early childhood teachers. Not having goals and objectives for using technology in curriculum, lack of guidance of curriculum in use of technology, necessity of detailed goals and objectives of technology use in curriculum, necessity of having standardization in curriculum about technology use and lack of detailed explanations as to technology use in the curriculum were the findings gathered from early childhood teachers. It can be reached from these findings that Turkish preschool curriculum does not include specific explanations or instructions as to integrating technology into preschool education. Findings also imply that teachers expect explicit statements about how to use technologies in various activities of children.

According to the findings of advantages of technology for teachers, the majority of teachers stated that technology makes teachers' job easier. Additionally, teachers pointed out that technology allows teacher to use different materials. Similarly, teachers use computers to support curriculum related activities (Yurt & Cevher-Kalburan, 2011). Moreover, using technology for acceleration of teaching, helping teacher in classroom management and saving time of teachers were the other findings as to the advantages of technology for teachers. It can be concluded from these findings that technology supports teaching activities of teachers and helps them control and guide children in classroom activities.

Teachers also mentioned the problems about technology use. In pedagogical problems, teachers stated that there are difficulties in one to one interaction with technology for all children. Additionally, teachers mentioned the inadequacy in teacher knowledge of technology use. Tsitouridou and Vryzas (2004) explained the importance of teacher knowledge of technology use by saying that "teachers with extensive knowledge and experience with computers believe that the introduction of computers into early childhood education is an urgent priority" (p. 40). Limited technology use skills was the other finding as to teachers' pedagogical problems about technology use. According to Chen and Chang (2006), "teacher proficiency in technology integration is a critical determinant of the educational benefits children gain from using computers" (p. 178). Similarly, Keengwe and Onchwari (2009) found that teachers have worries about their technology use skills to meet today's children expectations. In infrastructural problems, nearly half of the teachers emphasized lack of high quality resources. Similarly, teachers develop their own materials or softwares to use in early educational settings because of lack of resources (Kalaš, 2010). Nikolopoulou and Gialamas (2009) also supported this finding by saying that necessary and suitable resources should be integrated into early childhood classrooms. Difficulties in having a computer for each classroom and lack of projector in classrooms were other findings as to infrastructural problems about technology use. These findings reaffirm that necessary equipment is not provided to the majority of teachers when they are in need of using new technologies

(Kabadayi, 2006). Teachers also stated that crowded classrooms and lack of computer lab at schools were the other findings as to infrastructural problems about technology use. It can be concluded from these findings that teachers have problems not only causing from themselves but also coming from schools or educational system.

For teachers’ expectations about technology use, the majority of teachers stated that there is a need for professional development courses of advanced technology use. This finding is similar to the literature explaining that teacher training programs allow teachers to effectively integrate ICT into early educational settings (Chen & Chang, 2006; Cox & Marshall, 2007; Gialamas & Nikolopoulou, 2010; Nikolopoulou & Gialamas, 2009). Additionally, the majority of teachers emphasized that there is a need for limitations on technology use for children. It can be inferred form this finding that teachers are in favor of limited technology use for children rather than excessive use. Need for teacher control and need for parental control in technology use were other findings as to the expectations of teachers about technology use. This finding reaffirms that “the appropriate use of computer technology under the guidance of teacher or parent can assist the holistic development of the child. (Tsitouridou & Vryzas, 2004, p. 40). Moreover, most of the teachers declared that there is a necessity of using technology in an appropriate way. This is similar to the finding that appropriate technology use of early childhood teachers supports children’s involvement into several classroom activities (Gok et al., 2011). Need for technology integrated courses, need for teaching how to use technology, necessity of having materials suitable for children and need for using different kind of technologies were other findings as to the expectations of teachers about technology use. It can be inferred from these findings that early childhood teachers have a desire to integrate technologies into early educational settings. The findings indicated that teachers expect appropriate materials or softwares which are ready to use for children in preschool education. Teachers also stressed that there is a need for giving training to parents on how children use technology appropriately. This was an important finding because teachers believe that parents do not guide children in technology use correctly. Necessity of computer lab, need for a computer in each classroom and need for projector in classrooms were the other findings related with teachers' expectations about technology use. It can be concluded from these findings that teachers expect technologically equipped classrooms to integrate technologies into preschool education effectively. Lastly, some teachers stated that there is a need for assigning computer teachers. They believe that computer teachers can be more helpful to children in giving technology related activities.

According to the findings based on technology use activities of teachers, the majority of teachers stated that teachers search for educational softwares or programs suitable for children, use technology based on their choices, use technology to support teaching concepts or objectives and lead children to use computers at school. These findings are similar to the statement that "in the classroom, teachers adapt computer use to accommodate children's varying levels of skills, different personal interests, and optimal social groupings" (Chen & Chang, 2006, p. 181). Pre-lesson preparation of electronic materials and presenting stories or several topics on power point were other findings as to technology use activities of teachers. Similarly, Kalaš (2010) emphasized that since resources for using in early childhood education are limited, teachers tend to produce their own materials or softwares to use in early educational classrooms. Some of the teachers also stated that they use own personal computer at school and they guide children at the beginning of technology use. It can be inferred from these findings that there is a limited number of computers at schools or computers are not in a good condition. Findings also imply that teachers spend an effort to introduce technology to children.

Teachers also explained their thoughts about technology use. The majority of teachers stated that there is a necessity of using technology in preschool education. Similar to this finding, there are several statements in the literature indicating that computers or new technologies should be included in early childhood education and teachers have a positive attitude towards technology use in early childhood education (Chen & Chang, 2006; Nikolopoulou & Gialamas, 2009; Tsitouridou & Vryzas, 2004; Yurt & Cevher-Kalburan, 2011). In addition, technology as a tool making life easier and computer as the first idea of technology were other findings as to teachers' thoughts about technology use. It can be inferred from these findings that early childhood teachers mostly consider computers as technology and define technology as a helpgul tool in daily life. Teachers also stated that today's children have high technology use capabilities. In parallel to this finding, Tsitouridou and Vryzas (2004) mentioned about the familiarity of children with computers to integrate computers into early childhood education. Moreover, technology as a tool rather than a goal was another important finding about teachers' thoughts of technology use. Similarly, Chen and Chang (2006) emphasized on computer as a tool allowing teachers to help in learning activities. Teachers also declared that they guide children in technology use. This is similar to the finding that "the teachers did acknowledge that they were guiding children to use programs that were not only age appropriate, but also developmentally appropriate" (Towns, 2010, p. 83). Lastly, wrong parental guidance was the other finding as to teachers' thoughts about technology use.

In summary, teachers have positive intentions about integrating technology into preschool education. They also expect support from not only curriculum but also schools about using technology for children in an appropriate way. Teachers have a desire to include new technologies in preschool settings if they are organized and well developed. Besides, teachers, in general, are aware of both advantages and disadvantages of technology use. However, they focus on the advantages more than the problems caused by technology use. Teachers also use technology in several classroom activities in preschools. These findings were important for this study because findings indicated that teachers are open to use new technologies for children. That is, smart toys as new technological materials can be adapted to preschool environments by teachers.

5.2 Smart Toys and Design Principles

Refined design principles emerged after finishing the analysis, design, development and evaluation phases. In this part, these design principles in accordance with related themes were discussed with the findings in the literature.

5.2.1 Content

The first design principle in "content" theme was: *A variety of plush toys or cards should be included in smart toy play*. This is important because teachers expect to use more varied toys while playing with the smart toy. Since teachers prefer to use the smart toy collaboratively at classroom settings, using a variety of plush toys or cards allows each child to interact with a plush toy or card. Similar to this design principle, Hinske (2009) stated that several objects should be involved into virtual content.

The second design principle in "content" theme was: *High numbers of plush toys or cards should not be included in the smart toy to prevent loss of focus and concentration of children*. This principle is of importance because using high numbers of plush toys or cards can decrease the playability of the smart toy. In parallel to this principle, Kehoe et al. (2004) made a research about virtual peer system and concluded 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).

The third design principle in "content"theme was: *Content of the smart toy should be suitable for children with 36 months old – 72 months old.* Since early childhood teachers integrate activities based on the preschool curriculum into classroom settings, it is important to design the content of the smart toy as suitable for all children aged between 36 – 72 months old. Lampe and Hinske (2007) developed the Augmented Knight's Castle providing interactive learning experiences for children by combining physical and virtual realities. They emphasized in their study that the content and its structure can be suitable for developmental needs of children. This was similar to design principle about the necessity of smart toy's content suitable for preschool children.

The fourth design principle in "content" theme was: *Feedbacks should be clear, explanatory and easy to understand for children.* This principle should also be taken into account because clear and understandable feedbacks may help children focused on the smart toy play. Fontijn and Mendels (2005) developed StoryToy which is an environment including several stuffed farm animals telling stories and reacting each other animal's actions. One of the findings that they concluded was about the necessity of direct and immediate feedback to keep children focused on the play. In addition, Hinske (2009) stated that "feedback should always be immediate, correct and comprehensible" (p. 77). These findings reaffirmed the design principle about clear, explanatory and easy to understand feedbacks in content of the smart toy.

The fifth design principle in "content" theme was: *Instructions or directions used in the virtual content of smart toy should lead children to focus on the play and prevent loss of children's concentration.* Since preschool children can easily be distracted while doing an activity, directions can guide them to finish the tasks while playing in a fantasy environment presented by the smart toy. Similar to this design principle, the sixth design principle was: *Reminders should be used at some points of the virtual content of smart toy to keep children in the flow of the play.* Additionally, the seventh design principle about instructions and directions in "content" theme was: *Instructions or directions should be explicit and easily understandable.* These design principles are important because children need to be guided via explicit instructions, directions or reminders in smart toy play to enhance the concentration of them. Similar to these design principles, Hinske (2009) pointed out that all tasks or activities should be presented explicitly.

The eighth design principle in "content" theme was: *Each screen of the virtual content of the smart toy should be designed as clear and easily understandable by* *children.* Designing each screen of the virtual content can provide consistency of the smart toy play. This consistency may improve play experiences of preschool children. Hanna, Risden, Czerwinski and Alexander (1999) supported this principle by proposing that design related instructions should be easily understandable.

The ninth design principle in “content” theme was: *Smart toys supporting specific goals and objectives should be used in preschool education*. This design principle indicated that curriculum related activities should be integrated into smart toy play in an unobtrusive way. Since early childhood teachers use this smart toy as a supportive material in preschool education, it is important to design the content of the smart toy in accordance with the objectives mentioned in the preschool curriculum. Similar to this design principle, Large and Beheshti (2005) suggested as an interface design guideline that adding educational objectives into web portals can enhance children’s experiences while having fun.

The tenth design principle in “content” theme was: *“Help” screen should be presented detailed before starting to play the actual content of the smart toy.* This design principle is important because it aims to provide detailed and necessary information about how to play with the smart toy. Inal (2011) also reached as a design principle in his study that detailed instructions explaining play procedure in a physically interactive game should be given to children to adapt them effectively.

The eleventh design principle in “content” theme was: *Instructions, directions, or narrations should mostly be performed by a virtual young child character to improve identification of child (player) with the character in the smart toy.* This principle can be linked to the view that the virtual young child character who is at the same age with the child playing with the smart toy may support involvement and identification of children. This was also similar to Inal’s (2011) suggestion that avatars should be used in game environments to take attention of children.

The twelfth design principle in “content” theme was: *Smart toys should be designed for giving multiple tasks rather than providing a single and simple task.*

Additionally, the thirteenth principle was: *Unstructured content should be provided to children as an alternative option.* Besides, the fourteenth design principle was: *Content should be presented in a nonlinear and flexible way.* Moreover, the fifteenth principle was: *Different levels going from simple to hard should be presented in the content of smart toy.* All these design principles can be associated with the complexity of virtual content of smart toy. Since it can be hard for early childhood teachers to make children finish the whole content while playing with the smart toy, teachers should have an option to focus on the specific content in smart toy play. These principles also indicated that children should meet a challenge while playing with a smart toy instead of doing tasks in a drill and practice way. Because challenge is one of the components of flow in game play, it can also be advantageous in smart toy play to keep children in the flow. Similar to these design principles, Hanna et al. (1999) proposed that activities presented in computer products should be complex for children.

The sixteenth design principle in "content" theme was: *Background music should be used as optional to attract attention of children.* Background music has been integrated into several educational games or videos for children. Hence, adding background music to the content of the smart toy may increase the attractiveness of smart toy play. Similarly, Hinske, Lampe, Yuill, Price, and Langheinrich (2009) carried out a user study of an augmented toy environment with elementary school children. They found that background music made the environment fun for children and children were positive about background music although they preferred to ignore it sometimes. Hence, background music needs to be optional for children and they should have a control over it.

The seventeenth design principle in "content" theme was: *The final scene of smart toy should be presented clearly and children should be informed about what they accomplished at the end of smart toy play.* Besides, the eighteenth design principle was: *Positive feedbacks should be used more than giving negative feedbacks.* These principles are about supporting children throughout smart toy play since children need rewards about the tasks that they accomplished. Similarly, Hanna et al. (1999) suggested that reward structures which are suitable for developmental needs of children be used in user interfaces.

The nineteenth design principle in “content” theme was: *Story of the toy should be realistic and consistent with real life.* Additionally, the twentieth design principle was: *Content and scenario of smart toy should be consistent with real life.* Kehoe et al. (2004) developed a virtual peer system called as Sam and performed design experiments with children. According to Kehoe et al. (2004), child successfully interacted with virtual character which has a real life size and appearance and created meaningful stories. This finding can be associated with the design principles above since realistic characters or content which has life like activities can improve engagement of children into play environments.

The twenty first design principle in “content” theme was: *Dynamic content should be presented rather than showing only pictures.* Besides, the twenty second principle was: *Rich and varied content should be presented in smart toy.* These principles indicated that the content presented in virtual environment should include both visual and audial components creating a dynamic smart toy environment for children. These principles can be associated with the view that using animations or multimedia components in the content of the smart toy may increase the playability of the toy. Similarly, Inal (2011) found as a design principle for interactive game environments that a variety of age appropriate animations and sounds should be integrated into interactive game environments.

The twenty third design principle in “content” theme was: *Sounds or narrations should be warm and familiar for children. If an adult voice is used, a woman narrator should be preferred generally.* This principle was about using all sounds suitable for children’s needs. Since most of the teachers are female and children interact with women adults more than men, using a woman voice may enhance the familiarity of children to the smart toy play. Teachers also emphasized that a woman voice needs to be included if there is a need for an adult narrator in virtual content.

The last design principle in "content" theme was: *Time intervals among narrations should be small to prevent loss of children's concentration to the play.* This principle indicated that the flow of smart toy play should not be distracted with unnecessary pauses.

5.2.2 Visual Design

The first design principle in "visual design" theme was: *Size and design of both plush and virtual objects should be parallel to real life.* The reason of this design principle can be related with providing consistency between children's daily life play and play with the smart toy. This was similar to the finding that design of toys should be consistent with real life (Hinske, 2009).

The second design principle in "visual design" theme was: *There should be realistic animations and graphics.* Using realistic components may enhance both attractiveness and familiarity of the visual design. Similarly, Lampe and Hinske (2007) claimed in their study that "realistic illustrations of the figures, buildings and objects of the playset intensify the immersion into the game" (p. 4).

The third design principle in "visual design" theme was: *Smart toys should be designed in accordance with the needs of 36 – 72 months old children.* This principle was about designing plush toys and all objects in virtual content in accordance with developmental needs of preschool children. Since 36 – 72 months old children are in the preoperational stage of Piaget's (1964) intellectual development stages, designing the smart toy based on the characteristics of this stage can be helpful for children. Inal (2011) developed physically interactive games and investigated design principles of these games by conducting a research study. Similar to design principle shown above, Inal (2011) proposed that all visual design components, such as colors, sounds and animations should be suitable for age groups of children

The fourth design principle in “visual design” theme was: *Design and use of plush toys should be clear and age appropriate for children.* Plush toys are one of the important components of the smart toy. Plush toys can also be seen as the specific part which is different from other educational softwares or games. Therefore, designing plush toys in accordance with children’s age level characteristics may enhance the motivation of both children and teachers to play with the smart toy. Hinske (2009) supported this principle by saying that “designers should respect children’s intelligence by creating adaptive and age appropriate toys” (p. 92).

The fifth design principle in “visual design” theme was: *Soft plush toys should be used because these toys cannot be destroyed easily.* Teachers, in the present study, mentioned that soft plush toys can be used in smart toy system because these toys can be used by children for a long time without giving big damages. Hence, using soft plush toys can increase the playability of these toys for a long time. According to Hinske (2009), “augmented toys that contain highly sophisticated technology must be very reliable and durable since some children played quite vehemently and strained our play set severely” (p. 92).

The sixth design principle in “visual design” theme was: *Visual design of plush toys should be consistent with content, goal and objectives.* This design principle is important because it is about designing plush toys as suitable for specific objectives focused in context of smart toy play. Since early childhood teachers prefer to use smart toys at early educational settings, integrating curriculum based content into the smart toy may support teachers’ use of these toys as alternative materials in learning and teaching activities. Hinske (2009) explained this by stressing that “a toy should never be seen as a sole play object but should be put in context because it helps to understand the conveyed educational content” (p. 93).

The seventh design principle in “visual design” theme was: *Animations should be preferred as positive feedbacks in smart toy play.* It can be understood from this principle that a variety of feedback types, such as animations and visual feedbacks should be used especially after putting correct toys or cards onto the reader. Using animations or dynamic components as positive feedbacks may keep children motivated and enhance their confidence during smart toy play. For example, Lampe and Hinske (2007) used both verbal and musical feedbacks in the Augmented Knight's Castle playset which was developed for enriching the pretend play of children. Hinske (2009), also, mentioned about the importance of presenting a variety of feedback styles.

The eighth design principle in "visual design" theme was: *Objective related animations should be presented on time when a child puts related toy or card.* This principle was similar to the previous design principle shown above and it aimed at giving content related feedbacks as soon as child puts related toy or card onto the reader. Since children may get bored easily while doing an activity, response time of the smart toy should be small enough to keep children's concentration high.

The ninth design principle in "visual design" theme was: *Visual design should not confuse children and the virtual objects focused in the toy should easily be differentiated from other objects.* The reason of this design principle can be associated with keeping children's focus on the play environment. Druin et al. (2001) supported this principle by proposing that items presented on the screen should be large and distanced from other objects to control and select them easily.

