UNIVERSITY OF HERTFORDSHIRE

Faculty of Engineering and Information Sciences

Computer Science MSc Project

Final Report

June 2015

DESIGNING A LANGUAGE LEARNING WEB APPLICATION FOR CHILDREN

Natallia Akulenka

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABC (of CCI)	Activities, Behaviors, and Concerns. Three key differences between the computer use of adults and children (Read 2005).
ACI	Adult-Computer Interaction.
API	Application Program Interface.
CCI	Child-Computer Interaction.
HCI	Human-Computer Interaction.
ICT	Information and Communications Technology.
IDE	Integrated Development Environment.
NSFLEP	National Standards in Language Education Project.
UKCCIS	The United Kingdom Council for Child Internet Safety.
UX	User eXperience.

ABSTRACT

There are numerous language learning web applications promising to be effective tools for learning a foreign language. Most of these web applications are made for adults instead of children. Adults and children differ both in their way of interacting with computers and how they learn foreign languages. Moreover, the age of children plays a significant role in how they learn and interact with computers.

The objective of this project was to study the design principles for children's language e-learning and to design and develop a web application for children from nine to twelve for learning Russian as a foreign language. Due to the limited literature on language learning web applications for children, this project was based on the literature on web design for children and on web design for language learning. After extensive literature review, a set of design principles for language learning web applications for children was summarized. Based on these design principles, a web application "RussianForKids" was implemented. The design, implementation, and evaluation of the final web application are discussed. A set of recommendations for improving the web application is listed.

This project has the following contribution. Based on extensive literature review on language learning web application design for children, open research areas are identified, and a shortlisted set of most important design principles is proposed. The design, implementation, and evaluation of a practical language learning web application are discussed. With some added work, RussianForKids could be launched to fill the gap of existing Russian language learning tools for children.

1. INTRODUCTION

This chapter discusses the background and motivation for my project and introduces the nature, methods, research questions, objectives, and outline of my project.

1.1 Background, Motivation, Nature and Methodology of the Project

Information and communication technology is changing the way of learning foreign languages. It opens doors to native-speaking communities without the need to travel abroad. There is a growing trend of developing web applications for (language) learning purposes. Ideally, such web applications can function as online teaching tools and effective resources for learners. Developments in educational technology are increasing the role of web applications in foreign language learning (Levy, 2009; Meloncon et al., 2010; Nusir et al., 2011).

Numerous web applications have been developed with the promise of enhancing language teaching and learning but majority of them focus on adult user group. Adults and children differ not only in the way they learn foreign languages but also in how they interact with computer and web applications. When targeting a web application for children, one needs to consider the specific aspects of child-computer interaction (CCI). While many usability aspects apply for both children and adults, there are also big differences, such as different user goals, reading behavior, physical limitations, interests, etc. that require special features from children's interactive products (Nielsen, 2010).When the target user group consists of children, it is also very important to consider the age of the target users since children with different age have significant differences both in their physical development and abilities.

Language learning web application design also requires knowledge of the learning materials and their format that are used for practicing different language skills such as reading, writing, speaking, and listening. Most of the literature on language learning web

application design focuses on English, the most popular language learned, and study adults instead of children.

In my profession as a Russian foreign language teacher, I have faced difficulties finding good quality Russian language online learning materials for young children. Most Russian language learning web applications seem to focus on adults, e.g., “learnrussian.rt.com”, “masterrussian.com”, “russianlessons.net”, “learningrussian.net”, etc. There is also a limited number of Russian language learning web applications designed for children, e.g., “russianforfree.com” that is mainly made for adults and “russisch-fuer-kinder.de” that only has a German user interface. Motivated by this limitation, I decided to develop my web application “RussianForKids” with the objective of helping children to learn Russian as a foreign language. I started my project by performing a literature review of CCI studying the key design principles for children’s websites focusing on age group from nine to twelve that is the target user group of my web application. I considered the main aspects of language learning and what types of learning materials to include in the web application. Based on the literature review, I summarized my own set of design principles for designing language learning web applications for children. Then, I applied these design principles on my web application. Finally, I evaluated my results and discussed what can be done to further improve my project.

1.2 Project Aim, Research Questions, and Objectives

The aim of this project was to examine special features of CCI in the field of foreign language e-learning. Specifically, the aim was to design and develop a web application for children to learn Russian as a foreign language following the guidelines and best practices in the literature on web applications design for children’s and for language learning purposes.