The tenth design principle in "visual design" theme was: *The main characters or avatars that are at the close age with young children should be used*. In addition, the eleventh design principle was: *Characters used in the virtual content of the smart toy should be dynamic.* Since the characters or avatars used in virtual content of smart toy act like animated pedagogical agents leading children to accomplish several tasks in smart toy play, these characters can be associated with animated pedagogical agents. In the literature, animated pedagogical agents have valuable impact on interactive learning experiences since they are lifelike characters (Johnson, Rickel, & Lester, 2000; Lester et al., 1997). Hence, age appropriate dynamic characters acting like animated pedagogical agents should be provided in virtual content to help children engaged in smart toy play.

The twelfth design principle in “visual design” theme was: *Design of characters or objects should be nice and attractive for children.* This principle explained that both objects in virtual content and plush toys need to be designed as attractive and appealing for children. Appealing design may improve children’s involvement into enjoyable smart toy play. Similarly, Shneiderman (2004) emphasized that appealing and attractive graphics or animations make user interfaces more enjoyable.

The thirteenth design principle in “visual design” theme was: *The virtual part of smart toy should be designed in a similar way to computer games for young children. That is, computer game like design should be taken into account.* This principle indicated that the virtual content of smart toy should be designed as providing entertainment for children via game like design. Because children enjoy playing with computer games and they are used to the visual design of these games, computer game like design of the virtual content of the smart toy may be familiar for preschool children. This design principle can also be associated with Inal’s (2011) suggestion that cartoon like game components, such as graphics and animations should be included to make design appealing and effective.

The fourteenth design principle in “visual design” theme was: *Design should be consistent and related visuals should be appeared in accordance with the voices used.* Additionally, the fifteenth design principle was: *Animations should be consistent with narrations or verbal statements.* Besides, the sixteenth design principle was: *There should be a consistency in the design among different scenes.* Moreover, the seventeenth design principle was: *There should be a suitable contrast between foreground and background of the scenes in virtual environment.* All of these design principles were about the consistency in visual design of virtual content. According to these principles, suitable consistency should be provided to children to make smart toy play usable.

The eighteenth design principle in “visual design” theme was: *Explicit, simple and clear visuals should be put on the cards to notice and differentiate from other cards easily.* In addition, the nineteenth principle was: *Bigger cards should be used.* These design principles were about the appearance of cards used in smart toy. According to the findings, cards should be differentiated from any other cards easily and children should identify the visuals on these cards without any effort. Simple visuals may prevent children loss of their control in smart toy play environment.

The last design principle in “visual design” theme was: *Correct / positive / desired visuals or animations should be shown at the middle of the screen since the focus is mostly on there.* This design principle was about the correct placement of objects or characters in virtual environment. Scholars emphasized that visuals should be shown at the middle of screen to catch children’s attention. Because young children may not easily found the objects on the screen, putting objects or visuals at the middle of the screen may help children focus on the objects easily.

5.2.3 Interaction

The first design principle in “interaction” theme was: *The virtual environment should be interactive and children should change the environment with their desires.* This design principle is about controlling the virtual content based on children’s preferences. Children’s control of the smart toy may help children understand the smart toy play easily. Similarly, Kehoe et al. (2004) emphasized in their study of Sam – a virtual peer system that “we intend to create user profiles for individual children that will enable Sam to adapt story selection to their preferences” (p. 5). Additionally, “children should be empowered to select from available educational content to give them a feeling of autonomy and control” (Hinske, 2009, p. 93). These findings in the literature reaffirmed that children should have a control in interactive smart toy system to handle both physical toys and virtual content easily.

The second design principle in “interaction” theme was: *Guidance of teachers should be given to increase the effectiveness of smart toy play of children at school.*

Guidance or help of teachers during smart toy play may enhance the effective play especially at classroom settings. According to Luckin et al. (2003), children, in general, have a tendency to get help from human companions, such as parents and teachers rather than machines. In addition, Hinske (2009) suggested that teachers have a possibility to change and arrange educational content. These findings supported the design principle of guidance of teachers in smart toy play in preschool settings.

The third design principle in "interaction" theme was: *Character used in the virtual content of the toy should be designed as similar to a real young child's appearance and voice.* This design principle aimed at using realistic objects in virtual part of smart toy. In addition, the reason of this principle can be associated with effective identification of the child player with the main character provided in the virtual content of the smart toy. Lampe and Hinske (2007) supported this principle by stating that realistic visuals allow children to involve into the activity deeply.

The fourth design principle in "interaction" theme was: *Virtual images of plush toys should match entirely to create effective interactive environment in smart toy play.* Meaningful connection between real objects and their virtual images may decrease the confusion of children and help them keep in smart toy play. According to Lampe and Hinske (2007), "there should be semantic mapping between the physical and virtual realities, i.e. the appearance of the physical toy figure is semantically connected to the role or function such a figure played in real life in the Middle Ages (p. 4)". Lampe and Hinske (2007) also stated that "this semantic mapping empowers children to easily understand the role or function of a play object, and therefore allows fast and intuitive understanding" (p. 4). Additionally, Hinske (2009) proposed that semantic mapping be performed in designing all play objects. These findings supported the design principle that there should be meaningful connection between physical toys and their virtual characters to enhance interactivity.

The fifth design principle in “interaction” theme was: *A feedback should be given immediately when a child puts a toy or card onto the reader.* In addition, the sixth design principle was: *Feedbacks should be given after not only correct move but also wrong move in smart toy play.* If children cannot get any feedback to their actions, they can get easily distracted. Therefore, feedbacks as to the actions of children in smart toy play should be provided to keep children’s concentration high. Fontijn and Mendels (2005) found in their study that feedbacks should be provided to children immediately and directly. In addition, “the immediate feedback from the observed behavior of the robot allows children to examine and reflect on their initial mental models with respect to the outcomes they observe and gives them a chance to debug and extend their thinking. (Frei et al., 2000, p. 4). Farr, Yuill and Hinske (2012) also reached in their study that “system response provided immediate feedback which motivated children to continue to interact” (p. 121). These findings affirmed the design principle about providing immediate feedback to children when they put any toy or card onto the reader.

The seventh design principle in “interaction” theme was: *Smart toy should enable children to play collaboratively.* This design principle is about providing collaborative smart toy play option for children. Because early childhood teachers prefer to use smart toy collaboratively at classroom settings, smart toy should be designed in accordance with the collaborative play. In addition, collaborative play among children is supported in the literature to create interactive environment for children. Hence, collaboration among children while playing with the smart toy can be seen as an important strategy. Similarly, Cassell and Ryokai (2001) developed StoryMat offering a play space that records and recalls children’s storytelling and found that collaboration of children in StoryMat play improved children’s experiences.

The eighth design principle in “interaction” theme was: *Smart toy should be easily controllable to improve the interaction between player and smart toy.* This principle is important because children should easily understand how to play with smart toy and they should handle all virtual and physical objects. Similar to this principle, Hinske (2009) suggested that play environment should always be controlled by players.

The ninth design principle in “interaction” theme was: *Children’s voices should be recorded in smart toys for using storytelling activities.* Recording voices allows children to see what they accomplished at the end of the smart toy play. In parallel to this principle, StoryMat recorded children’s own stories and then recalled these stories to enhance storytelling experiences of children (Cassell & Ryokai, 2001).

The last design principle in “interaction” theme was: *Virtual character or avatar should do narrations mostly rather than a voice over to improve one to one interaction level.* This design principle is important because virtual characters which can also be considered as animated agents can provide one to one interaction with children by doing all necessary narrations.

5.3 Smart Toy Play of Preschool Children

According to the results of the usability test of the smart toy, all children liked the smart toy and the majority of them played with the toy enthusiastically. This finding can be linked to the view that children have positive attitudes and great tendencies toward technological materials. Similarly, Hinske (2009) found as a result of the user study that majority of children enjoyed playing with the Augmented Knight’s Castle which was an augmented toy for enriching the pretend play of children by providing sound effects and verbal reactions of toys. In addition, Hinske et al. (2009) reached as a result of the user study comparing Augmented Knight’s Castle toy with non-augmented edition that children would significantly prefer to play with augmented toy rather than the non-augmented one. They also concluded that children considered augmented toy as providing more fun than traditional toy and computer games. In parallel to these findings, Vaucelle and Jehan (2002) emphasized that children had fun while playing with Dolltalk, a computational toy recording gestures and speech of children and playbacking their voices. Moreover, Fontijn and Mendels (2005) developed StoryToy which is an environment including several stuffed farm animals telling stories and reacting each other animal's actions. They concluded as a result of the experiments of StoryToy with children aged between 2 and 6 that "stories and games prove to be very enjoyable to young children and adults in the right mindset" (Fontijn & Mendels, 2005, p. 42).

Another important finding of the user study of the smart toy with preschool children was that older ages completed cognitive skills part of the smart toy shorter time than younger ages. Additionally, the usability test revealed that older ages finished the pattern activity which can also be considered as a part of cognitive activity in a shorter time than younger ages. Since preschool children included in this study are in the preoperational stage of Piaget (1964)'s four intellectual development stages, the characteristics of this stage can be the reason of this finding. According to Piaget (1964), children's cognitive abilities get higher in accordance with their ages. For instance, children in the concrete operations stage have more advanced cognitive abilities than children in the preoperational stage. This can also be adapted to the children in the same stage. Since preoperational stage includes children aged between 2 – 7, 5 years old children may have improved cognitive skills than 3 years old children. Therefore, the finding of older ages finishing cognitive skills part of the smart toy in a shorter time than younger ages can be linked to the preoperational stage characteristics of children. These findings also reaffirm that age 4 group children participated in storytelling activity less than age 5 and age 6 groups while playing with StoryTech which is a smart toy allowing children to create their own stories by interacting plush toys or background cards with virtual environment (Kara et al., 2013). Kara et al. (2014b) also found that "age group 6 produced more complex stories than either age group 4 or 5 during StoryTech play" (p. 561). Similar to these findings, Frei et al. (2000) reached as a result of informal user study of *curlybot*, a smart toy doing mathematical recording and repated motions, that "children under the age of four generally could not meaningfully interact with *curlybot*" (p. 6). It can be conluded from all these findings that older age group children interact with smart toys more effectively than the younger ones.

Another important finding of the user study of smart toy with preschool children was that 4 of 10 children didn't want to play with the smart toy again. This finding can be associated with the static structure of the smart toy since it provides the same scenes with the same content in each play. Similarly, Kehoe et al. (2004) carried out a user test of Sam which is a virtual peer interacting with children by means of real toys. They pointed out as a result of these tests that children got bored since they listened to same stories in each session. It can be inferred from these findings that smart toy systems should provide dynamic and adaptive content to children to sustain playability.

Another important finding of the user study of smart toy with preschool children was that almost all children had difficulties in deciding to put a toy or card onto the reader especially at the beginning of smart toy play. This is similar to Hinske's (2009) finding that "children tried to make several figures talk simultaneously especially at the beginning of a play session until they understood the concept of how to make figures talk" (p. 225-226). According to Price and Rogers (2004), children need to be informed about the digitally augmented environments and how to interact in these environments effectively.

Another important finding of the user study of smart toy with preschool children was that children aged 36 – 48 months got help from the teachers for almost all tasks. Their concentration was relatively low than older age children and teachers accompanying provided guidance during the smart toy play. According to Ryokai and Cassell (1999), 3 years old children showing a parallel play do separate their own play from others. Since 3 years old children prefer to play with a toy individually, they may need help or guidance when they have problems while playing. This can be the reason of 36 – 48 months old children getting help from teachers for almost all tasks presented in the smart toy. On the other hand, children aged 48 – 72 months completed several tasks without the help of their teachers. Ryokai and Cassell (1999) emphasized that by age 4, children start to be included in social play and interact with others in a cooperative way. It can be understood from this statement that children, by age 4, do not need too much guidance from their teachers since they prefer to play with their friends in collaboratively. This can be the reason of the finding that children aged 48 – 72 months completed several tasks without the help of their teachers. This age group of children may individually try to handle all tasks presented in the smart toy. If they play with their friends, they can handle the tasks in collaborative play environment. Luckin et al. (2003) developed Arthur toy which is a stuffed toy interacting with software and investigated help provided by Arthur. Luckin et al. (2003) reached as a result of user study of Arthur with children that young or inexperienced children, mostly, requested immediate help from researcher during Arthur play. This supports the finding that 36 – 48 months old children got help in nearly every task during the smart toy play. In parallel of these findings, “children who played with StoryTech in the age 4 group, both alone and in dyads, received more support during their discourse process than the children who played with StoryTech in the age 5 and age 6 groups” (Kara et al., 2013, p. 41). It can be concluded from these findings that younger children need more support and help than older children while interacting with smart toys.

Another important finding of the user study was that almost all 5 years old children were successful at solving the patterns without getting any help. Additionally, 5 years old children, in general, finished all tasks of the smart toy in a short time. These findings can be associated with the findings presented above. It can be concluded from these findings that 5 years old children (60 – 72 months) showed greater performance than younger age group of children in completing tasks presented in the smart toy. According to Cagiltay et al. (2014), both cognitive and behavioral activities supported in smart toys can be suitable for children in the preoperational stage. Preoperational stage indicates that children can be included in activities with both behavioral and cognitive purposes. While 3 years old children in the preoperational stage can be leaded to the activities with behavioral purposes, 5 years old children can mostly be leaded to the activities with cognitive purposes. Hence, 5 years old children can be more successful at cognitive activities than 3 and 4 years old children based on the intellectual development stages.

Another important finding of the user study was that plush toys were attractive for all children. Softness, colorfulness and similarity to children's daily life toys can be the reason of this attractiveness. Similarly, Johansson (2009) developed Sniff which is a tangible toy providing multimedia feedback by means of wireless technology. Johansson (2009) emphasized that Sniff has an effective stuffed animal toy for children since it has graspable, soft characteristics and suitable for design elements.

The last finding of the user study of smart toy with preschool children was that interaction of children with the smart toy was successful. Cassell and Ryokai (2001) developed StoryMat offering a play space that records and recalls children's storytelling by using stuffed animals. "StoryMat enhances children's experience by supporting connections, inter-child scaffolding, and the exchange of narrative fantasy in the form of a natural and open-ended collaboration" (Cassell & Ryokai, 2001, p. 189). In addition, Glos and Cassell (1997) developed Rosebud which is a tangible user interface interacting with computer. Glos and Cassell (1997) concluded as a result of user test that "the combined physical and digital interface allows for a richer and more powerful interaction" (p. 360). Moreover, digitally augmented toy environments providing mixed reality improve children's playing experiences and interacting with both physical and virtual realities (Hinske, 2009; Price & Rogers, 2004). In conclusion, smart toys allow children to live powerful interactions since they include the capabilities of both physical and virtual reality.

5.4 Early Childhood Teachers' Smart Toy Experiences

In this part of the study, early childhood teachers' smart toy experiences were evaluated by considering their opinions as to the design and use of smart toy in preschools. Since there have been very limited number of studies investigating teachers' opinions and perspectives about smart toy practices in early educational settings, discussions of teachers' findings can be considered as suggestions or future implications of smart toy practices for formal learning environments.

One of the findings as to smart toy use in preschools was that teachers preferred to use collaborative smart toy play by including projector or television. Similarly, Price and Rogers (2004) stated that “compared with static screen collaboration, digitally augmented physical spaces can support more diverse forms of collaboration, between children and others” (p. 149). Additionally, Cassell and Ryokai (2001) developed StoryMat which can be considered as smart toy allowing children to do storytelling collaboratively by using stuffed animals without requiring keyboard or desktop. Moreover, Farr et al. (2012) found as a result of user study of Augmented Knight’s Castle that augmented play space leaded children to cooperative play rather than solitary play. It can be concluded from these findings that one of the main goals of developing smart toys is to enhance collaboration or cooperation among children during play sessions. It can also be commented that early childhood teachers prefer to integrate smart toys allowing collaborative play into the curriculum based activities.

Teachers, mostly, emphasized the guidance of teacher in smart toy play. In parallel to this finding, Luckin et al. (2003) investigated how children need assistance while interacting with Arthur which is a smart toy combining plush toy with computer software and found that children get help from people, such as peers and parents rather than systems. It can be reached from this finding that early childhood teachers do not want to give the full control to the children while playing with the smart toy.

Based on the findings, teachers considered smart toys as materials which can be used for teaching and learning activities. Additionally, teachers emphasized that smart toys help children in quick and easy learning. Similarly, Hinske (2009) emphasized that augmented toy environments supported playful learning of children by engaging them into these environments. In addition, Price and Rogers (2004) pointed out that “the spaces provide opportunities for a new genre of physical–digital interactions, that can support active learning, and in particular exploration, initiation and reflection” (p. 148). Moreover, Hinske (2009) made interviews with teachers to get their opinions as to Augmented Knight’s Castle toy and found that teachers considered the augmented toy as useful for both formal and informal learning. Furthermore, Frei et al. (2000) found that Curlybot, a self contained smart toy, helped children to learn basic mathematical and computational concepts. It can be concluded from these findings that smart toys can be used in teaching and learning activities of children. Teachers, also think that smart toys can be useful in teaching and learning activities in preschool settings.

One of the findings indicated that teachers considered smart toys as materials which can be used for reinforcement activities. In addition, teachers preferred to use smart toy as an alternative and supportive material in preschool education. Teachers also emphasized that smart toy helps teacher in giving several concepts. Bodén, Dekker, Viller and Matthews (2013) developed *Save the wild* which is an augmented reality based system allowing children interacting with computer via origami paper characters. According to Bodén et al. (2013), “through the use of the markers, physical activities can be extended and reused to help reinforce the learning objectives, passively augmented by technology” (p. 234-235). Additionally, Piper and Ishii (2002) developed Pegblocks which is a smart toy aiming at showing basic physics principles to elementary school students and found that Pegblocks support children to understand abstract concepts in physics rather than teaching. It can be concluded that early childhood teachers have a tendency to use smart toys for supporting classroom practices and reinforcing children’s learning.

Another finding as to the smart toy use in preschools was that teachers considered smart toys as materials which can be used for assessment and evaluation activities. According to early childhood teachers, smart toys can be applied in preschool settings for evaluating children’s performances about curriculum related activities. It can be concluded from this finding that smart toys can be integrated into preschool education to carry out assessment and evaluation of classroom based activities.

Based on teachers’ responses, smart toy took attention of children. In addition, most of the teachers stressed that smart toy improves motivation of children. It can be inferred from these findings that teachers support integrating smart toys into preschool settings to enhance motivation of children since these toys provide enjoyable and fun play. Similarly, Hinske et al. (2009) found as a result of user study of Augmented Knight's Castle that children preferred to play with the augmented toy rather than the non-augmented version in terms of its fun and entertainment characteristics. Additionally, Kehoe et al. (2004) found in their study that children had fun while playing with Sam which is a virtual peer system interacting with real toys.

According to the early childhood teachers, smart toy is suitable for individual play. Although teachers, in general, prefer to use smart toys in collaborative classroom environments, they also think that smart toys are suitable for individual play of children. This finding also implies that early childhood teachers support smart toy play for not only formal learning environments but also informal learning environments.

Another finding as to smart toy use in preschools was that teachers emphasized the suitability of smart toys for 3 and 4 years old children. Additionally, teachers declared that the structure of smart toy is simple for children. These two findings can be associated with each other because teachers think that the content presented in the smart toy developed in this study was static and simple for children. It can be concluded from these findings that complexity is required in smart toy play to sustain smart toy play for not only very young age group of children but also older age groups. In parallel to this view, Fontijn and Mendels (2005) stressed in their study that complexity can make augmented toy environments suitable for different age group of children.

Teachers also agreed on the authenticity of the smart toy. It can be inferred from teachers' opinion that the original structure of smart toys allowing mutual interaction between physical toys and computers is valuable in preschool education. Similarly, Price and Rogers (2004) stated that "authenticity is another aspect of digitally augmented physical spaces is that they can provide children with the means by which to interact with the physical environment" (p. 149).

Based on the teachers' responses, smart toys make teacher's job easier. Additionally, majority of teachers pointed out the easiness of showing patterns via the smart toy. It can be concluded from these findings that teachers consider the smart toy as a supportive material which can be used at some points in classroom activities. They also implied that pattern activities can effectively be done by using smart toys since different type of patterns can be presented by interacting real toys with virtual content.

According to the early childhood teachers, novelty effect is one of the problems of smart toy. It can be inferred from this finding that teachers have a desire to know whether smart toys can be used in formal learning environments for a long time.

The last finding as to the smart toy use in preschools was the problem of one to one play of children with the smart toy at crowded classrooms. Teachers think that smart toy practices can not be effective at crowded classrooms. Similarly, "careful attention to the existing infrastructure in classrooms can lead to the introduction of new technology that is not invasive but supports and enhances existing classroom and learning activities" (Bodén et al., 2013, p. 234). That is, the situation of preschool classrooms needs to be analyzed well to decide to integrate new technologies like smart toys.

5.5 Implications for Preschool Education

According to Siraj-Blatchford and Siraj-Blatchford (2006), four key areas of learning in ECE and its relationship with ICT are described as follows:

- Communication and collaboration – they naturally appear in collaborative problem solving, drawing, video recording, or construction, using screen-based applications, in experimenting with programmable toys.

- Creativity – to be creative, children need to acquire a repertoire of schemes, and they need the playful disposition to try out these schemes in new contexts.
- Socio-dramatic play – there is an enormous scope for the integration of ICT into young children's play environments.
- Learning to learn – the ICT applications that support the development of metacognition and learning to learn are also those that most effectively support communication and collaboration and socio-dramatic play.

For *communication and collaboration*, the findings of this study revealed that early childhood teachers prefer to use smart toys in collaborative way in early educational settings. This collaborative smart toy play can allow children to build effective communications with not only teachers but also classmates. Since children can interact with both the virtual environment presented in Flash animation and tangible interfaces, such as plush toys and cards while playing with the smart toy, several tasks offered in smart toy play can be accomplished by different children under the guidance of teachers. This can also create an affective learning environment for children while playing with the toy. This is also supported by the finding that teachers considered the smart toy as not only a supporting tool but also a material which can be used in teaching, learning and evaluation activities.

For *creativity*, smart toys can be considered as technology giving a chance to improve children's creativity with its mixed reality structure. According to early childhood teachers, one of the findings of the benefits of smart toy play was that smart toy improves creativity of children. Therefore, smart toy as a form of ICT can support children's learning in early educational settings. Since children interact with physical toys or educational softwares seperately, smart toys can increase the creative play by combining physical toys with virtual environments. Integrating fun, entertaining and technological components of virtual media into plush toys or cards can allow children to be included in several creative activities.

For *socio-dramatic play*, ICT can offer several possibilities for children to be involved into dramatic play activities. The rich, varied and entertaining structure of ICT can provide a learning environment in which several socio-dramatic play activities can occur. In this study, several design principles for content, visual design and interaction themes were generated for smart toys. These principles can be seen as guidelines for practitioners or teachers to create socio-dramatic play environment including smart toy practices. Since engaging children into play activities help them learn easily in preschool education, smart toys can be considered as supporting technology creating an interactive play environment. In this environment, children can have different roles while playing with the smart toy. For instance, if different seasons are provided in smart toy play, a child who has a specific season role can interact with the smart toy by putting the suitable season plush toy or card to interact with the season in virtual environment. This smart toy based play activity helps children learn seasons in the way of dramatic play.

For *learning to learn,* ICT applications provide a rich environment for learners to support their learning. Smart toys as practices of ICTs can provide an interactive environment for children to interact with both physical toys and virtual media. Since smart toys provide content in line with visual design and interaction components, children have a chance to build their own learning based on the smart toy play experiences. This is also similar to Constructionist view that children can build their own knowledge by actively creating meaningful products.

In summary, smart toy practices can be integrated into preschool education to support children’s learning. A new, rich and integrated structure of smart toys help teachers use these toys in collaborative activities in preschool settings to create supportive and alternative learning environment.

5.6 Implications for Instructional Designers

The design and development model of this study can be helpful for instructional designers who are interested in designing issues of smart toys. Additionally, the design principles emerged at this study can guide instructional designers to design and develop similar systems combining physical and virtual realities. Since the smart toy interacting with computer has a virtual content developed in Flash animation, the design principles which are also valid for virtual environment can be adapted to other computer applications, such as educational games and softwares. Moreover, iterative cycles which are important in design and development research can be guidance for instructional designers or practitioners. Finally, user study findings and teachers' views as to smart toy practices can yield strategies for instructional designers to shape early educational settings in accordance with technology use, specifically smart toy play.

5.7 Implications for Early Childhood Teachers

Based on the findings of this study, early childhood teachers, in general, have a desire to use technology in classroom settings. Findings also indicated that teachers are not supported by the curriculum in terms of how to appropriately integrate technology into classrooms. Another finding was that there is a lack of high quality digital resources to use for children. It can be understood from these findings that teachers want to use technology if it is suitable for children and preschool education. At this point, this study can be helpful for early childhood teachers in terms of using smart toys in preschool education. Since early childhood teachers were the main contributors of this study, design principles emerged at the end of the analysis, design, development and evaluation phases can be guidelines for teachers in adapting similar technologies into preschool settings. The findings of semi-structured interviews conducted in the summative evaluation phase can yield practical samples for early childhood teachers in using smart toys in preschool education. Several objectives covered in both personal care and cognitive parts of the smart toy can help teachers support teaching activities. Because teachers considered the pattern activity part of the smart toy as the most useful activity in giving pattern concept to children, the presentation of pattern part in the smart toy can be applicable for all early childhood teachers who try to teach or practice patterns to preschool children. Since smart toys include both physical toys and virtual interface, design principles generated as a result of this study can be valid for similar virtual programs, such as educational softwares and educational digital games. Hence, the findings of this study can be useful for early childhood teachers in being aware of the design principles that educational softwares should have.

5.8 Implications for Policy Makers

It is expected with this study that the findings can offer implications for policy makers in preschool education. First of all, preschool teachers' needs and expectations as to technology use in preschool education can be taken into consideration by policy makers especially in revising preschool curriculum in terms of integrating technology into preschool education. Additionally, design principles emerged at this study can be guidelines for policy makers to determine specific tools or materials to be used in preschool education. Moreover, the design and development research model of this study can guide policy makers to follow specific design and development phases to develop specific educational technologies suitable for both early childhood teachers and preschool children. Finally, the findings of this study can be helpful for policy makers to understand preschool teachers' strategies as to smart toy practices.

5.9 Conclusion

Smart toys can be considered as new forms of play activities combining physical toys with virtual settings. Since play activities have valuable role in preschool education, smart toys have potential to support and enhance these play activities by including not only physical toys but also the richness of virtual mediums. Hence, it can be concluded that smart toys having the power of both physical and virtual realities may be enjoyable and supportive material for children. On the other hand, these toys may be the materials enhancing early educational settings by integrating technology into preschool curriculum appropriately.

The main goal of this study was to design, development and use of smart toy for preschool children. Since early childhood teachers, mainly, lead preschool education in preschool settings based on the preschool curriculum, these teachers were mainly included in the study. Hence, curriculum focused design was selected to consider the objectives in preschool curriculum while designing the smart toy. Additionally, user studies were accomplished with children to improve the design and investigate the effectiveness of the smart toy. Moreover, scholars were included to get their suggestions as to design and development process. Based on this process, it can be concluded that integrating early childhood teachers, preschool children and academics into design and development of smart toys are important to create the most effective and useful material. Another important conclusion as to design and development period can be seen as the iterative cycles of collecting data from scholars, teachers and children. These cycles allow researcher or designer to revise the product iteratively to reach the best design which is suitable for children and teachers' expectations. Design and development research, at this point, meets researcher's data collection and analyse strategies since it allows several methods and strategies in iterative design and development period.

At the end of the study, several design principles emerged. These principles were categorized as content, visual design and interaction. It is expected with these principles that the best smart toy practices can be applied in preschool education by following these design principles in design and development of smart toys. Additionally, usability tests of the smart toy were carried out with preschool children. It might be concluded from the results of the user studies that children, both girls and boys enjoy while playing with the smart toy. Since today's children have a big tendency to play with digital materials, integrating the virtual power into children's daily toys can be supportive and enjoyable for children. Moreover, teachers' views as to both technology and smart toy use were gathered in this study. According to early childhood teachers, technology needs to be included in preschool education in case of appropriate integration. They also emphasized that smart toys can be adapted to preschool settings by following several strategies. It might be concluded from teachers' statements that they are positive to technology use in preschool education. Smart toys can be alternative and supportive material since they have not only enjoyable, fun and augmented characteristics but also a structure allowing curriculum based components.

With this study, a smart toy was designed, developed and evaluated with the contributions of early childhood teachers, preschool children and scholars. Although the study provides a road map for designing and developing smart toys, several research studies, still, need to be done to improve the smart toy literature. It is expected that the results of this study help children, teachers, researchers and instructional designers who are interested in smart toys.

5.10 Suggestions for Future Research

This study was about designing and developing smart toy by including early childhood teachers, preschool children and IT and ECE scholars. At the end of the study, design principles as to designing and developing smart toys were produced. On the other hand, children's and teachers' smart toy practices were analyzed. Although this study can provide a broad perspective to design, develop and use of smart toys, future research would be needed in the following areas:

- Design principles were provided in this study. These design principles could be investigated by conducting large scale user studies of children playing with smart toys.
- Long terms studies could be applied to evaluate the effectiveness of smart toy play in early educational settings.
- Observation studies could be done to investigate the integration of smart toys into curriculum activities in preschool settings.

- Although this study mainly focused on designing and developing smart toys for formal learning environments, using smart toys in informal learning environments could be investigated as future research.

- Parents could be included in future research studies to evaluate children's smart toy play out of school.

- Phenomenological research studies could be implemented to understand children's experiences as to play in mixed reality environments.

- Gender differences could be analyzed by conducting research studies comparing boys' and girls' play experiences with smart toys.

5.11 Limitations of the Study

There were limitations of this study. These limitations were as follow:

- This study was limited to early childhood teachers, preschool children and IT and ECE scholars who attended as participants.

- Qualitative methods were mostly applied throughout the study. Since several participants' views were included in the study, qualitative methods were mostly preferred. On the other hand, usability tests of the smart toy with preschool children were also carried out.

- The smart toy interacting with computer was mainly considered in this study. Although smart toys are separated as self-contained and interacting with computers, smart toy interacting with computer was the main material of the study.

- RFID technology was the main component providing communication between physical toys and virtual environment. Other technologies could also be option for digital augmentation of physical toys.

- Researcher was the main person doing all transcriptions and analysis of data.

REFERENCES

Amiel, T., & Reeves, T. C. (2008). Design-based research and educational technology: Rethinking technology and the research agenda. *Educational Technology & Society, 11*, 29–40.

Atay-Turhan, T., Koc, Y., Isiksal, M., & Isiksal, H. (2009). The new Turkish early childhood teacher education curriculum: A brief outlook. *Asia Pacific Education Review, 10*, 345–356.

Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *Journal of the Learning Sciences, 13*(1), 1–14.

Bell, P. (2004). On the theoretical breadth of design-based research in education. *Educational Psychologist, 39*(4), 243–253.

Bers, M., & Cassell, J. (1998). Interactive Storytelling Systems for Children: Using Technology to Explore Language and Identity. *Journal of Interactive Learning Research, 9*(2), 183–215.

Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers & Education, 77*, 82–90.

Bodén, M., Dekker, A., Viller, S., & Matthews, B. (2013). Augmenting play and learning in the primary classroom. *Proceedings of the 12th International Conference on Interaction Design and Children* (pp. 228–236). New York: ACM.

Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theory and methods* (5th ed.). Boston: Allyn & Bacon.

Bolstad, R. (2004). *The role and potential of ICT in early childhood education. A review of New Zealand and international literature.* Wellington: Ministry of Education.

Bowman, B. (1993). Early childhood education. *Review of Research in Education, 19*, 101–134.

Brenner, M. E. (2006). Interviewing in educational research. In J. L. Green, G. Camilli, & P. B. Elmore (Eds.), *Handbook of complementary methods in education research* (pp. 357–370). Mahwah, NJ: Lawrence Erlbaum.

Brna, P., & Cox, R. (1998). Adding intelligence to a learning environment: Learner-centred design? *Journal of Computed Assisted Learning, 14*, 268–277.

Cagiltay, K., Kara, N., & Aydin, C. C. (2014). Smart toy based learning. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of Research on Educational Communications and Technology* (4th ed., pp. 703–711). New York: Springer.

Cassell, J., & Ryokai, K. (2001). Making space for voice: Technologies to support children's fantasy and storytelling. *Personal and Ubiquitous Computing, 5*(3), 169–190.

Chan, T.-W., Roschelle, J., Hsi, S., Kinshuk, Sharples, M., Brown, T., . . . Hoppe, U. (2006). One to one technology-enhanced learning: An opportunity for global research collaboration. *Research and Practice in Technology Enhanced Learning Journal*, *1*, 3–29.

Chen, J., & Chang, C. (2006). Using computers in early childhood classrooms: Teachers' attitudes, skills and practices. *Journal of Early Childhood Research, 4*(2), 169–188.

Cifuentes, L., Sharp, A., Bulu, S., Benz, M., & Stough, L. M. (2010). Developing a Web 2.0-based system with user-authored content for community use and teacher education. *Educational Technology Research and Development, 58*(4), 377–398.

Cox, M., & Marshall, G. (2007). Effects of ICT: Do we know what we should know? *Education and Information Technologies, 12*(2), 59–70.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into Practice, 39*(3), 124–130.

Donaldson, J. A., & Knupfer, N. N. (2002). Education, learning and technology. In P. L. Rogers (Ed.), *Designing instruction for technology-enhanced learning* (pp. 19–54). Hershey, PA: Idea Group Publishing.

Druin, A. (2002). The role of children in the design of new technology. *Behaviour and Information Technology, 21*(1), 1–25.

Druin, A., Bederson, B., Hourcade, J. P., Sherman, L., Revelle, G., Platner, M., & Weng, S. (2001). Designing a digital library for young children: An intergenerational partnership. In E. Fox, & C. Borgman (Eds.), *Proceedings of the First ACM/IEEE-CS Joint Conference on Digital Libraries* (pp. 398–405). New York: ACM Press

Eisenberg, M. (2003). Mindstuff: Educational technology beyond the computer. *Convergence*, *9*(2), 29–53.

Farr, W., Yuill, N., & Hinske, S. (2012). An augmented toy and social interaction in children with autism. *International Journal of Arts and Technology, 5*(2/3/4), 104–125.

Fontijn, W., & Mendels, P. (2005, May 8–13). StoryToy: The interactive storytelling toy. In H. Gellersen, R. Want, & A. Schmidt (Eds.), *Third International Conference, PERVASIVE 2005*. Munich, Germany. *Proceedings series: Lecture notes in computer science, 3468*, 37–42.

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education* (6th ed.). New York, NY: McGraw-Hill.

Frei, P., Su, V., Mikhak, B., & Ishii, H. (2000). Curlybot: designing a new class of computational toys. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 129–136). New York: ACM Press. doi:10.1145/332040.332416

Gialamas, V., & Nikolopoulou, K. (2010). In-service and pre-service early childhood teachers' views and intentions about ICT use in early childhood settings: a comparative study. *Computers & Education, 55*, 333–341.

Glos, J., & Cassell, J. (1997). Rosebud: Technological toys for storytelling. In S. Pemberton (Ed.), *Proceedings of the Conference on Human Factors in Computing Systems* (pp. 359–360). New York, NY: ACM Press.

Gok, A., Turan, S., & Oyman, N. (2011). Okul öncesi öğretmenlerinin bilişim teknolojilerini kullanma durumlarına ilişkin görüşleri. *Pegem Eğitim ve Öğretim Dergisi, 1*(3), 59–66.

Hanna, E., Risden, K., Czerwinski, M., & Alexander, K. J. (1999). The role of usability research in designing children's computer products. In A. Druin (Ed.), *The design of children's technology* (pp. 4–26). San Francisco, CA: Morgan Kaufmann.

Hay, K. E., & Barab, S. A. (2001). Constructivism in practice: A comparison and contrast of apprenticeship and constructionist learning environments. *The Journal of the Learning Sciences*, *10*, 281–322.

Hinske, S. (2009). *Digitally augmenting traditional play environments*. (Unpublished doctoral dissertation), ETH Zurich, Zurich.