My project work was guided by three research questions:

1. Why web applications need to be designed differently for children ages from nine to twelve compared to adults?
2. What are the key design principles for user-friendly web applications for children ages from nine to twelve?
3. What are the key features for an effective language learning web application?

In order to address reviewers' comments, I modified the original research questions in the extended project proposal as follows. First, I narrowed research questions one and two to a smaller target user group of children ages from nine to twelve instead of children in general. Second, I clarified the third research question by replacing the subjective measures "easy" and "funny" by a less subjective measure of "effective", which is also commonly used in the literature.

My work had the following core objectives:

1. Finish literature review of child-computer interaction and language e-learning for children.
2. Analyze the key design differences for user-friendly children web applications.
3. Summarize ideas and techniques of how to create easy and funny online environment for learning foreign languages.
4. Create a use case diagram and state transition diagram for the web application.
5. Implement the first draft of the application.
6. Add APIs to the application.
7. Compile necessary demonstration materials for the website.
8. Complete and polish the application.
9. Write the final report.

Originally, I also had two advanced objectives of creating an additional German language user interface and adding animations, such as talking figures, to my application. However, these objective were overly ambitious and were ignored due to time constraints.

The project plan including the objectives and their deadlines as well as descriptions how the objectives were planned to be achieved is presented in Appendix 1. The degree to which each objective was completed is discussed in Chapter 6.

1.3 Outline of the Report

This project report has the following outline. Chapter 2 includes the literature review on CCI including the special characteristics of children's user experience (UX), the role of age groups in CCI, and the importance of age groups in web application design. Chapter 3 continues discussing the CCI literature focusing on the key design principles for user-friendly web applications for children ages from nine to twelve. Guidelines for web application design for children in general and for the age group from nine to twelve are discussed. Chapter 4 also continues the CCI literature review covering the key features and design of effective language learning web applications. Chapter 4 also discusses some Web 2.0 features that can be used to increase the effectiveness of language learning web applications. Based on Chapter 2 – Chapter 4, Chapter 5 presents a set of design principles for designing children's language learning web applications. Then, Chapter 5 discusses how these design principles were applied in the design and development of my web application RussianForKids. Chapter 6 concludes the report by evaluating the completion of objectives and by comparing the research questions to the literature review outcomes and the finished web application. Chapter 6 also discusses future work.

2. CHILD-COMPUTER INTERACTION

This chapter focuses on my first research question: Why web applications need to be designed differently for children ages from nine to twelve compared to adults? Based on literature review, child-computer interaction and its key aspects are discussed. Then, the chapter introduces the special features of the user experience of children and how it differs to the user experience of adults. The chapter also discusses the role of age groups in CCI and the importance of age groups in web application design.

2.1 What is Child-Computer Interaction

It is unclear when exactly CCI became a specialized field. The first papers discussing this new area include (Papert, 1980), (Jenkins and Cassell, 1990), and (Druin and Solomon, 1996). Potentially, the first time CCI was used as a separate design concept at the Interaction Design and Children Workshop in Eindhoven in 2002 (Read et al., 2014). In the beginning CCI was considered as a branch of human-computer interaction (HCI) studying how children use interactive products. However, some researchers oppose the idea that CCI is just a branch of HCI. For example, (Read, 2005) claims that children are not little adults and that there are three key differences between adults and children: activities, behaviors, and concerns, also known as the "ABC of CCI". First, children's activities on a computer tend to be more focused on play than work. Second, compared to adults, children deal differently with computers. Third, children's concerns are more related to fun and playability than usability and safety.

Later, Read and Bekker (Read and Bekker, 2011) state that the ABC of CCI fails to focus on children's abilities and that it is very important to consider, e.g., the physical size, memory, and reading abilities of children. The authors also claim that the CCI definition should include the outside influences from parents, teachers, policy makers, etc. Often adults make decisions about children's computer activities and assist children's

computer use. To consider these additional aspects, the authors have proposed an alternative CCI definition:

Child-computer interaction is "*a study of the activities, behaviors, concerns and abilities of children as they interact with computer technologies, often with the intervention of others (mainly adults) in situations that they partially (but generally do not fully) control and regulate*" (Read and Bekker, 2011).

Recognizing children as a user group with features different to adults is crucial for technology manufacturers. (Bruckman et al., 2002) has divided the technologies made for children in entertainment, education, and edutainment categories. Technologies in the entertainment category are mainly intended for fun and pleasure whereas technologies in the education category are directed to support children's learning. The edutainment category mixes the first two categories. For example, a computer game aimed to develop a specific skill of children would fall into the edutainment category. As already discussed, children interact with computer to have fun rather than to get work done. Therefore, an effective educational children's application should be a mix of entertainment and education. RussianForKids aims to be an edutaining web application by including both traditional language learning methods (reading, writing, exercises) and entertaining and fun learning methods (practicing with cartoons, song videos, social media aspects).

2.2 The User Experience for Children

UX, the central aspect of good web design, can be defined as the way: *"how people feel about a product and their pleasure and satisfaction when using it, looking at it, holding it, and opening or closing it"* (Rogers et al., 2011). The UX aspects that should be considered in web application design include usability, functionality, look and feel, content, user age, user education, etc.

Similarly as children interact with computers in a different way compared to adults, the user experience of children also differs considerably from the user experience

of adults. First, children have different user goals (Watson, 2014). Adults tend to be more focused on tasks interacting with computers to get things done, to communicate, etc. On the other hand, children mostly interact with computers to play and have fun. For example, animations and sounds can be disturbing or even annoying for adults whereas children can find them very entertaining. The second major difference between the adult-computer interaction (ACI) and CCI are the physical limitations of children (Nielsen, 2010). Children have limited fine motor skills that strongly develop with the age. E.g. it may be difficult for children to control the mouse or tap on small icons. Children also like to explore everything around them without worrying of doing something wrong. They might, e.g., click an undesired link and get lost without knowing how to navigate back. Depending on age, children may either read slowly or cannot read at all. Older children with reading skills may have trouble scanning text – they tend to read it word by word. This means that the text should be kept to a minimum and simple words should be used. As children do not have commercial awareness, they tend to unaware of advertising (Idler, 2014). Since ads are often animated and designed with bright colors, exactly what draws kids' attention, kids might click on ads and get lost. It is also very important that the web application is easy to learn (Watson, 2014). This requires the consistency through the web application for avoiding confusion. For example, a certain icon should always mean the same.

Designing for children can be challenging and there are no clear rules how to create an effective interactive product.(Idler, 2013a) suggests the following five key criteria of good UX for children:

- Entertainment
- Visual appeal
- Usability
- Age-appropriate content

- Encourage learning.

Children expect a high entertainment factor. If a web application is not fun to use, a child will leave it quickly and look for something else. An attractive design can also trigger children's curiosity. If a web application provides children with positive feelings, they are more likely to come back. The web application should also be intuitive to use since children do not have the patience to try to understand how something works. The web application should match the cognitive level of the target age group of children. Children can quickly deem too simple content boring and too complicated content frustrating. Finally, since children are curious by nature, they enjoy interesting and new content that can make them return to the application.

(Smith, 2014) has proposed a set of design considerations for a good children's UX called "the 5Ps":

- Parenting
- Play
- Practice
- Patience
- Popularity.

Parents have a big influence on children and often control their computer use. Therefore, web designers should focus not only on children's wishes but also on parents' concerns. Play and fun are crucial since children love playing. Children want to master things and can practice the same things over and over again without getting bored. For the UX, this implies familiarity and repetition. Children's limited patience should be considered, e.g., by playing a simple animation or music during application loading times. Popularity is a sign of social status for children. Children want to do the same things that their peers do.

These design considerations make it evident why web applications need to be designed differently for children compared to adults. However, instead of trying to address the needs of all children, web designers should target their application for a narrower age group of children to be able to consider the different behaviors of each age group (Nielsen, 2010). The next subsection discusses age-appropriate design for children.

2.3 The Role of Age Groups for Child-Computer Interaction

The age of children greatly influences their behavior and abilities and thus, their way of interacting with a computer. Children develop rapidly, which causes their skills to change quickly. There are also big differences in what children like or dislike and how they behave. Therefore, children's age must be considered in the interaction design.

CCI typically focuses on children from five to twelve. However, in recent years there has been increasing research about babies, toddlers, and teenagers thus, extending CCI to both younger and older children (Read and Markopoulos, 2013).