Hinske, S., Lampe, M., Yuill, N., Price, S., & Langheinrich, M. (2009). Kingdom of the knights: evaluation of a seamlessly augmented toy environment for playful learning. In *Proceedings of the 8th International Conference on Interaction Design and Children* (pp. 202–205). New York, NY: ACM.

Hogle, J. G. (1996). *Considering games as cognitive tools. In Search of effective "edutainment"*. University of Georgia Department of Instructional Technology. Retrieved June 10, 2015, from http://eric.ed.gov/?id=ED425737

Hourcade, J. P. (2008). Interaction design and children. *Foundations and Trends in Human-Computer Interaction, 1*(4), 277–392.

Hsi, S., & Soloway, E. (1998). Learner-centered design: Addressing, finally, the unique needs of learners. In *Proceedings of Computer Human Interaction '98* (pp. 211–212). New York: ACM Press.

Huizinga, J. (1955). Nature and significance of play as a cultural phenomenon. In K. Salen & E. Zimmerman (Eds.), *The game design reader: A rules of play anthology* (pp. 96–120). Cambridge: MIT Press.

Inal, Y. (2011). *Physically interactive educational game design for childen: Defining design principles* (Unpublished doctoral dissertation). Middle East Technical University, Ankara.

Isikoglu, N., Basturk, R., & Karaca, F. (2009). Assessing in-service teachers' instructional beliefs about student-centered education: A Turkish perspective. *Teaching and Teacher Education, 25*, 350–356.

Johansson, S. (2009). Sniff: designing characterful interaction in a tangible toy. In P. Paolini & F. Gartotto (Eds.), *Proceedings of the 8th International Conference on Interaction Design and Children (IDC '09)* (pp. 186–189). New York: ACM press.

Johnson, W. L., Rickel, J. W., & Lester, J. C. (2000). Animated pedagogical agents: Face-to-face interaction in interactive learning environments. *International Journal of Artificial Intelligence in Education, 11*, 47–78.

Kabadayi, A. (2006). Analyzing pre-school student teachers' and their cooperating teachers' attitudes towards the use of educational technology. *Turkish Online Journal of Educational Technology, 5*(4). Retrieved June 15, 2015, from www.tojet.net

Kalaš, I. (2010). *Recognizing the potential of ICT in early child education. Analytical Survey*. Moscow: UNESCO Institute for Information Technologies in Education.

Kara, N., Aydin, C. C., & Cagiltay, K. (2013). Investigating the activities of children toward a smart storytelling toy. *Educational Technology and Society*, *16*(1), 28–43.

Kara, N., Aydin, C. C., & Cagiltay, K. (2014a). Design and development of a smart storytelling toy. *Interactive Learning Environments*, *22*(3), 288–297.

Kara, N., Aydin, C. C., & Cagiltay, K. (2014b). User study of a new smart toy for children's storytelling. *Interactive Learning Environments*, *22*(5), 551–563.

Keengwe, J., & Onchwari, G. (2009). Technology and early childhood education: a technology integration professional development model for practicing teachers. *Early Childhood Education Journal*, *37*(3), 209–218.

Kehoe, C., Cassell, J., Goldman, S., Dai, J., Gouldstone, I., MacLeod, S., . . . Wang, A. (2004). Out of the lab and into the world: Bringing story listening systems to the classroom. *AERA*.

Lampe, M., & Hinske, S., (2007). Integrating interactive learning experiences into augmented toy environments. *Proceedings of Pervasive Learning Workshop at Pervasive 2007* (pp. 1–9). Toronto, Canada.

Large, A., & Beheshti, J. (2005). Interface design, web portals, and children. *Library Trends*, *54*(2), 318–342.

Lester, J., Converse, S., Kahler, S., Barlow, S., Stone, B., & Bhogal, R. (1997). The persona effect: affective impact of animated pedagogical agents. In S. Pemberton (Ed.), *Human Factors in Computing Systems: CHI'97 conference proceedings* (pp. 359–366). New York: ACM Press.

Luckin, R., Connolly, D., Plowman, L., & Airey, S. (2003). Children's interactions with interactive toy technology. *Journal of Computer Assisted Learning, 19*(2), 165–176.

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow & M. J. Farr (Eds.), *Aptitude learning and instruction: Volume 3: Cognitive and affective process analyses* (pp. 223–253). Retrieved June 22, 2015, from http://ocw.metu.edu.tr/mod/resource/view.php?id=1311

Mangen, A. (2010). Point and click: theoretical and phenomenological reflections on the digitization of early childhood education. *Contemporary Issues in Early Childhood, 11*(4), 415–431.

Marsh, J., Brooks, G., Hughes, J., Ritchie, L., Roberts, S. & Wright, K. (2005) *Digital beginnings: young children's use of popular culture, media and new technologies*. Retrieved July 22, 2015, from http://www.digitalbeginnings.shef.ac.uk/final-report.htm

Marshall, C., & Rossman, G. B. (2011). *Designing qualitative research* (5th ed.). Thousand Oaks, CA: Sage Publications.

McKenney, S., & van den Akker, J. (2005). Computer-based support for curriculum designers: a case of developmental research. *Educational Technology Research and Development, 53*(2), 41–66.

Miles, M. B., & Huberman, A. M. (1994). *An expanded sourcebook: Qualitative data analysis* (2nd ed). Thousand Oaks, CA: Sage Publications.

MoNE. (2013). *Okul öncesi eğitim programı*. Retrieved May 14, 2015, from http://tegm.meb.gov.tr/dosya/okuloncesi/ooproram.pdf

MoNE. (2014). *National Education Statistics. Formal Education 2013/'14*. Retrieved June 16, 2015, from http://sgb.meb.gov.tr/www/milli-egitim-istatistikleri-orgun-egitim-2013-2014/icerik/95

Nielsen, J. (1993). *Usability Engineering*. London: Academic Press.

Nikolopoulou, K., & Gialamas, V. (2009). Investigating pre-service early childhood teachers' views and intentions about integrating and using computers in early childhood settings: Compilation of an instrument. *Technology, Pedagogy and Education, 18*(2), 201–219.

Oguz, E., Ellez, A. M., Akamca, G. O., Kesercioglu, T. I., & Girgin, G. (2011). Early childhood teacher candidates' attitudes towards computer and computer assisted instruction. *Elementary Education Online, 10*(3), 934–950. Retrieved May 20, 2015, from http://ilkogretim-online.org.tr/

Onkol, F. L., Zembat, R., & Balat, G. U. (2011). Computer use attitudes, knowledge and skills, habits and methods of preschool teachers. *Procedia Computer Science, 3*, 343–351. Retrieved June 15, 2015, from http://www.sciencedirect.com/science/article/pii/S1877050910004333

Papert, S. (1991). Situating constructionism. In I. Harel, & S. Papert (Eds.), *Constructionism* (pp. 1–14). Hillsdale, NJ: Lawrence Erlbaum Associate.

Pardo, S., Vetere, F., & Howard, S. (2005). Broadening stakeholder involvement in UCD: designers' perspectives on child-centred design. In *Proceedings of the 19th conference of the computer-human interaction special interest group (CHISIG) of Australia on Computer-human interaction: citizens online: considerations for today and the future* (pp. 1–9). Australia: ACM Press.

Parette, H. P., Quesenberry, A. C., & Blum, C. (2010). Missing the boat with technology usage in early childhood settings: a 21st century view of developmentally appropriate practice. *Early Childhood Education Journal, 37*(5), 335–343.

Petersson, E., & Brooks, A. (2006). Virtual and physical toys: Open-ended features for non-formal learning. *Cyberpsychology & Behavior, 9*(2), 196–199.

Piaget, J. (1964). Development and learning. In R. E. Ripple & V. N. Rockcastle (Eds.), *Piaget rediscovered: Report of the conference on cognitive studies and curriculum development* (pp. 7–20). Ithaca, NY: Cornell University Press.

Piper, B., & Ishii, H. (2002). PegBlocks: A learning aid for the elementary classroom. In L. Terveen & D. Wixon (Eds.), *CHI '02 extended abstracts on human factors in computing systems* (pp. 686–687). Minneapolis, MN: ACM Press.

Plowman, L., & Stephen, C. (2003). A 'benign addition'? Research on ICT and pre-school children. *Journal of Computer Assisted Learning, 19*, 149–164.

Plowman, L., & Stephen, C. (2005). Children, play and computers in pre-school education. *British Journal of Educational Technology, 36*(2), 145–157.

Plowman, L., Stephen, C., & McPake, J. (2010). Supporting young children's learning with technology at home and in preschool. *Research Papers in Education, 25*(1), 93–113.

Price, S., & Rogers, Y. (2004). Let's get physical: The learning benefits of interacting in digitally augmented physical spaces. *Computers and Education, 43*(1–2), 137–151.

Reeves, T. C., Herrington, J., & Oliver, R. (2004). A development research agenda for online collaborative learning. *Educational Technology Research and Development, 52*(4), 53–65.

Reichel, M., Osterloh, A., Katterfeldt, E.-S., Butler, D., & Schelhowe, H. (2008). Eduwear: designing smart textiles for playful learning. In *Readings in Technology in Education: Proceedings of ICICTE'08* (pp. 252–263). Corfu, Greece.

Resnick, M. (1998). Technologies for lifelong kindergarten. *Educational Technology Research and Development, 46*(4), 43–55.

Richey, R. C., & Klein, J. D. (2008). Research on design and development. In J. M. Spector, M. D. Merrill, J. van Merrienboer, & M. P. Driscoll (Eds.), *Handbook of Research on Educational Communications and Technology* (3rd ed., pp. 748–757). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Richey, R. C., & Klein, J. D. (2014). Design and development research. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of Research on Educational Communications and Technology* (4th ed., pp. 141–150). New York: Springer.

Rode, J. A., Stringer, M., Toye, E. F., Simpson, A. R., & Blackwell, A. F. (2003). Curriculum-focused design. In *Proceeding of the 2003 Conference on Interaction Design and Children* (pp. 119–126). Preston, UK.

Ryokai, K., & Cassell, J. (1999). Computer support for children's collaborative fantasy play and storytelling. In *Proceedings of Computer Support for Collaborative Learning* (pp. 510–517). Stanford, CA, USA: International Society of the Learning Sciences.

Sanders, E. B.-N. (2002). From user-centered to participatory design approaches. In J. Frascara (Ed.), *Design and the social sciences: making connections* (pp. 1–8). London: Taylor & Francis.

Scaife, M., Rogers, Y., Aldrich, F., & Davies, M. (1997). Designing for or designing with? Informant design for interactive learning environments. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 343– 350). New York: ACM Press.

Schweikardt, E., & Gross, M. (2007). A brief survey of distributed computational toys. In *Proceedings of DIGITEL* (pp. 57–64). Jhongli, Taiwan.

Shneiderman, B. (2004). Designing for fun: How to make user interfaces more fun? *Interactions, 11*(5), 48–50.

Siraj-Blatchford, I., Siraj-Blatchford, J. (2006). *A Guide to Developing the ICT Curriculum for Early Childhood Education*. UK: Trentham Books.

Smith, B., K. & Reiser, B. J. (1998). National Geographic unplugged: Classroom centered design of interactive nature films. In C. Karat, A. Lund, J. Coutaz, &

J. Karat (Eds.), *Proceedings of the CHI 98 Conference on Human Factors in Computing Systems* (pp. 424–431), Reading, MA: Addison-Wesley.

Stephen, C., & Plowman, L. (2003). Information and communication technologies in pre-school settings: A review of the literature. *International Journal of Early Years Education, 11*(3), 223–234.

Stipek, D. J., & Byler, P. (1997). Early childhood education teachers: Do they practice what they preach? *Early Childhood Research Quarterly, 12*, 305–325.

Towns, B. (2010). *Computer education and computer use by preschool educators* (Order No. 3403175). Available from ProQuest Dissertations & Theses Global. (365702854). Retrieved June 22, 2015, from http://search.proquest.com/docview/365702854?accountid=13014

Tsitouridou, M., & Vryzas, K. (2004). The prospect of integrating ICT into the education of young children: The views of Greek early childhood teachers. *European Journal of Teacher Education, 27*(1), 29–45.

Vaucelle, C., & Jehan, T. (2002). Dolltalk: a computational toy to enhance children's creativity. In *CHI '02 Extended Abstracts on Human Factors in Computing Systems* (pp. 776–777). New York, NY: ACM Press.

Vredenburg, K., Mao, J.-Y., Smith, P. W., & Carey, T. (2002). A survey of user-centered design practice. In L. Terveen, D. Wixon, E. Comstock, & A. Sasse (Eds.), *Proceedings of ACM Conference on Human Factors in Computing Systems* (pp. 472–478). New York: ACM Press.

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, *53*(4), 5–23.

Wood, E., Specht, J., Willoughby, T., & Mueller, J. (2008). Integrating computer technology in early childhood education environments: issues raised by early childhood educators. *Alberta Journal of Educational Research*, *54*(2), 210–228.

Yelland, N. (1999). Technology as play. *Early Childhood Education Journal*, *26*(4), 217–220.

Yelland, N. (2005). The future is now: A review of the literature on the use of computers in early childhood education (1994-2004). *AACE Journal*, *13*(3), 201–232.

Yurt, O., & Cevher-Kalburan, N. (2011). Early childhood teacher's thoughts and practices about the use of computers in early childhood education. *Procedia Computer Science*, *3*, 1562–1570. Retrieved June 10, 2015, from http://www.sciencedirect.com/science/article/pii/S1877050911000512#

APPENDIX A

TEACHER INTERVIEW QUESTIONS FOR NEEDS ANALYSIS – 1

Görüşme Planı

Okul	Tarih ve Zaman (başlama-bitiş)	Görüşmeci

Giriş

Merhaba, adım Nuri Kara. Orta Doğu Teknik Üniversitesi Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü'nde araştırma görevlisiyim. Aynı zamanda aynı bölümde doktoramı yapmakta olup, şu an tez aşamasında bulunmaktayım. Sizinle de bu tez çalışması kapsamında görüşme yapma amacıyla burada bulunmaktayım. Tez başlığım okul öncesi çocuklar için akıllı oyuncak tasarımı, geliştirilmesi ve kullanımı olup, ilk aşamada Okul öncesi öğretmenlerinin teknolojiye bakış açılarını ve var olan teknoloji kullanma durumlarını ortaya çıkarmak amacıyla okul öncesi öğretmenleriyle görüşmeler yapıyorum. Araştırma sonuçlarının okul öncesi eğitimi destekleme noktasında bilimsel bir katkı yapmasını umut etmekteyim. Bu nedenle sizin içten ve samimi cevaplarınızı duymak büyük bir mutluluk verecektir.

Konuşmalarımız tamamen gizli tutulacak olup, üçüncü şahıslarla kesinlikle paylaşılmayacaktır. Ayrıca sizin ve okulunuzun ismi yazılı akademik belgelerde asla yer almayacaktır.

Sormak istediğiniz başka sorular varsa lütfen sorun?

Bu arada görüşmemizi ses kayıt cihazıyla kaydetmek istiyorum, izin verir misiniz? Ayrıca görüşmemiz yaklaşık 45 dakika ya da 1 saat sürecektir.

Demografik Sorular

İlk olarak sizi ve konumunuzu daha iyi tanımlayabilmek adına bazı giriş sorularıyla başlamak istiyorum.

1. Kaç yıldır okul öncesi öğretmenliği yapıyorsunuz?
2. Yaşınızı sorabilir miyim?
3. Hangi üniversiteden mezun oldunuz?

İçerik ve Süreç ile İlgili Sorular

1. Halihazırda okul öncesi eğitiminde teknoloji kullanma düzeyiniz nedir? Ne tür teknolojiler kullanıyorsunuz?

2. Bu teknolojileri hangi ortamlarda (derslerde) kullanıyorsunuz?

3. Bu teknolojileri hangi amaçlar için kullanıyorsunuz?
   Prompt. Özellikle hangi kazanımları teknoloji destekli olarak işliyorsunuz?

4. Bu teknolojilerin sürece katkısı hakkında neler düşünüyorsunuz?
   Prompt. Eğitim-öğretim sürecine katkıları (öğretmenler açısından)
   Çocukların öğrenmesine olan katkıları
   Ders işlenişi ve müfredata yönelik katkıları

5. Okul öncesi eğitimde teknoloji kullanımına yönelik herhangi bir destek aldınız mı ya da halihazırda veriliyor mu? (Hizmet içi eğitim, çalıştığınız kurum tarafından verilen destek,...vb.) Aldıysanız içeriği nedir, nasıl buldunuz?

6. Okul öncesi müfredatı sizi öğretimde teknoloji kullanımına yönelttiğini düşünüyor musunuz? Düşünüyorsanız, özellikle hangi alanlarda böyle bir beklenti var?
   Alt S. Müfredat, teknolojinin okul öncesi eğitime entegre edilmesi konusunda yeterli detayları veriyor mu? Bu noktada müfredattan beklentileriniz nelerdir?

7. Okul öncesi eğitim kurumunda teknoloji kullanımına nasıl bakıyorsunuz?
   Prompt. Avantajları ve dezavantajları neledir?

8. Çocuklar açısından bakarsanız, çocukların okul öncesi eğitimde teknolojiye ihtiyaç duyduğunu hissediyor musunuz? Nedenleri nelerdir?
   Alt S. Okul öncesi eğitimde bazı derslerin teknoloji destekli olarak verilmesi hakkında ne düşünüyorsunuz? Çocukların böyle bir eğitime ihtiyaçları olabilir mi?

9. Teknolojinin çocuklar üzerindeki olumlu ya da olumsuz etkilerini düşündüğünde bunlar size göre neler olabilir? Hangi tarafın daha ağır bastığını düşünüyorsunuz?

10. Teknolojinin özellikle eğitim hayatına yönelik katkıları hakkında ne düşünüyorsunuz?

11. Teknoloji hakkında herkes farklı bir fikre sahip olabilir. Sizin için “teknoloji” neyi ifade ediyor?
    Alt S. Teknoloji herkes için farklı anlamlar ifade edebilir. Sizin için teknolojiye yönelik hangi kavram, fikir ya da tanım daha önemli gelmektedir?

12. Teknolojiye yönelik tutumunuzu nasıl tanımlarsınız?
    Prompt. Günlük hayatta kullandığınız teknolojiler nelerdir?

13. Kendinizi teknoloji kullanımı açısından yetkin hissediyor musunuz? Size göre yetkinlik düzeyiniz nedir?
    Alt S. Teknoloji kullanımı sırasında karşılaştığınız zorluklar nelerdir?

APPENDIX B

TEACHER INTERVIEW QUESTIONS FOR NEEDS ANALYSIS – 2

Görüşme Planı

Okul Tarih ve Zaman (başlama-bitiş) Görüşmeci

Giriş

Merhaba, adım Nuri Kara. Orta Doğu Teknik Üniversitesi Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü'nde araştırma görevlisiyim. Aynı zamanda aynı bölümde doktoramı yapmakta olup, şu an tez aşamasında bulunmaktayım. Sizinle de bu tez çalışması kapsamında görüşme yapma amacıyla burada bulunmaktayım. Tez başlığım okul öncesi çocuklar için akıllı oyuncak tasarımı, geliştirilmesi ve kullanımı olup, bu aşamada Okul önesi öğretmenlerinin akıllı hikaye oyuncağına yönelik fikirlerini almak amacıyla okul öncesi öğretmenleriyle görüşmeler yapıyorum.

Konuşmalarımız tamamen gizli tutulacak olup, üçüncü şahıslarla kesinlikle paylaşılmayacaktır. Ayrıca sizin ve okulunuzun ismi yazılı akademik belgelerde asla yer almayacaktır.

Sormak istediğiniz başka sorular varsa lütfen sorun?
Bu arada görüşmemizi ses kayıt cihazıyla kaydetmek istiyorum, izin verir misiniz? Ayrıca görüşmemiz yaklaşık 20-30 dakika sürecektir.

İçerik ve Süreç ile İlgili Sorular

1. Etkileşimli hikaye yaratma amaçlı akıllı oyuncağı nasıl buldunuz? İlk izlenimleriniz nelerdir?

2. Akıllı oyuncakların okul öncesi eğitimde kullanılabileceğini düşünüyor musunuz? Nedenleri nelerdir?

3. Akıllı oyuncakların öğrenme ve öğretme süreçlerine yönelik katkıları neler olabilir?

4. Akıllı oyuncağa baktığınızda size göre okul öncesi eğitimde kullanılabilir olma durumu açısından olumlu ve olumsuz tarafları nelerdir?

    Prompt. Öğretmen ve çocuk açısından.

5. Benzer akıllı oyuncakların müfredattaki bilişsel kazanımlara yönelik olarak geliştirilmesine nasıl bakarsınuız? Öneriniz olursa, bu oyuncaklarla hangi kazanımların verilebileceğini düşünüyorsunuz?

6. Oyuncağın tasarımını nasıl buldunuz? Okul öncesi eğitimde kullanımına yönelik geliştirilmesi açısından önerileriniz neler olabilir?

APPENDIX C

TEACHER INTERVIEW QUESTIONS FOR FORMATIVE EVALUATION

Görüşme Planı

Okul Tarih ve Zaman (başlama-bitiş) Görüşmeci

Giriş

Merhaba, adım Nuri Kara. Orta Doğu Teknik Üniversitesi Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü'nde araştırma görevlisiyim. Aynı zamanda aynı bölümde doktoramı yapmakta olup, şu an tez aşamasında bulunmaktayım. Sizinle de bu tez çalışması kapsamında görüşme yapma amacıyla burada bulunmaktayım. Tez başlığım okul öncesi çocuklar için akıllı oyuncak tasarımı, geliştirilmesi ve kullanımı olup, bu aşamada geliştirilen akıllı oyuncağın ilk prototipine ilişkin okul öncesi öğretmenlerinin görüşlerini almak amacıyla görüşmeler yapıyorum.

Konuşmalarımız tamamen gizli tutulacak olup, üçüncü şahıslarla kesinlikle paylaşılmayacaktır. Ayrıca sizin ve okulunuzun ismi yazılı akademik belgelerde asla yer almayacaktır.

Sormak istediğiniz başka sorular varsa lütfen sorun?
Bu arada görüşmemizi ses kayıt cihazıyla kaydetmek istiyorum, izin verir misiniz? Ayrıca görüşmemiz yaklaşık 20-30 dakika sürecektir.

Görüşme Soruları

1. Oyuncağın genel tasarımı hakkında ne düşünüyorsunuz?

2. Oyuncağın tasarımsal problemleri nelerdir?

3. Tasarıma ilişkin problemlerin düzeltimesi için neler önerirsiniz?

4. İçeriğe ilişkin problemler nelerdir?

5. İçeriğe ilişkin problemlerin düzeltilmesi için neler önerirsiniz?

APPENDIX D

TEACHER INTERVIEW QUESTIONS FOR SUMMATIVE EVALUATION

Görüşme Planı

Okul	Tarih ve Zaman (başlama-bitiş)	Görüşmeci

Giriş

Merhaba, adım Nuri Kara. Orta Doğu Teknik Üniversitesi Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü'nde araştırma görevlisiyim. Aynı zamanda aynı bölümde doktoramı yapmakta olup, şu an tez aşamasında bulunmaktayım. Sizinle de bu tez çalışması kapsamında görüşme yapma amacıyla burada bulunmaktayım. Tez başlığım okul öncesi çocuklar için akıllı oyuncak tasarımı, geliştirilmesi ve kullanımı olup, son aşamada Okul önesi öğretmenlerinin tasarlanıp geliştirilmiş akıllı oyuncaklar hakkındaki düşüncelerini ortaya çıkarmak amacıyla okul öncesi öğretmenleriyle görüşmeler yapıyorum. Araştırma sonuçlarının okul öncesinde akıllı oyuncakların kullanımı noktasında bilimsel bir katkı yapmasını umut etmekteyim. Bu nedenle sizin içten ve samimi cevaplarınızı duymak büyük bir mutluluk verecektir.

Konuşmalarımız tamamen gizli tutulacak olup, üçüncü şahıslarla kesinlikle paylaşılmayacaktır. Ayrıca sizin ve okulunuzun ismi yazılı akademik belgelerde asla yer almayacaktır.

Sormak istediğiniz başka sorular varsa lütfen sorun?
Bu arada görüşmemizi ses kayıt cihazıyla kaydetmek istiyorum, izin verir misiniz? Ayrıca görüşmemiz yaklaşık 30 dakika sürecektir. Son olarak, görüşme esnasında yanıtlarınızdan emin olmak için oyuncakla oynayabilirsiniz.

Demografik Sorular

1. Kaç yıldır okul öncesi öğretmenliği yapıyorsunuz?
2. Yaşınızı sorabilir miyim?
3. Hangi üniversite ve bölümden mezun oldunuz?
4. Sınıfınızda teknoloji kullanır mısınız?

İçerik ve Süreç ile İlgili Sorular

5. Akıllı oyuncağın tasarım unsurları hakkında ne düşünüyorsunuz?

Prompt. Renk uyumu, çizimler, karakterlerin büyüklüğü, gerçeklik, ses unsurları, peluş oyuncakların tasarımı

6. Akıllı oyuncağın senaryosu ve içeriği hakkında ne düşünüyorsunuz?

Prompt. Senaryonun okul öncesine uygunluğu ve içeriğin yapılandırılma şekli

Alt S. Oyuncak içerisindeki bazı becerilerin (renk, örüntü, sosyal yaşam becerileri...) sunulma biçimleri ve uygulaması açısından neler söylersiniz?

7. Çocuklarla etkileşim düşünüldüğünde, bu akıllı oyuncak etkileşim açısından neler sunmaktadır?

Alt S. Çocukların grup arkadaşıyla oyuncağı kullanma durumları nasıl gelişiyor?

8. Çocukların akıllı oyuncağı oynaması motivasyonlarını nasıl etkilemektedir?

9. Akıllı oyuncak çocuğu ölçme ve değerlendirmede nasıl kullanılabilir?

10. Ders içi ve ders dışı aktiviteler düşünüldüğünde bu akıllı oyuncağı nasıl kullanırsınız?

11. Öğretmen ve çocuk açısından akıllı oyuncağın katkıları hakkında ne düşünüyorsunuz?

12. Akıllı oyuncağın eksik tarafları nelerdir ve hangi yönleri geliştirilmelidir?

Prompt. Dezavantajlı yönleri var mıdır? Nelerdir ve nasıl avantaja dönüştürülebilir?

APPENDIX E

FOCUS GROUP MEETING SCRIPT FOR EARLY CHILDHOOD TEACHERS

Merhaba. Ben Araştırma Görevlisi Nuri Kara. Orta Doğu Teknik Üniversitesi Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü'nde doktora tez öğrencisiyim. Doktora tezim kpsamında araştırma konum akıllı oyuncak tasarımı, geliştirilmesi ve kullanımıdır. Sizinle bu odak toplantılarını gerçeleştirecek olmamın sebebi de, okul öncesi öğretmenleri olarak akıllı oyuncak tasarımı sürecine sizi aktif olarak dahil etmektir. Okul öncesi öğretmnlerinin hem çocukların ihtiyaçlarını bilme açısından hem de çeşitli aktiviteleri çocuklara ve müfredata uygun olarak seçmeleri bakımından çalışmamda yer alması son derece önemlidir.

Sizlerin ilk olarak akıllı oyuncak nedir ve ne işe yarar sorusunun cevabını vermek istiyorum. Akıllı oyuncak konsepti, fiziksel oyuncakların yapılandırılmış ve anlamlı bir amaç doğrultusunda teknolojik olarak geliştirilmiş halidir. "Yapılandırılmış ve anlamlı amaçlar" akıllı oyuncakları klasik elektronik ya da dijital oyuncaklardan ayıran önemli bir özelliktir. Klasik elektronik ya da dijital oyuncaklar teknolojik bileşenleri sadece oyuncağın ilgi çekiciliğini arttırmak için kullanırken, akıllı oyuncaklar çocuklara bilişsel görevleri gerçekleştirebilecekleri teknolojiyle zenginleştirilmiş bir ortam sunarlar. Akıllı oyuncağı daha iyi anlayabilmede daha önceden geliştirdiğimiz Akıllı hikaye yaratma amaçlı oyuncak faydalı olacaktır. Bugünkü ilk toplantıda hem akıllı hikaye yaratma amaçlı oyuncağın bir demosunu sie gostereceğim hem de bu oyuncağı tanıtan videoyu sizlerle paylaşacağım. Ayrıca çocuklarla yaptığımız uygulamaların video görüntülerini sizlere sunacağım.

Odak toplantılarımızda her bir öğretmenin görüşlerini ve kişisel deneyimlerini paylaşması önemli görülmektedir. Bu fikirler ve aktif katılım akıllı oyuncağın tasarlanması ve örnek bir model yaratılmasında büyük önem ar etmektedir. Her bir odak görüşmesinin yaklaşık 1 saat sürmesi planlanmaktadır. Ayrıca görüşmeler video kamerayla kayıt altına alınacak, görüşleriniz isimsiz olmak kaydıyla sadece akademik amaçlı yayınlarda kullanılacaktır.

Özveriniz, katılımınız ve işbirliğiniz için şimdiden teşekkür ederim.

APPENDIX F

OBSERVATION CHECKLIST FOR CHILDREN PLAYING WITH THE FIRST PROTOTYPE

Görevler	Yaptı	Yapamadı	Yorumlar
1. Kartı koyarak Ayşe'nin odasına gitti.			
2. Banyo kartını koyarak banyoya gitti.			
3. Sabunu yüzeyin üzerine koydu.			
4. Tarağı yüzeyin üzerine koydu.			
5. Mutfak kartını koyarak mutfağa gitti.			
6. Bal kartını yüzeyin üzerine koydu.			
7. Peynir kartını yüzeyin üzerine koydu.			
8. Süt kartını yüzeyin üzerine koydu.			
9. Yumurta kartını yüzeyin üzerine koydu.			
10. Banyo kartını koyarak banyoya gitti.			
11. Diş fırçasını yüzeyin üzerine koydu.			
12. Kartı koyarak Ayşe'nin odasına gitti.			
13. Kırmızı ayıcığı üst rafa koydu.			
14. Kırmızı bebeği üst rafa koydu.			
15. Kırmızı arabayı üst rafa koydu.			
16. Kırmızı topu üst rafa koydu.			
17. Mavi ayıcığı orta rafa koydu.			
18. Mavi bebeği orta rafa koydu.			

19. Mavi arabayı orta rafa koydu.			
20. Mavi topu orta rafa koydu.			
21. Sarı ayıcığı alt rafa koydu.			
22. Sarı bebeği alt rafa koydu.			
23. Sarı arabayı alt rafa koydu.			
24. Sarı topu alt rafa koydu.			
25. Daire oyuncağını koydu.			
26. Kare oyuncağını koydu.			
27. Dikdörtgen oyuncağını koydu.			
28. Birinci örüntüde kırmızı ayıcığı yüzeye koydu.			
29. İkinci örüntüde sarı topu yüzeye koydu.			
30. Üçüncü örüntüde sarı topu yüzeyin üzerine koydu.			

APPENDIX G

OBSERVATION CHECKLIST FOR CHILDREN PLAYING WITH THE SMART TOY

Görevler	Yaptı	Yapamadı	Yorumlar
Giriş			
1. Güneş kartını koyarak yardım ekranına gitti.			
2. Oda kartını koyarak Ayşe'nin odasına gitti.			
Özbakım Becerileri			
3. Banyo kartını koyarak banyoya gitti.			
4. Sabun kartını koydu.			
5. Tarak kartını koydu.			
6. Mutfak kartını koyarak mutfağa gitti.			
7. Bal kartını koydu.			
8. Peynir kartını koydu.			
9. Süt kartını koydu.			
10. Yumurta kartını koydu.			
11. Banyo kartını koyarak banyoya gitti.			
12. Diş fırçasını koydu.			
Ayşe'nin Oyun Odası (Bilişsel Beceriler)			
13. Oda kartını koyarak Ayşe'nin odasına gitti.			
14. Kırmızı ayıcığı üst rafa koydu.			

15. Kırmızı bebeği üst rafa koydu.			
16. Kırmızı arabayı üst rafa koydu.			
17. Kırmızı topu üst rafa koydu.			
18. Mavi ayıcığı orta rafa koydu.			
19. Mavi bebeği orta rafa koydu.			
20. Mavi arabayı orta rafa koydu.			
21. Mavi topu orta rafa koydu.			
22. Sarı ayıcığı alt rafa koydu.			
23. Sarı bebeği alt rafa koydu.			
24. Sarı arabayı alt rafa koydu.			
25. Sarı topu alt rafa koydu.			
26. Daire kartını koydu.			
27. Kare kartını koydu.			
28. Dikdörtgen kartını koydu.			
29. Üçgen kartını koydu			
Örüntü Ekranı (Bilişsel Beceriler)			
30. Örüntü kartını koyarak örüntü ekranına gitti.			
31. Birinci örüntüde kırmızı ayıcığı koydu.			
32. İkinci örüntüde kırmızı arabayı koydu.			
33. Üçüncü örüntüde sarı topu koydu.			
34. Dördüncü örüntüde mavi topu koydu.			
35. Beşinci örüntüde dişfırçasını koydu.			
36. Altıncı örüntüde kırmızı ayıcığı koydu.			
37. Yedinci örüntüde kırmızı arabayı koydu.			
38. Sekizinci örüntüde sarı topu koydu.			
39. Dokuzuncu örüntüde mavi topu koydu.			
40. Onuncu örüntüde tarağı koydu.			

APPENDIX H

PERMISSION LETTER FROM MINISTRY OF EDUCATION

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

ÖĞRENCİ İŞ...
DAİRESİ BAŞKA...
Ev. Arş. Md. Sa...

Sayı : 14588481/605.99/602148 15/04/2013
Konu: Araştırma İzni
(Nuri KARA)

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
(Öğrenci İşleri Daire Başkanlığı)

İlgi : a) Meb Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2012/13 nolu genelgesi
b) 08/04/2013 tarih ve 1755 sayılı yazınız.

Üniversiteniz Bilgisayar ve Öğretim Teknolojileri Eğitimi Ana Bilim Dalı Doktora Programı öğrencisi Nuri KARA'nın "Okul Öncesi Çocuklarına Yönelik Teknolojiyle Zenginleştirilmiş Öğrenme Ortamı Tasarımı" konulu tez önerisi kapsamında uygulama yapma isteği Müdürlüğümüzce uygun görülmüş ve araştırmanın yapılacağı İlçe Milli Eğitim Müdürlüğüne bilgi verilmiştir.

Anketlerin uygulama yapılacak sayıda çoğaltılması ve çalışmanın bitimimde iki örneğinin (CD ortamında) Müdürlüğümüz Strateji Geliştirme Bölümüne gönderilmesini arz ederim.

İlhan KOÇ
Müdür a.
Şube Müdürü

Güvenli Elektronik İmzalı
Aslı İle Aynıdır.
16/04/2013

Yaşar SUBAŞI 17-04-2013-6530

Bu belge, 5070 sayılı Elektronik İmza Kanununun 5 inci maddesi gereğince güvenli elektronik imza ile imzalanmıştır
Evrak teyidi http://evraksorgu.meb.gov.tr adresinden 0491-4982-3001-bb47-b5a9 kodu ile yapılabilir.

Emniyet Mh. Alparslan Türkeş Cd. No: 4/A Yenimahalle/ANKARA
www.ankara.meb.gov.tr
istatistik06@meb.gov.tr

Ayrıntılı bilgi için: Murat YILMAZER
Tel: (0 312) 212 36 00
Faks: (0 312) 212 02 16

APPENDIX I

PERMISSION LETTER FROM ETHICAL REVIEW BOARD

1956

Orta Doğu Teknik Üniversitesi
Middle East Technical University

Fen Bilimleri Enstitüsü
Graduate School of
Natural and Applied Sciences

06800 Ankara, Türkiye
Phone: +90 (312) 2102292
Fax: +90 (312) 2107959
www.fbe.metu.edu.tr

Sayı:B.30.2.ODT.O.40.O5.O2/126/911 15.03.2012

GÖNDERİLEN: Prof. Dr. Belgin Ayvaşık
Rektör Danışmanı

GÖNDEREN : Prof.Dr.Gürsevil Turan
Fen Bilimleri Enstitüsü
Müdür Yardımcısı

KONU : Nuri Kara hk.