Interacting with computers can be seen as a cognitive activity, which depends on the mental and intellectual development (Fang et al., 2011). It is important to discuss the children's cognitive development in web design since one of the big challenges for web designers is seen in designing an interface and information architecture that are addressed to children on an appropriate cognitive level (Chow et al., 2012). Cognitive skills include for example memory load, concentration, response time, and reading skills. Therefore, the user interface should be intuitive and understandable from children's point of view (Tse, 2013).

Generally, the cognitive level depends on the age of a child. The Swiss psychologist Jean Piaget (Piaget, 1970) divided children's cognitive development into four age stages:

- Sensorimotor (birth to 2 years)
- Preoperational (ages 2 to 7)

- Concrete Operational (ages 7 to 11)
- Formal Operational (ages 11 and up)

In the sensorimotor stage (0-2 years), children's cognition is heavily dependent on what they feel. Children interaction with computer is very limited. It is hard to design web applications for babies since they cannot use input devices such as a mouse. An alternative would be the use of tangible technologies. Moreover, since such little users are not able to read, all instructions must be given in audio or video (Bruckman et al., 2002).

In the preoperational stage (2-7 years), children have very short attention and experience challenges with abstractions. This age group is considered as preliterate even though some children can already read by the age of seven. Using images in web application is a good solution.

In the concrete operational stage (7-11 years), kids can already group items and categorize. They are able to work with the keyboard and control the mouse.

In the formal operational stage (11 years or older), children's cognitive abilities are similar to adults. However, their preferences and interests are still very different. Designing for this group is less problematic since designers can follow their own intuition to a certain extent (Bruckman et al., 2002).

The computer skills of all children's age groups have changed over time. Nowadays, kids learn to use computers much earlier than the children did just ten years ago, e.g., today's children over six are in general skilled with the computer, mouse, and passwords (Buckleitner, 2008).

(Nielsen, 2010) claims that the concept "designing for children" as such does not even exist. Instead, he suggests distinguishing between the following groups:

- Young children (ages 3 to 5)
- Mid-range children (ages 6 to 8)
- Older children (ages 9 to 12).

The main target age group of RussianForKids are nine to twelve olds, i.e., “Older children” by (Nielsen, 2010). The users need to be proficient in reading and writing that restricts most children younger from the target users. On the other hand, children older than twelve are considered as teenagers who typically prefer environments specifically designed for them. Design principles for the target age group are discussed Chapter 3.

3. DESIGN PRINCIPLES FOR CHILDREN'S WEB APPLICATIONS

This chapter discusses literature guidelines and the most important design principles for designing web applications for children. The chapter also covers the specific design principles for the age group from nine to twelve.

3.1 Guidelines for Designing Children's Web Applications

Design principles are intended to orient web designers towards possible design solutions and suggest things to both include and avoid in the interface (Rogers et al., 2011). A number of design principles have been suggested, such as visibility, feedback, simplicity, consistency, etc., but most of the literature focuses on web applications for adults. In the beginning, web designers thought that web applications can be made suitable for children by just adding animations and bright colors (Druin et al., 1998). However, such simple changes only partially address the different interests, needs, abilities, and expectations of children. Even though recent years have seen a growing interest for developing guidelines for designing children's technology, it can still be difficult to find relevant materials. Finding relevant literature is also challenging since the technology design for children is studied in a variety of fields including computing, education, art and design, psychology, sociology, etc. and the research outcomes are not suitable for every product. Specifically, there are only few available guidelines for web design for children.

First guidelines for designing for children was presented by Hanna et al. (Hanna et al., 1998). The authors proposed user interface design principles categorized in three areas: activities, instructions and screen design. Although the proposed design principles are quite general, they considerably contributed to the web design for children. (Gilutz and Nielsen, 2002) studied the similarities and differences in web application interaction of adults and children. In their usability study, they tested 55 children from six to eleven, and proposed 70 design recommendations for children's web applications that are more

specific than the design principles proposed by Hanna. Later, the authors extended their previous work to children from three to twelve (Nielsen, 2010). This second study extended the number of design guidelines from 70 to 130 in order to include two new age groups and to consider the modern web site technologies. The authors observed that children have more advanced computer skills nowadays than at the time of the first study. For example, children ages nine and older have less challenges with scrolling than they used to have. The authors also observed a change in children's reading behaviors. At the time of the first study, children used to read all instructions but today they scan the text as adults do.