Bilgisayar ve Öğretim Teknolojileri Eğitimi EABD doktora programı öğrencisi Nuri Kara'nın Mart-Haziran 2012 tarihleri arasında "*Okul öncesi çocuklarına yönelik teknolojiyle zenginleştirilmiş öğrenme ortamı tasarımı*" başlıklı araştırmasına ilişkin hazırlanan anketi ekli listede belirtilen okul öncesi eğitim kurumlarında uygulama yapmak için görevlendirilme başvurusu incelenmiş; ilgili danışman görüşüne dayanarak adı geçen öğrencinin isteği doğrultusunda görevlendirilmesine Etik Komite onayı koşulu ile uygun görülmüştür.

Gereği için bilgilerinize saygılarımla sunarım.

Ek: EYK kararı ve ekleri

Etik Komite Onayı

Uygundur

15.03.2012

Prof.Dr.Canan Özgen
Uygulamalı Etik Araştırma
Merkezi (UEAM) Başkanı
ODTÜ 06531 ANKARA

274

APPENDIX J

INFORMED CONSENT FORM

Bu çalışma, Arş Gör. Nuri Kara'nın doktora tez çalışması olup, danışmanlığını Prof. Dr. Kürşat Çağıltay yapmaktadır. Bu çalışmanın amacı okul öncesi çocuklarına yönelik teknolojiyle zenginleştirilmiş öğrenme ortamlarının tasarımı ve geliştirilmesidir. Çalışma kapsamında akıllı oyuncaklar, okul öncesi eğitim müfredatında yer alan bilişsel ve sosyal yaşam becerilerini desteklemek amacıyla geliştirilecektir. Çalışma süreci; analiz, tasarım ve geliştirme, değerlendirme olmak üzere üç bölümden oluşacaktır. Süreçler içerisinde okul öncesi öğretmenleriyle görüşmeler ve geliştirilen yeni teknolojilerin sunumuna ve uygulamasına yönelik okul öncesi öğretmenlerini ve öğrencilerini kapsayan katılımcı uygulamaları gerçekleştirilecektir. Çalışmaya katılım tamamıyla gönüllülük temelinde olmalıdır. Belirli kimlik bilgileri dışında sizden özel bilgiler istenmeyecektir. Öğrencilerin ad, yaş, cinsiyet gibi bilgileri de sadece akademik amaçlı yayınlar için kullanılacaktır. Cevaplarınız tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir; elde edilecek bilgiler bilimsel yayınlarda kullanılacaktır. Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için Orta Doğu Teknik Üniversitesi Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü Araştırma görevlisi Nuri Kara (Oda: C105; Tel: 210 4183; E-posta: nkara@metu.edu.tr) ya da öğretim üyesi Prof. Dr. Kürşat Çağıltay (Oda: Z14; Tel: 210 3683; E-posta: kursat@metu.edu.tr) ile iletişim kurabilirsiniz.

Bu projeye tamamen gönüllü olarak katılıyorum ve istediğim zaman yarıda kesip çıkabileceğimi biliyorum. Verdiğim bilgilerin bilimsel amaçlı yayımlarda kullanılmasını kabul ediyorum. (Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim Soyad	Tarih	İmza
	----/----/-----	

APPENDIX K

CONSENT FORM FOR PARENTS

Sayın Veli, **09.03.2012**

Orta Doğu Teknik Üniversitesi, Bilgisayar ve Öğretim teknolojileri Eğitimi Bölümü'nde araştırma görevlisi olarak çalışmaktayım. Prof. Dr. Kürşat Çağıltay hocamın danışmanlığında doktora tezim kapsamında okul öncesi çocuklarına yönelik teknolojiyle zenginleştirilmiş öğrenme ortamı tasarımı adlı bir çalışma yürütmekteyim. Çalışmanın içeriğinde akıllı oyuncaklar okul öncesi eğitim müfredatında yer alan bilişsel ve sosyal yaşam becerilerini desteklemek amacıyla geliştirilecektir. Geliştirilen yeni uygulamaların okul öncesi çocuklar tarafından algısının belirlenebilmesi amacıyla gerektiğinde bu çocuklar ile görüşmeler ve yeni teknolojilerin sunumu yapılacaktır. Bu mektubun yollanış amacı, çocuklarınızın çalışma kapsamına dahil edilebilmesinde sizden gerekli iznin alınabilmesidir.

Çalışmaya istinaden çocuğunuzun belirli kimlik bilgileri dışında (ad, yaş, cinsiyet) herhangi özel kimlik bilgisi saklanmayacaktır. Belirli kimlik bilgileri de araştırma sonunda oluşturulacak yayınlarda kullanılacaktır. Akademik amacın dışında bu bilgiler hiç kimse ve hiçbir kurumla paylaşılmayacaktır.

Çalışmaya katılımda çocuğunuzun gönüllü olması ilk ve en önemli aşamadır. Çocuğunuzun çalışmaya katılmaya istekli olması şartı sağlandıktan sonra sizden bu mektuba yanıt vermeniz beklenmektedir. Bununla birlikte projeye katılım tamamen gönüllülük çerçevesinde gerçekleşeceğinden ötürü, herhangi bir yaptırıma maruz kalmadan siz ya da çocuğunuz katılımdan vazgeçme hakkına sahip olduğunuzu özellikle belirtmek isteriz.

Araştırmayla ilgili sorularınızı aşağıdaki e-posta adresini veya telefon numarasını kullanarak bize yöneltebilirsiniz.

Saygılarımızla,

Arş. Gör. Nuri Kara
Bilgisayar ve Öğretim teknolojileri Bölümü
Orta Doğu Teknik Üniversitesi, Ankara
Tel: (0312) 210 4183
e-posta: nkara@metu.edu.tr

Prof. Dr. Kürşat Çağıltay
Bilgisayar ve Öğretim Teknolojileri Bölümü
Orta Doğu Teknik Üniversitesi
Tel: (0312) 210 3683
e-posta: kursat@metu.edu.tr

Yukarıda açıklamasını okuduğum çalışmaya, oğlum/kızım _____________________’nin katılımına izin veriyorum. Ebeveynin:

Adı, soyadı: ________________ İmzası: ___________________Tarih:______________

APPENDIX L

POST STUDY INFORMATION SHEET

Bu çalışma daha önce de belirtildiği gibi ODTÜ Bilgisayar ve Öğretim Teknolojileri Bölümü doktora öğrencisi Nuri Kara tarafından doktora tezi kapsamında yürütülen bir çalışmadır. Bu çalışmanın amacı okul öncesi çocuklarına yönelik teknolojiyle zenginleştirilmiş öğrenme ortamlarının tasarımı ve geliştirilmesidir. Çalışma kapsamında akıllı oyuncaklar, okul öncesi eğitim müfredatında yer alan bilişsel ve sosyal yaşam becerilerini desteklemek amacıyla geliştirilecektir.

Bu çalışmadan alınacak ilk verilerin Temmuz 2013 sonunda elde edilmesi amaçlanmaktadır. Elde edilen bilgiler sadece bilimsel araştırma ve yazılarda kullanılacaktır. Çalışmanın sonuçlarını öğrenmek ya da bu araştırma hakkında daha fazla bilgi almak için aşağıdaki isimlere başvurabilirsiniz. Bu araştırmaya katıldığınız için tekrar çok teşekkür ederiz.

Arş. Gör. Nuri Kara (Oda: C105; Tel: 210 4183; nkara@metu.edu.tr)

Prof. Dr. Kürşat Çağıltay (Oda: Z14; Tel: 210 3683; E-posta: kursat@metu.edu.tr)

APPENDIX M

TENTATIVE OBJECTIVES AND THEIR INDICATORS

Bilişsel Gelişim Kazanımları

Kazanım 1: Nesne/durum/olaya dikkatini verir.
Gösterge: Dikkat edilmesi gereken nesne/durum/olaya odaklanır.

Kazanım 2: Nesne/durum/olayla ilgili tahminde bulunur.
Gösterge: İpuçlarını birleştirerek tahminini söyler.

Kazanım 3: Nesneleri sayar.
Gösterge 1: İleriye/geriye doğru birer ritmik sayar.
Gösterge 2: Saydığı nesnelerin kaç tane olduğunu söyler.

Kazanım 4: Nesne ya da varlıkları gözlemler.
Gösterge 1: Nesne/varlığın adını söyler.
Gösterge 2: Nesne/varlığın rengini söyler.
Gösterge 3: Nesne/varlığın şeklini söyler.

Kazanım 5: Nesne ya da varlıkları özelliklerine göre eşleştirir.
Gösterge 1: Nesne/varlıkları birebir eşleştirir.
Gösterge 2: Nesne/varlıkları rengine göre ayırt eder, eşelştirir.
Gösterge 3: Nesne/varlıkları şekline göre ayırt eder, eşleştirir.
Gösterge 4: Nesne/varlıkları büyüklüğüne göre ayırt eder, eşleştirir.

Kazanım 6: Nesne ya da varlıkları özelliklerine göre gruplar.
Gösterge 1: Nesne/varlıkları rengine göre gruplar
Gösterge 2: Nesne/varlıkları şekline göre gruplar
Gösterge 3: Nesne/varlıkları büyüklüğüne göre gruplar

Kazanım 7: Nesne ya da varlıkların özelliklerini karşılaştırır.
Gösterge 1: Nesne/varlıkların rengini ayırt eder, karşılaştırır.
Gösterge 2: Nesne/varlıkların şeklini ayırt eder, karşılaştırır.
Gösterge 3: Nesne/varlıkların büyüklüğünü ayırt eder, karşılaştırır.

Kazanım 8: Nesne ya da varlıkları özelliklerine göre sıralar.
Gösterge: Nesne/varlıkları büyüklüklerine göre sıralar.

Kazanım 9: Mekânda konumla ilgili yönergeleri uygular.
Gösterge: Yönergeye uygun olarak nesneyi doğru yere yerleştirir.

Kazanım 10: Geometrik şekilleri tanır.
Gösterge 1: Gösterilen geometrik şeklin ismini söyler.
Gösterge 2: Geometrik şekillerin özelliklerini söyler.
Gösterge 3: Geometrik şekillere benzeyen nesneleri gösterir.

Kazanım 11: Günlük yaşamda kullanılan sembolleri tanır.
Gösterge: Verilen açıklamaya uygun sembolü gösterir.

Kazanım 12: Nesnelerle örüntü oluşturur.
Gösterge 1: Modele bakarak nesnelerle örüntü oluşturur.
Gösterge 2: Bir örüntüde eksik bırakılan öğeyi söyler.
Gösterge 3: Bir örüntüde eksik bırakılan öğeyi tamamlar.

Özbakım Becerileri Kazanımları

Kazanım 1: Bedeniyle ilgili temizlik kurallarını uygular.
Gösterge 1: Saçını tarar.
Gösterge 2: Dişini fırçalar.
Gösterge 3: Elini/yüzünü yıkar.

Kazanım 2: Giyinme ile ilgili işleri yapar.
Gösterge 1: Giysilerini çıkarır.
Gösterge 2: Giysilerini giyer.

Kazanım 3: Yaşam alanlarında gerekli düzenlemeler yapar.
Gösterge 1: Ev/okuldaki eşyaları temiz ve özenle kullanır.
Gösterge 2: Ev/okuldaki eşyaları toplar.
Gösterge 3: Ev/okuldaki eşyaları asar.
Gösterge 4: Ev/okuldaki eşyaları yerleştirir.

Kazanım 4: Yeterli ve dengeli beslenir.
Gösterge 1: Öğün zamanlarında yemek yemeye çaba gösterir.
Gösterge 2: Sağlığı olumsuz etkileyen yiyecekleri ve içecekleri yemekten/içmekten kaçınır

Kazanım 5: Günlük yaşam becerileri için gerekli araç ve gereçleri kullanır.
Gösterge 1: Beslenme sırasında uygun araç ve gereçleri kullanır.
Gösterge 2:Beden temizliğiyle ilgili malzemeleri kullanır.

APPENDIX N

FIRST DRAFT OF THE STORY

Akıllı Oyuncak Hikayesi / 1. taslak / 13.12.2012
Güzel bir Pazar sabahıydı. Ayşe güneşin doğuşuyla uyandı.
- Günaydın. Benim adım Ayşe, 5 yaşındayım. Peki ya sen? (1-10 arasındaki sayı kartlarından birini yüzeyin üzerine koyar).

- Teşekkür ederim.

- Bugün hafta sonu tatili olduğu için çok mutluyum. Evde ailemle ve sizinle vakit geçireceğim. Bana yapacağım işlerde yardımcı olabilir misin?

- Önce banyoda elimi yüzümü yıkayıp saçlarımı tarayacağım.

Bunun için banyo resmini koy. (Banyo kartını yüzeyin üzerine koyar).

- Elini yüzünü yıkaması için sabunu koyar mısın? (Sabun objesini yüzeyin üzerine koyar).

- Saçlarını taraması için tarak koyar mısın? (Tarak objesini yüzeyin üzerine koyar).

- Şimdi birlikte kahvaltıya gidelim.

- Bunun için mutfak resmini koy. (Mutfak kartını yüzeyin üzerine koyar).

Ayşe sağlıklı ve dengeli beslenmek için sence kahvaltıda neler yemeli?

Kartları kullanarak Ayşe'ye yardımcı olur musun?

(olumlu: süt, yumurta, bal ve peynir kartları)
(olumsuz: şeker, cips, çikolata ve kola kartları)

Not: Olumsuz kartlardan birisini koyması durumunda "Hayır yiyemem/içemem, yersem/içersem hasta olurum" geribildirimi verilir.

Ayşe şimdi sizce ne yapmalı?

Not: Burda zaman aralığı verilerek biraz beklenmeli.

Banyo resmini koy. (Banyo kartını yüzeyin üzerine koyar)

Not: Banyo resmi haricindeki resimlerde "Tekrar dene" sözü verilir.

- Dişlerimi fırçalamam için diş fırçamı verir misin?

Diş fırçasını koy. (Diş fırçası objesini yüzeyin üzerine koyar).

- Teşekkür ederim.

- Şimdi benimle oynamaya ne dersin?

Oyun odası resmini koy. (Oyun odası kartını yüzeyin üzerine koyar).

- Oyuncaklarımı yeni alınan dolabıma yerleştirmeye yardımcı olabilir misin?

- Kırmızı renkte olan oyuncaklarımı üst rafa koyar mısın?
(Araba, ayıcık, bebek ve top objelerinden kırmızı olanları yüzeyin üzerine koyar).

- Mavi renkte olan oyuncaklarımı ortadaki rafa koyar mısın?
(Araba, ayıcık, bebek ve top objelerinden mavi olanları yüzeyin üzerine koyar).

- Sarı renkte olan oyuncaklarımı ortadaki rafa koyar mısın?
(Araba, ayıcık, bebek ve top objelerinden sarı olanları yüzeyin üzerine koyar).

- Şimdi biraz oyun halımda oynamaya ne dersin?

Not: Oyun halısında kare, dikdörtgen, üçgen ve daire şekilleri mevcut.

- Bana büyük üçgeni gösterir misin? (Büyük üçgen objesini yüzeyin üzerine koyar).

- Bana küçük kareyi gösterir misin? (Küçük kare objesini yüzeyin üzerine koyar).

- Bana büyük dikdörtgeni gösterir misin? (Büyük dikdörtgen objesini yüzeyin üzerine koyar).

- Bana küçük daireyi gösterir misin? (Küçük daire objesini yüzeyin üzerine koyar).

- Bana küçük üçgeni gösterir misin? (Küçük üçgen objesini yüzeyin üzerine koyar).

- Bana büyük kareyi gösterir misin? (Büyük kare objesini yüzeyin üzerine koyar).

- Bana küçük dikdörtgeni gösterir misin? (Küçük dikdörtgen objesini yüzeyin üzerine koyar).

- Bana büyük daireyi gösterir misin? (Büyük daire objesini yüzeyin üzerine koyar).

- Odamdaki eşyaları birlikte saymaya ne dersin?

- Odamda kaç halı var? (1 numaralı kartı yüzeyin üzerine koyar).

- Odamdaki halının üzerindeki şekilleri sayar mısın? (8 numaralı kartı yüzeyin üzerine koyar).

- Halının üzerinde kaç üçgen var? (2 numaralı kartı yüzeyin üzerine koyar).

- Odamda kaç arabam var? (3 numaralı kartı yüzeyin üzerine koyar).

- Sarı renkli oyuncaklarım kaç tane? (4 numaralı kartı yüzeyin üzerine koyar).

APPENDIX O

SECOND DRAFT OF THE STORY

Akıllı Oyuncak Hikayesi / 2. taslak / 20.12.2012

1) Ayşe Özbakım Becerilerini Kazanıyor

Dış ses: Güzel bir Pazar sabahıydı. Ayşe güneşin doğuşuyla uyandı.
Ayşe: Günaydın. Benim adım Ayşe, 5 yaşındayım. Peki ya sen? (1-10 arasındaki sayı kartlarından birini yüzeyin üzerine koyar).

Ayşe: Teşekkür ederim.

Ayşe: Bugün hafta sonu tatili olduğu için çok mutluyum. Evde ailemle ve sizinle vakit geçireceğim. Bana yapacağım işlerde yardımcı olabilir misin?

Ayşe: Önce banyoda elimi yüzümü yıkayıp saçlarımı tarayacağım.

Dış ses: Bunun için banyo resmini elin üzerine koymalısın. (Banyo kartını yüzeyin üzerine koyar).

Dış ses: Elini yüzünü yıkaması için sabunu elin üzerine koyar mısın? (Sabun objesini yüzeyin üzerine koyar).

Ayşe: Teşekkür ederim.

Dış ses: Saçlarını taraması için tarak resmini elin üzerine koyar mısın? (Tarak objesini yüzeyin üzerine koyar).

Ayşe: Teşekkür ederim.

Ayşe: Şimdi birlikte kahvaltıya gidelim.

Dış ses: Bunun için mutfak resmini elin üzerine koymalısın. (Mutfak kartını yüzeyin üzerine koyar).

Dış ses: Ayşe sağlıklı ve dengeli beslenmek için sence kahvaltıda neler yemeli?

Dış ses: Kartları kullanarak Ayşe'ye yardımcı olur musun?

(olumlu: süt, yumurta, bal ve peynir kartları)
(olumsuz: şeker, cips, çikolata ve kola kartları)

Not: Olumsuz kartlardan birisini koyması durumunda "Hayır yiyemem/içemem, yersem/içersem hasta olurum" geribildirimi verilir.
Dış ses: Ayşe şimdi sizce ne yapmalı?

Not: Burda zaman aralığı verilerek biraz beklenmeli.

Dış ses: Banyo resmini elin üzerine koymalısın. (Banyo kartını yüzeyin üzerine koyar)

Not: Banyo resmi haricindeki resimlerde "Tekrar dene" sözü verilir.

Ayşe: Dişlerimi fırçalamam için diş fırçamı verir misin?

Dış ses: Diş fırçasını elin üzerine koymalısın. (Diş fırçası objesini yüzeyin üzerine koyar).

Ayşe: Teşekkür ederim.

2) Ayşe Kavramları Öğreniyor

Ayşe: Şimdi benimle oynamaya ne dersin?

Dış ses: Oyun odası resmini elin üzerine koymalısın. (Oyun odası kartını yüzeyin üzerine koyar).

Ayşe: Oyuncaklarımı yeni alınan dolabıma yerleştirmeye yardımcı olabilir misin?

Ayşe: Kırmızı renkte olan oyuncaklarımı üst rafa koyar mısın?
(Araba, ayıcık, bebek ve top objelerinden kırmızı olanları yüzeyin üzerine koyar).

Ayşe: Mavi renkte olan oyuncaklarımı ortadaki rafa koyar mısın?
(Araba, ayıcık, bebek ve top objelerinden mavi olanları yüzeyin üzerine koyar).

Ayşe: Sarı renkte olan oyuncaklarımı alttaki rafa koyar mısın?
(Araba, ayıcık, bebek ve top objelerinden sarı olanları yüzeyin üzerine koyar).

Ayşe: Şimdi biraz oyun halımda oynamaya ne dersin?

Not: Oyun halısında kare, dikdörtgen, üçgen ve daire şekilleri mevcut.

Ayşe: Bana büyük üçgeni gösterir misin? (Büyük üçgen objesini yüzeyin üzerine koyar).

Ayşe: Bana küçük kareyi gösterir misin? (Küçük kare objesini yüzeyin üzerine koyar).

Ayşe: Bana büyük dikdörtgeni gösterir misin? (Büyük dikdörtgen objesini yüzeyin üzerine koyar).

Ayşe: Bana küçük daireyi gösterir misin? (Küçük daire objesini yüzeyin üzerine koyar).

Ayşe: Bana küçük üçgeni gösterir misin? (Küçük üçgen objesini yüzeyin üzerine koyar).

Ayşe: Bana büyük kareyi gösterir misin? (Büyük kare objesini yüzeyin üzerine koyar).

Ayşe: Bana küçük dikdörtgeni gösterir misin? (Küçük dikdörtgen objesini yüzeyin üzerine koyar).

Ayşe: Bana büyük daireyi gösterir misin? (Büyük daire objesini yüzeyin üzerine koyar).

Ayşe: Odamdaki eşyaları birlikte saymaya ne dersin?

Ayşe: Odamda kaç halı var? (1 numaralı kartı yüzeyin üzerine koyar).

Ayşe: Odamdaki halının üzerindeki şekilleri sayar mısın? (8 numaralı kartı yüzeyin üzerine koyar).

Ayşe: Halının üzerinde kaç üçgen var? (2 numaralı kartı yüzeyin üzerine koyar).

Ayşe: Odamda kaç arabam var? (3 numaralı kartı yüzeyin üzerine koyar).

Ayşe: Sarı renkli oyuncaklarım kaç tane? (4 numaralı kartı yüzeyin üzerine koyar).

Ayşe: Şimdi örüntü oyunu oynamaya ne dersin?

Dış ses: Oyuna başlamak için örüntü panosunu elin üzerine koymalısın.

Ayşe: Evet, şimdi oyunumuzu oynayabiliriz.

Ayşe: 1. sıradaki örüntüde eksik nesneyi bulup elin üzerine koymalısın.

Ayşe: Aferin, harikasın

Ayşe: 2. sıradaki örüntüde eksik nesneyi bulup elin üzerine koymalısın.

Ayşe: 3. sıradaki örüntüde eksik nesneyi bulup elin üzerine koymalısın.

Ayşe: Benimle oyun oynadığın için teşekkür ederim.

APPENDIX P

STORYBOARD OF THE SMART TOY

Table P.1 Storyboard of the smart toy (Turkish version)

Sahne 1	
Senaryo	Ses 1 okunur. Okuyan bayanın görüntüsü de ekranda olmalı ve konuşuyor şeklinde ağzı hareket etmelidir. Ev ve güneş resimleri ayrıca kart olarak basılacak. Çocuk ev’i elin üzerine koyduğunda “Oyuncağı oynamaya başla” başlığı tik sesi gibi benzer bir sesle birlikte yazının üstünde seçilmişlik görüntüsüyle seçilecek ve direkt oyunun ilk ekranına gidecek. Güneş’in basılı olduğu kart elin üzerine koyulursa ev resmindeki ses ve görüntü değişiklikleri yine olur ve altta anlatılan “bilgi al” ekranına gidilir.
Ses	Bunu genç bir bayan okur: Ses 1: Merhaba, Ayşe’nin oyuncak evine hoşgeldin. Oyuncağı hemen oynamak için, üzerinde ev resmi olan kartı el şeklindeki yüzeyin üzerine koymalısın. Oyuncağın nasıl oynandığı hakkında bilgi almak için üzerinde güneş resmi olan kartı el şeklindeki yüzeyin üzerine koymalısın.

Table P.1 (continued)

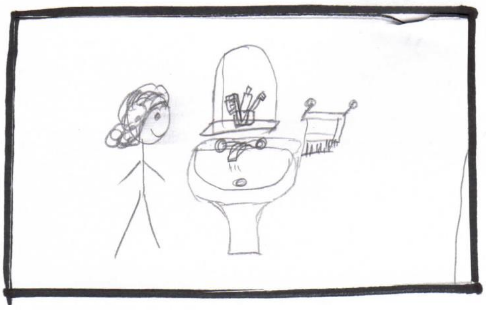
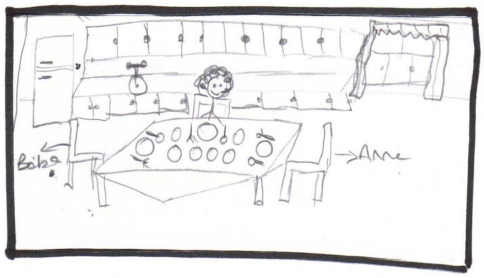
Sahne 2	 
Senaryo	Çocuk banyo ve mutfak kartlarını doğru koyduğunda ilgili kartın olduğu mutfak ya da banyoya gidilir. Bayan orada konuşmasına devam eder. Çocuk ayıcık oyuncağını doğru olarak koyduğunda ayıcık oyuncağı bayanın eline gelir. Ses 2a okunurken ekranın sağ üst köşesinde bir elin oyuncak ve kartı sırasıyla el yüzeyinin üzerine koyduğu animasyon gösterilir. Banyo kartı için yanlış koyduğunda ses 2b okunur. Ses 2b okunurken sağ üst köşede önce banyo kartının resmi, hemen akabinde banyo kartının el yüzeyinin üzerine konulması animasyonu gösterilir. Mutfak kartı için yanlış koyduğunda ses 2c okunur. Ses 2c okunurken sağ üst köşede mutfak kartının resmi, hemen akabinde mutfak kartının el yüzeyinin üzerine konulması animasyonu gösterilir. Ayıcık için yanlış koyduğunda ses 2d okunur. Ses 2d okunurken sağ üst köşede ayıcığın resmi, hemen akabinde ayıcığın el yüzeyinin üzerine konulması animasyonu gösterilir. En sonda ses 2e okunur. Ses 2e okunduktan sonra oyuncağın ilk ana ekranına geçilir.

Table P.1 (continued)

Ses	Bunu aynı genç bayan okur: Ses 2: a) Bu ekranda oyuncağı nasıl oynaman gerektiğini öğreneceksin. Oyuncağı oynarken Ayşe'nin sana söylediklerini iyi dinlemelisin ve ekranda gördüğün gibi istenen kartı ya da oyuncağı el şeklindeki yüzeyin üzerine koymalısın. Şimdi birlikte bir örnek yapalım. ilk olarak üzerinde banyo resmi olan kartı elin üzerine koyar mısın? Doğru koyarsa: Tebrikler, banyo kartını elin üzerine koydun ve banyoya geldik. b) Yanlış koyarsa: Malesef yanlış kartı koydun. Şimdi banyo kartını bulup, elin üzerine koymalısın. Şimdi de mutfak kartını elin üzerine koyar mısın? Doğru koyarsa: Tebrikler, mutfak kartını elin üzerine koydun ve mutfağa geldik. c) Yanlış koyarsa: Malesef yanlış kartı koydun. Şimdi mutfak kartını bulup, elin üzerine koymalısın. Son olarak da ayıcığı elin üzerine koyar mısın? Doğru koyarsa: Tebrikler, ayıcık oyuncağını elin üzerine koydun ve ayıcığı şu an elimde tutuyorum. d) Yanlış koyarsa: Malesef olmadı. Şimdi ayıcık oyuncağını bulup, elin üzerine koymalısın. e) Böylelikle oyuncağı nasıl oynanacağını öğrenmiş oldun. Şimdi oyuncağı oynamaya başlayabilirsin.
Sahne 3	
Senaryo	Önce güneş doğarak etraf yavaş yavaş aydınlanır. Daha sonra kapı ekranda büyür ve yavaş yavaş aralanır. Koridor görüntüsü verilerek Ayşe'nin odasına geçilir.

Table P.1 (continued)

Sahne 4	
Senaryo	Ayşe'nin odasında; yatak (üzerinde oyuncaklar), çalışma masası, halı, duvarda asılı örüntü çerçevesi, duvarda asılı saat ve oyuncak sepeti bulunmaktadır. Araba, ayıcık, bebek ve top oyuncaklarını yerleştirmek için 3 gözlü raf bulunmaktadır. Odada Ayşe ses 3a konuşmasını yapar. Ses 3a bittikten sonra çocuk doğru olan banyo kartını koyarsa Sahne 5'e geçilir. Yanlış koyarsa veya 5-6 saniye boyunca işlem yapmazsa ses 3b okunur.
Ses	Ses 3: (Bundan sonraki bütün okumalar 5 yaşında bir kız çocuk tarafından yapılır) a) Ayşe: Günaydın. Benim adım Ayşe, 5 yaşındayım. Bugün hafta sonu tatili olduğu için çok mutluyum. Evde ailemle ve seninle vakit geçireceğim. Bana yapacağım işlerde yardımcı olabilir misin? Önce banyoda elimi yüzümü yıkayıp saçlarımı tarayacağım. Haydi şimdi banyo kartını elin üzerine koy ve banyoya gidelim. b) Banyoya gitmek için banyo kartını elin üzerine koyar mısın?

Table P.1 (continued)

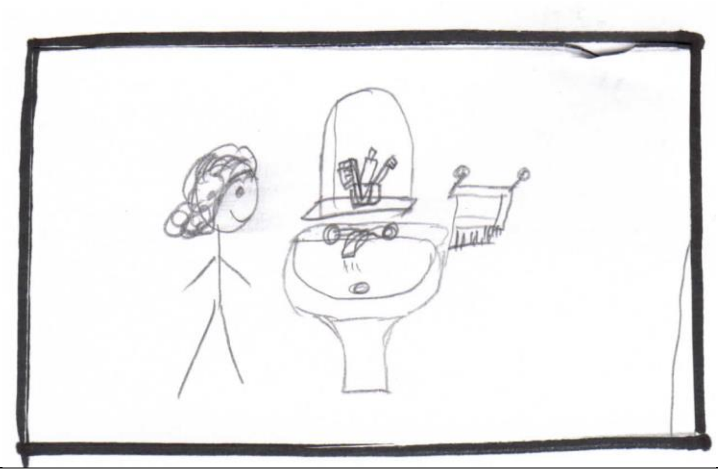
Sahne 5	
Senaryo	Lavabo ve duvara monte edilmiş şekilde duran ayna vardır. Lavabo üzerinde diş macunu, diş fırçası ve tarağın içinde bulunduğu bir kutu vardır. Ayrıca bir sabunluk yapılarak, sabun da ekranda gösterilir. Sağ tarafta asılı duran bir havlu da vardır. Ayşe koridordan banyoya geçer. Ayşe lavabo önündedir. Musluğu açar, su sesi duyularak su akar. Ses 4a okunur. Doğru koyduğunda ses 4b okunur. Yanlış koyduğunda ses 4c okunur. Çocuk elin üzerine sabun objesini koyduktan sonra Ayşe'nin elleri köpürür. Ellerini havluyla kurular. Ses 4d okunur. Doğru koyarsa ses 4e okunur ve tarak resmi cihaza yerleştirildikten sonra Ayşe saçlarını tarar. Yanlış koyarsa ses 4f okunur. Ses 4g okunur. Burda 3-4 saniye kadar beklenir. Çocuk mutfak kartını doğru olarak koyarsa sahne 6'ya geçilir. Yanlış koyarsa veya 3-4 saniye içinde herhangi bir işlem yapmazsa ses 4h okunur.
Ses	Ses 4: a) Ayşe: Haydi elini sabunlamak için sabunu elin üzerine koyar mısın? (Sabun objesini yüzeyin üzerine koyar). b) Doğru koyarsa: Teşekkür ederim. c) Yanlış koyarsa: Elimi sabunlayabilmem için sabunu elin üzerine koymalısın. d) Ayşe: Haydi şimdi de saçımı taramak için tarağı elin üzerine koyar mısın? e) Doğru koyarsa: Çok güzel oldu. f)Yanlış koyarsa: Saçımı tarayabilmem için tarağı elin üzerine koymalısın. g) Ayşe: Şimdi birlikte kahvaltı yapmak için mutfağa gidelim. h) Yanlış koyarsa: Mutfağa gitmek için mutfak kartını elin üzerine koyar mısın?

Table P.1 (continued)

Sahne 6	
Senaryo	Mutfak resminde masa ön plandadır. Ekranda görüldüğü gibi mutfak ortamında; mutfak dolapları, buzdolabı, vs. eşyalar bulunmaktadır. Masada karşılıklı anne baba oturmaktadır. Ayşe ise ortada oturmaktadır. Masada süt, yumurta, bal, peynir, cips ve kola vardır. Ayşe koridordan yürüyerek mutfağa geçer. Masanın ortasına oturur. Ses 5a okunur. Ses 5b okunur. 4-5 saniye kadar beklenir. (Çocuğun burda süt, yumurta, bal, peynir, kola veya cips kartlarından birini koymasını bekliyoruz. Çocuğun cihaza koyduğu resim kartları masa üzerinde büyüyerek belirginleşir.). Çocuk eğer herhangi bir kart koymazsa veya yanlış bir kart koyarsa ses 5c okunur. Çocuk süt, yumurta, bal ve peynir kartlarından birisini koyarsa ses 5d okunur. Çocuk cips kartını koyarsa, ses 5e okunur. Çocuk kola kartını koyarsa, ses 5f okunur. Burada çocuktan süt, yumurta, bal ve peynir kartlarının tamamını koymasını bekliyoruz. Dolayısıyla, örneğin sütü koyduktan sonra 3-4 saniye beklenir. Çocuk bir işlem yapmazsa ses 5g okunur. Ses 5g, tüm doğru besinler tamamlanıncaya kadar aralarda okunur. Çocuk süt, yumurta, bal ve peynir kartlarının hepsini koyduktan sonra ses 5h okunur. Ses 5i okunur. 4-5 saniye kadar beklenir. Doğru olan banyo kartını koyarsa Sahne 7'ye gidilir. Banyo kartı haricinde yanlış bir kart koyarsa ses 5j okunur. Eğer çocuk 4-5 saniye sürecinde hiç işlem yapmazsa ses 5k okunur.

Table P.1 (continued)

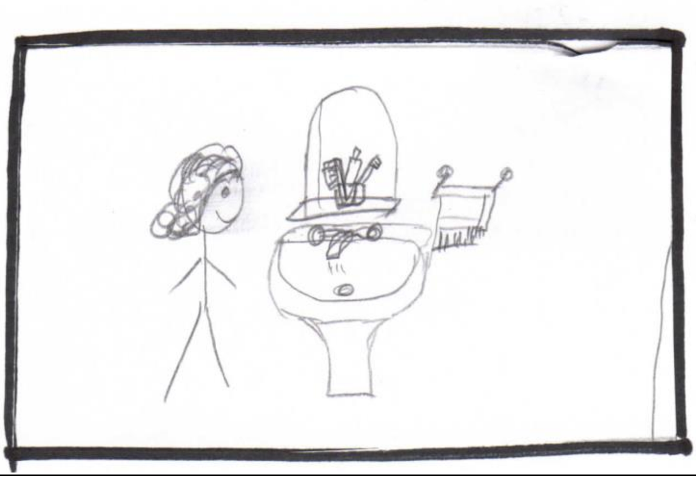
Ses	Ses 5: a) Ayşe: Günaydın anne (annesine dönerek), Günaydın baba (Babasına dönerek) b) Ayşe: Sağlıklı ve dengeli beslenmek için kahvaltıda neler yemeliyim? c) Yanlış koyarsa: Masanın üzerinde bulunan yiyeceklerin veya içeceklerin olduğu kartlardan birini elin üzerine koyar mısın? d) Ayşe: Harikasın, sağlığım için faydalı bir besin. e) Cips konulursa: Üzgünüm yiyemem, sağlığım için zararlı bir yiyecek. f) Kola konulursa: Üzgünüm içemem, sağlığım için zararlı bir içecek. g) Kahvaltıda yiyebileceğim ya da içebileceğim başka bir besin var mı, elin üzerine koyar mısın? h) Harika! süt, yumurta, bal ve peynir sabah kahvaltıda yiyebileceğim sağlığım için faydalı besinler. i) Ayşe: Şimdi kahvaltıyı bitirdikten sonra ne yapmalıyım? Yardımcı olur musun? j) Ayşe: Kahvaltıyı bitirdikten sonra başka bir yere gitmemiz gerek. k) Ayşe: Haydi şimdi banyo kartını elin üzerine koy ve tekrar banyoya gidelim.
Sahne 7	
Senaryo	Ayşe banyoya gelir ve ses 6a okunur. 5 saniye kadar beklenir. Çocuk herhangi bir işlem yapmazsa ses 6b okunur. Eğer çocuk yanlış bir objeyi koyar ise ses 6c okunur. Çocuk doğru olan diş fırçasını koyar ise ses 6d okunur. Ayşe macunu fırçaya sürerek, dişini fırçalama animasyonu gösterilir. Ses 6e okunur. Doğru olan oda kartını koyarsa sahne 8'e geçilir. Yanlış kartı koyarsa veya çocuk 5-6 saniye boyunca işlem yapmazsa ses 6f okunur.