(Chiasson and Gutwin, 2005) presents a list of design principles for interfaces of children's applications based on HCI, education, and psychology literature. The proposed design principles consider the stages of children's development and are categorized into three main areas: cognitive, physical, and social/emotional. However, the results are general for all children instead of specific age groups and without sufficient knowledge of children's psychology, these principles can be hard to organize based on child's development level.

(Jochmann-Mannak et al., 2012) discusses web design for children and identifies three types of children's informational websites based on their playfulness: classical web sites, classical play web sites, and image map web sites. The authors also propose design conventions for each of the three website types. These conventions can be useful for a web designer who has a clear idea of the type of the web site he/she wants to create. Based on the authors' classification, RussianForKids could be defined to be a classic web site since no playful features such as games or figures are included.

The next subsections discuss the main areas of web application design for children: general interaction, text, multimedia, navigation and search, graphical user interface, and content.

3.1.1 General Interaction

The general interaction refers to the general picture about the website including domain names, members-only features, scrolling, instructions, use of icons, etc. (Gilutz and Nielsen, 2002). Since familiarity is very important for children, web applications should be consistent, e.g., an icon should be used with the same meaning everywhere. Ordered page design can also support children since it makes it easier to scan information (Jochmann-Mannak et al., 2012). The developer should carefully consider which (if any) of the web application features are limited to registered users only since many users might never see them (Gilutz and Nielsen, 2002). (Chiasson and Gutwin, 2005) remind of presenting instructions in an age-appropriate easy-to-remember format. According to (Hanna et al., 1998), icons should be easy for children to understand and become familiar with. The homepage should have a solid single colored background (Jochmann-Mannak et al., 2012). Scrollable pages should be avoided for children younger than nine years (Nielsen, 2010). Figure 1 shows an example of a web site with the discussed design conventions for children.

3.1.2 Text

The text for children should be as short as possible and should utilize subheadings (Jochmann-Mannak et al., 2012). Text should be avoided altogether with very young children since they cannot read yet (Hanna et al., 1998). (Nielsen, 2010) recommends to use simple and large fonts, the size of 14 point for young children and 12 point for older children. To make the text easier for children to read, the authors also recommend using a high contrast between the text and the background (Figure 1). Additionally, any website sections that are directed to adults should be clearly separated from children's content and clearly indicated to be meant for adults.

3.1.3 Multimedia

Offering occasional entertaining activities, e.g., watching cartoons or listening to songs, can help to keep children's motivation and engagement at a task (Chiasson and Gutwin, 2005). (Hanna et al., 1998) suggests to give control of the audio and video player to children to enable them to stop or skip some parts. Additionally, included animations, if any, should be short (10- 20 seconds) and meaningful (funny or surprising). It is advisable to limit the use of animations since they can cause difficulties with scanning and parsing web sites (Jochmann-Mannak et al., 2012).

Figure 1. A web site utilizing the design principles for children's web application (Jochmann-Mannak et al., 2012)

3.1.4 Navigation and Search

Children's applications should have a simple navigation (Smyk, 2013). Especially in applications designed for small children, it is preferable to utilize a lot of graphics with

limited text as done. Figure 2 shows an example from children's Netflix website where children can select a cartoon by clicking an image of a cartoon character, which children easily recognize.

Figure 2. Using graphics for navigation in children's applications ("Netflix," 2015)

Extensive menus and sub-menus should be avoided since children may not have the skill to categorize (Chiasson and Gutwin, 2005). It is also recommendable to always offer an access to the search feature by including a search box on every page (Gilutz and Nielsen, 2002). Overall, every step of the navigation functionality should be easy to understand and remember (Hanna et al., 1998).

3.1.5 Graphical User Interface

One of the most important design principles for children's web applications is to use more images and less text (Smyk, 2013). Figure 3 shows a good example of this from the Peppa Pig website that mainly uses pictures for young children.

Animated pedagogical agents, even the ones that do not provide any interaction, are also very useful for learning environments (Chiasson and Gutwin, 2005). Clickable items, for example buttons and links, should look clickable by adding visual effects (Gilutz and Nielsen, 2002). The use of promotional elements should be limited since they can take a young user away from the web site without the user being able to find back.