Table P.1 (continued)

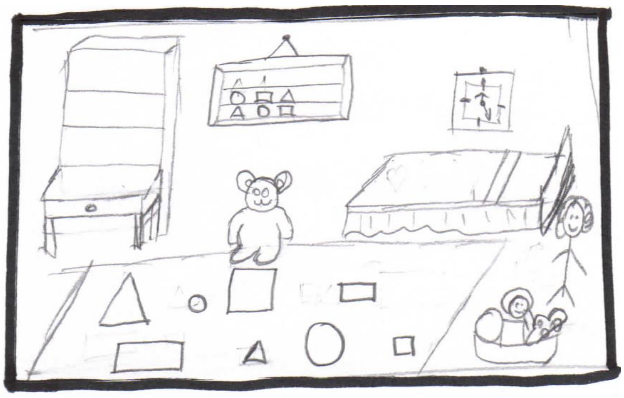
Ses	Ses 6: a) Ayşe: Dişlerimi fırçalamam için diş fırçamı verir misin? b) Diş fırçasını elin üzerine koyar mısın? c) Yanlış koyarsa: Bununla dişlerimi fırçalayamam. Diş fırçasını vermen gerekiyor. d) Ayşe: Teşekkür ederim. e) Ayşe: Şimdi benimle oynamaya ne dersin? Haydi, oyun oynamak için oda kartını elin üzerine koy ve odama geçelim. f) Yanlış koyarsa: Odama gitmek için oda kartını elin üzerine koyar mısın?
Sahne 8	
Senaryo	Ses 7a okunur. Çocuk burda kırmızı, mavi ve sarı rengindeki oyuncaklarını (araba, ayıcık, bebek ve top) raflardaki ilgili yerlerine koymaya çalışır. Üst raf, kırmızı oyuncakların; orta raf, mavi oyuncakların; alt raf ise sarı oyuncakların yeridir. İlgili rafla işlem yapılırken o raf parlak bir şekilde yanacaktır. Ses 7b okunur. Çocuk mavi veya sarı renkte bir oyuncak koyarsa, ses 7c okunur. Kırmızı oyuncakları bitirinceye kadar aralarda eğer çocuk 5-6 saniyeden fazla işlem yapmazsa, ses 7d okunur. Kırmızı oyuncakların hepsini koyduğunda, ses 7e okunur. Yanlış koyarsa, oyuncak yerleşmez ve olumsuz bir ses verilir. Doğru koyarsa, oyuncak yerleşir ve olumlu (click sesi gibi) bir ses verilir. Ses 7f okunur. Çocuk kırmızı veya sarı renkte bir oyuncak koyarsa, ses 7g okunur. Mavi oyuncakları bitirinceye kadar aralarda eğer çocuk 5-6 saniyeden fazla işlem yapmazsa, ses 7h okunur. Mavi oyuncakların hepsini koyduğunda, ses 7i okunur. Ses 7j okunur. Çocuk kırmızı veya mavi renkte bir oyuncak koyarsa, ses 7k okunur. Sarı oyuncakları bitirinceye kadar aralarda eğer çocuk 5-6 saniyeden fazla işlem yapmazsa, ses 7l okunur. Sarı oyuncakların hepsini koyduğunda, ses 7m okunur.

Table P.1 (continued)

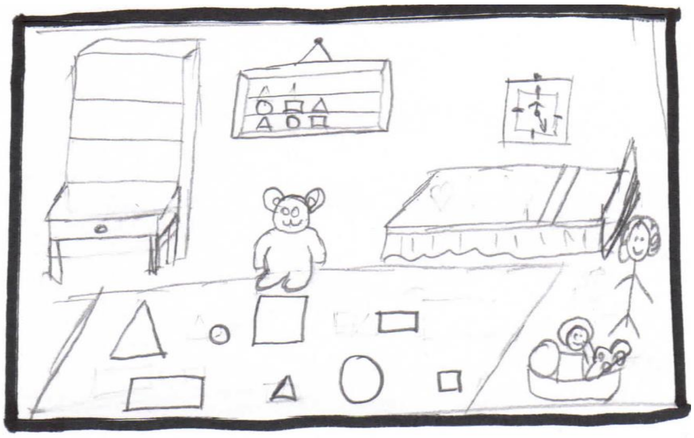
Ses	Ses 7: a) Yeni alınan oyuncaklarımı dolabıma yerleştirmeye yardımcı olabilir misin? b) Kırmızı renkte olan oyuncaklarımı üst rafa koyar mısın? c) Önce kırmızı oyuncakları koyman gerekiyor. d) Daha kırmızı oyuncaklar bitmedi, lütfen devam et. e) Harikasın, bütün kırmızı oyuncakları üst rafa yerleştirdin. f) Mavi renkte olan oyuncaklarımı ortadaki rafa koyar mısın? g) Mavi oyuncakları koymamız gerekiyor. h) Daha mavi oyuncaklar bitmedi, lütfen devam et. i) Harikasın, bütün mavi oyuncakları orta rafa yerleştirdin. j) Sarı renkte olan oyuncaklarımı alttaki rafa koyar mısın? k) Sarı oyuncakları koymamız gerekiyor. l) Daha Sarı oyuncaklar bitmedi, lütfen devam et. m) Harikasın, bütün sarı oyuncakları alt rafa yerleştirdin.
Sahne 9	

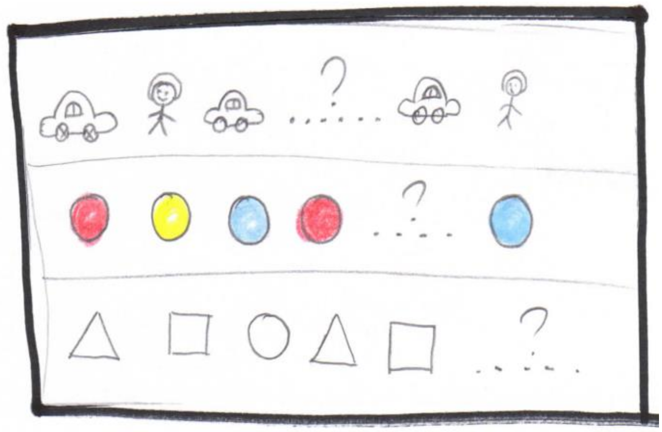
Table P.1 (continued)

Senaryo	Burada şekiller oyunu oynanacak. Odanın içindeki objelerin etrafı kalın çizgilerle yanıp sönüp çocuğa gösterilecek ve çocuk da bu objenin benzediği geometrik şekli yüzey üzerine koyacak. Hangi şekillerin kullanılacağı altta yazılı. Ses 8a okunur. Daha sonra ses 8b okunur. Ses 8b okunurken, odadaki top objesinin etrafı kalınlaşır ve parlak bir renk alır. Çocuk bu toptan bahsedildiğini kolaylıkla anlar. Çocuk topun benzediği daire şeklini doğru olarak koyarsa, ses 8c okunur. Eğer çocuk yanlış bir objeyi koyarsa, ses 8d okunur. Eğer çocuk uzunca bir süre işlem yapmazsa, ses 8e okunur. Ses 8f okunur. Ses 8f okunurken, duvardaki saat objesinin etrafı kalınlaşır ve parlak bir renk alır. Çocuk bu saatten bahsedildiğini kolaylıkla anlar. Çocuk duvardaki saatin benzediği kare şeklini doğru olarak koyarsa, ses 8g okunur. Eğer çocuk yanlış bir objeyi koyarsa, ses 8h okunur. Eğer çocuk 5-6 saniye kadar işlem yapmazsa, ses 8i okunur. Ses 8j okunur. Ses 8j okunurken, duvardaki dolabın ilk iki rafının etrafı kalınlaşır ve parlak bir renk alır. Çocuk bu kısımdan bahsedildiğini kolaylıkla anlar. Çocuk dikdörtgen şeklini doğru olarak koyarsa, ses 8k okunur. Eğer çocuk yanlış bir objeyi koyarsa, ses 8l okunur. Eğer çocuk 5-6 saniye kadar işlem yapmazsa, ses 8m okunur. Ses 8n okunur. Ses 8n okunurken, yerdeki üçgen biçimindeki nesnenin etrafı kalınlaşır ve parlak bir renk alır. Çocuk bu kapaktan bahsedildiğini kolaylıkla anlar. Çocuk üçgen şeklini doğru olarak koyarsa, ses 8o okunur. Eğer çocuk yanlış bir objeyi koyarsa, ses 8p okunur. Eğer çocuk 5-6 saniye kadar işlem yapmazsa, ses 8r okunur. Ses 8s okunur. 2-3 saniye kadar beklenip 8t okunur. (Eğer bir değişiklik yapılması gerekirse diye seslendirme arasında boşluk olmasında fayda var). Sahne 10'a geçilir. Eğer çocuk yanlış bir kart koyarsa veya 6-7 saniye kadar işlem yapmazsa ses 8u okunur.

Table P.1 (continued)

Ses	Ses 8: a) Şimdi birlikte şekiller oyunu oynayacağız. Odanın içinde parlak bir şekilde yanıp sönen oyuncakların hangi şekile benzediğini bulacaksın. Haydi başlayalım. b) Ayşe: Sence bu hangi şekle benziyor? (top resmi için) c) Doğru koyarsa: Evet, bildin. Bu bir daire. d) Yanlış koyarsa: Hayır, bilemedin, tekrar denemelisin. e) Yanıp sönen oyuncağın benzediği şekli elin üzerine koyar mısın? f) Sence bu hangi şekle benziyor? (duvardaki saat resmi için) g) Doğru koyarsa: Evet, bildin. Bu bir kare h) Yanlış koyarsa: Hayır, bilemedin, tekrar denemelisin. i) Yanıp sönen oyuncağın benzediği şekli elin üzerine koyar mısın? j) Sence bu hangi şekle benziyor? (duvarda asılı rafın ilk sıra çerçevesi için) k) Doğru koyarsa: Evet, bildin. Bu bir dikdörtgen l) Yanlış koyarsa: Hayır, bilemedin, tekrar denemelisin. m) Yanıp sönen oyuncağın benzediği şekli elin üzerine koyar mısın? n) Sence bu hangi şekle benziyor? (yerdeki üçgene benzeyen bir nesne için) o) Doğru koyarsa: Evet, bildin. Bu bir üçgen p) Yanlış koyarsa: Hayır, bilemedin, tekrar denemelisin. r) Yanıp sönen oyuncağın benzediği şekli elin üzerine koyar mısın? s) Oleeyy, bütün şekilleri buldun. t) Şimdi birlikte örüntü oyunu oynayalım. Bunun için örüntü panosu kartını elin üzerine koymalısın. u) Örüntü oyunu oynamak için örüntü panosu kartını elin üzerine koyar mısın?

Table P.1 (continued)

Sahne 10	
Senaryo	Odada bulunan örüntü panosu koyulduğunda örüntü ekranı, ekranı kaplayacak şekilde öne gelmektedir. İlk olarak yukarıdaki ekran gelir. Birinci örüntü çözülürken, ilk sıra daha parlak ve ön plandadır, diğerleri soluktur. Diğerlerine sıra gelince parlaklık diğer sıraya geçer. İlk sıra: araba, ayıcık, araba, ?, araba, ayıcık şeklinde gitmektedir. (Boş olan yere ayıcık gelmelidir. Burada araba ve ayıcıkların rengi aynı olmalıdır. Kırmızı, mavi veya sarı renklerinden biri olmalıdır). İkinci sıra: kırmızı top, sarı top, mavi top, kırmızı top, ?, mavi top şeklinde gitmektedir. (Boş olan yere sarı top gelmelidir). Üçüncü sıra: üçgen, kare, daire, üçgen, kare, ? şeklinde gitmektedir (Boş olan yere daire gelmelidir). Ses 9a okunur. Ses 9b okunur. Doğru olan ayıcık objesini koyduğunda ses 9c okunur. Yanlış bir obje koyarsa, ses 9d okunur. Ses 9e okunur. Doğru olan sarı top objesini koyduğunda ses 9f okunur. Yanlış bir obje koyarsa, ses 9g okunur. Ses 9h okunur. Doğru olan daire objesini koyduğunda ses 9i okunur. Yanlış bir obje koyarsa, ses 9j okunur. Hepsini tamamladıktan sonra ses 9k okunur.
Ses	Ses 9: a) Evet, şimdi örüntü oyunu oynayacağız. b) 1. sıradaki örüntüde eksik nesneyi bulup elin üzerine koyar mısın? c) Doğru koyarsa: Evet, harikasın. d) Yanlış koyarsa: Malesef doğru değil, tekrar denemelisin. e) 2. sıradaki örüntüde eksik nesneyi bulup elin üzerine koyar mısın? f) Doğru koyarsa: Evet, harikasın. g) Yanlış koyarsa: Malesef doğru değil, tekrar denemelisin. h) 3. sıradaki örüntüde eksik nesneyi bulup elin üzerine koyar mısın? i) Doğru koyarsa: Evet, harikasın. j) Yanlış koyarsa: Malesef doğru değil, tekrar denemelisin. k) Hepsini çözünce: Harikasın, işte bu. Bütün örüntüleri çözdün. Benimle oyun oynadığın için teşekkür ederim.

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Kara, Nuri
Nationality: Turkish (T.C.)
Date of Place and Birth: 16 June 1985, Başmakçı
Marital Status: Single
Phone: +90 535 4364955 (GSM)
email: nkara@metu.edu.tr

EDUCATION

Degree	**Institution**	**Year of Graduation**
Ph.D.	Middle East Technical University, Computer Education and Instructional Technology	2015
BS	Dokuz Eylul University, Computer Education and Instructional Technology	2007
High School	Nazilli Anatolian High School	2003

FOREIGN LANGUAGES

Advanced English

PUBLICATIONS

Book Chapters

Cagiltay, K., **Kara, N.**, & Aydin, C. C. (2014). Smart toy based learning. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of Research on Educational Communications and Technology* (pp. 703-711). New York: Springer.

Cagiltay, K., & **Kara, N.** (2013). Bilgisayar ve ağ güvenliği. Ö. Yılmazel (Ed.) *Temel Bilgi Teknolojileri-II* (ss. 140-163). Eskişehir: Anadolu Üniversitesi Açıköğretim Fakültesi Yayını.

International Journal Papers

Kara, N., Aydin, C. C., & Cagiltay, K. (2014). User study of a new smart toy for children's storytelling. *Interactive Learning Environments*, *22*(5), 551–563. **(SSCI)**

Kara, N., Aydin, C. C., & Cagiltay, K. (2014). Design and development of a smart storytelling toy. *Interactive Learning Environments*, *22*(3), 288–297. **(SSCI)**

Kara, N., Aydin, C. C., & Cagiltay, K. (2013). Investigating the activities of children toward a smart storytelling toy. *Educational Technology & Society*, *16*(1), 28-43. **(SSCI)**

Kara, N., & Sevim, N. (2013). Adaptive Learning Systems: Beyond Teaching Machines. *Contemporary Educational Technology*, *4*(2), 108-120.

Kara, N., Sevim, N., & Duman, M. (2013). An Investigation of the perceptions of early career academics towards science. *International Online Journal of Educational Sciences*, *5*(1), 60-71.

National Journal Papers

Kara, N., Duman, M., Sevim, N., & Yildirim, S. (2014). Araştırma görevlilerinin bilim ve bilimsel etkinliklere ilişkin algılarının karşılaştırmalı analizi. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi, 47*(1), 43-66.

International Conference Papers

Kara, N., Uzun, C., & Cagiltay, K. (2012). Technology enhanced learning environments for preschool children. *23rd April TRT International Pre-School Children and Media Applications Congress*, Konya, Turkey, April 17-18.

Kara, N., Aydin, C. C., & Cagiltay, K. (2011). Usability study of smart storytelling toy for children's storytelling. *Association for Educational Communications and Technology 2011 Convention,* Jacksonville, Florida, November 8-12.

Yildirim, Z., Sevim N., **Kara N.**, & Tufan D. A. (2011). Professional development needs and preferences of early career academics and their perceived faculty characteristics for successful teaching. *3rd International Conference on Educational Sciences (ICES'11)*, June 22-25, Famagusta, North Cyprus.

Kara, N. & Cagiltay, K. (2010). An instructional design model for colloborative learning based robotics environments. *Association for Educational Communications and Technology 2010 Convention*, Anaheim, California, October 26-30.

Kara, N., Aydin, C.C., Yildiz, I., Karakus, T. & Cagiltay, K. (2010). Smart toy project for kindergarten children. *Abstract in the Proceedings of 4th International Computer & Instructional Technologies Symposium*, Konya, Turkey, 24-26 September, 2010, p.594.

Kara, N. & Cagiltay, K. (2009). Perceptions of students toward robotic clubs at schools. In *Proceedings of International Conference on Education and New Learning Technologies (EDULEARN09)* (pp. 1890-1895), Barcelona, Spain.

National Conference Papers

Yıldırım, S., **Kara N.**, Duman M., & Sevim N. (2011). Araştırma görevlilerinin bilim algılarının karşılaştırmalı analizi. *20. Ulusal Eğitim Bilimleri Kurultayı Bildiri Özetleri Kitabı*, (s. 399), 8-10 Eylül, Burdur, Türkiye.

Yıldırım, Z., Sevim N., Duman M., Gök A., Tufan D. A., Erdoğmuş F. U., & **Kara, N.** (2011). Araştırma görevlilerinin öğretim üyesi olma sürecindeki ihtiyaçları nelerdir?. *20. Ulusal Eğitim Bilimleri Kurultayı Bildiri Özetleri Kitabı*, (s. 638), 8-10 Eylül, Burdur, Türkiye.