Figure 3. Image-based user interface for small children ("Peppa Pig," 2015; Smyk, 2013)

3.1.6 Content

The content of the web application should be interesting for children and appropriative for their development stage (Nielsen, 2010). If the web application is created for multiple age groups, it should offer multiple levels of difficulty. Figure 4 shows an example from the Fisher-Price website that offers different games for children of different age groups (infants, toddlers, and preschoolers) based on their abilities.

The design principles discussed above are general for all children and do not address the specific characteristics and needs of different age groups. The next subsection discusses the specific design principles for children ages nine to twelve, the target age group of RussianForKids web application.

Figure 4. A website considering children's age groups ("Fisher-Price," 2015)

3.2 Design Principles for Children Ages From Nine to Twelve

The literature on web design for specific age groups of children is very limited. Although many authors emphasize that web design for children should be age-appropriate, most of the authors suggest design principles for children in general. The few age specific design principles in the literature utilize different age groupings. Next, only the relevant age groups for my web application are discussed.

(Nielsen, 2010) distinguishes between mid-range (six to eight years old) and older (nine to twelve years old) children mostly based on readings skills, behavior and interests. Based on children's development, cognition, playing, and learning, (Gelman, 2014) proposes two age groups: kids with a cool factor (eight to ten years old) and growing up kids (ten to twelve years old). (Gallavin, 2015) gives some design suggestions utilizing Piaget's age groupings. (Gaffney and Hunter, 2011) distinguish children's age groups based on the school system and call children from nine to twelve "Later primary years".

Based on the literature review above, Table 1 lists a summary of the most relevant design principles for children from nine to twelve. The design principles discussed so far

are universal for all children's web applications. To address the objective of RussianForKids web application, the next chapter discusses design principles for language learning web applications.

Table 1. Summary of design principles for children from nine to twelve

Category	Design Principles
Visual design	• Use the font size of 12 or 14 point • Include images, animations, videos • Select bright colors • Be consistent in layout
Content	• Keep text simple and short • Adjust the vocabulary to reflect children's level of education • Provide content that appears more "grown up" than that for early primary years • Certain terms, such as "sign-in" and "sign-up" are understandable, but "submit" and "username" are confusing. It is better to use "start" or "go" and "nickname". • Present instructions in more than one format, for example in text and picture • Use rather over labeling rather than under labeling • It is totally acceptable to group items and display lists • Provide description using text and images (younger kids tend to read, but older scan) • Leverage knowledge children may have from social media and popular games • Avoid promotions or ads. Despite
Navigation & Search	• Keep the functionality of the navigation bar simple • Provide time-saving shortcuts • Provide a search option
Multimedia	• Include video and audio • Allow user control for audio and video players
Interactions	• Let the users to share their opinion of a content item by using pictures "thumbs-up" and "thumbs down". • Allow rating. Children are very curios and like to see others opinions.

4. EFFECTIVE LANGUAGE LEARNING WEB APPLICATIONS

This chapter focuses on my third research question of the key features of effective language learning web applications. The chapter discusses the key features of effective language learning web applications and introduces best practices from existing Russian, English, German, and Spanish language learning websites. The chapter also describes how Web 2.0 features can be used to make language learning web applications more effective.

4.1 Educational Web Applications for Children

Children use web applications not only for playing but also for educational purposes (Meloncon et al., 2010). Online educational materials have great potential. Typically, e-learning is seen as a support to the traditional learning with the aim to improve the efficiency of the learning process (Nusir et al., 2011). However, e-learning can be seen broader as any form of education by means of ICT (Koohang and Harman, 2005; Šimonová, 2013).

Similarly to the literature on children's web application design, the literature on children's e-learning is quite limited. Most papers focus on online teaching tools for adults (Dirksen, 2011). Naturally, there is an extremely wide body of pedagogical literature on children's learning but it comes from a broad range of fields including education, psychology, sociology, computer science, etc., which can make it difficult for web designers to understand and apply in practice.

(Meloncon et al., 2010), one of the most relevant papers to this project, proposes guidelines for creating educational web sites for children focusing on: children's development, web design for children, and children's e-learning. The first two areas, children's development and web design for children, are discussed in Chapter 2 and Chapter 3. The last area, children's e-learning, is discussed in this chapter with the objective of understanding how to create an effective language learning web application

for children. In order to design an effective educational web application, it is important to consider the content and format of the included materials. A combination of text, pictures, audio, and video can attract different types of learners, lead to better learning outcomes, and increase students' motivation (Nusir et al., 2011).

(Naidu, 2005) examines the usability of educational websites for children ages seven to eleven years old and provides suggestions based on the results. The authors claim that providing too many choices, e.g., too many topics or sub-topics, can be confusing for children. The authors also suggest to use simple and descriptive words for identifying topics, e.g., the authors note that children did not understand what Bibliography is.

(Harding et al., 2009) claim that a children's educational web site should be a community for children and should provide a clear description about the goals and interests of the community. The authors also state a web site can be made more dynamic and supportive for different learning types of users by utilizing different types of materials including audio, video, games, social media aspects, etc. The paper also claims that allowing sharing and content creation can be beneficial for a web site since it can provide useful information about the user interests and preferences.

(Meloncon et al., 2010) emphasizes that the quality of content is one of the most important aspects to achieve the learning goals of a web application. The authors recommend to target the content based on the reading skills of a target user group. The authors also emphasize the importance of clear and short instructions and the use of short sentences and paragraphs to make reading easier for children.

This subsection discusses design principles for educational web applications in general while the next subsection focuses on the language learning web applications.

4.2 Key Features of Effective Language Learning Web Applications

The use of technologies and diverse media can be effective for teaching and learning languages (*Common European Framework of Reference for Languages:*

Learning, Teaching, Assessment, 2001). Self-study web applications can help learners by providing autonomy and self-awareness in learning. Online resources are also available independent of the physical location of a user. Learning by using web applications can significantly save learners' time and money. Authentic learning materials, which can support pronunciation, comprehension skills, and teach cultural aspects, can be easily provided online. For some learners, online resources are the only way to access authentic materials. However, language e-learning has also some drawbacks. For some learners, it can be hard to organize their self-study and keep themselves motivated (Mohammadi et al., 2011). Therefore, online language learning tools work the best as supplementary resources used under teachers' or parents' guidance.

To create good language learning web applications (Kartal and Uzun, 2010) suggest focusing on physical, contextual, and pedagogical characteristics. The physical characteristics include web design aspects such as color, sections, links, buttons, etc., which create a pleasant user interface and enable easy navigation. Since language learning requires a frequent use of dictionaries, the paper also suggests including online dictionaries to the web application. The authors also recommend adding a search feature that allows the users to find text, audio, and visual materials related to different language skills (reading, writing, speaking, and listening). The contextual characteristics of the web application include its content features. The authors suggest that a web application should have a clear instructions about its contents and explanations of the skills that each area of exercises develop. The materials should be authentic, grouped under appropriate titles, and flexible to use. The pedagogical characteristics contribute to the process of learning and teaching and contributing to the main purpose of the website. Thus, the materials should match user's age and interests. The included activities should be motivating and benefit the overall learning process.

Since English is the most popular language to learn, most of the available language learning web applications are made for learning English as a foreign language (Kır and Kayak, 2013). It is challenging to find publications either of language learning web applications designed for children or web applications for learning Russian as a foreign language. Therefore, this report is based on the literature of design principles of English language learning web applications and of children's web sites.

(Yang and Chan, 2008) present a set of evaluation criteria for English learning websites focusing on six areas: general information, integrated English learning, listening, speaking, reading, and writing. The authors also recommend to use authentic learning content (for example news, cartoons, real-life conversations, etc.). Additionally, allowing commenting, content sharing or reading of postings from peers can also contribute to development of different language skills.

(Liu et al., 2011) have suggested to provide transcriptions of the audio and video files that learners can check if they understood everything correct or can see how to write some words. They have also recommended to provide tips on how to practice a foreign language and provide explanations for all learning materials in the native language of the learners. The authors also suggest to provide opportunities for learners to interact with others for example discussing a certain topic in the chat room or forum. Modern language learning websites have a trend to present features of social networking, which is a big part of Web 2.0. Next subsection discusses how Web 2.0 features can increase the effectiveness of a language learning websites.

4.3 Increasing the Effectiveness with Web 2.0

(O'Reilly, 2005) defines Web 2.0 as a collaborative environment in which users enable to share knowledge and participate in online communities. The Web is becoming an area for social networking, where users exchange content and collaborate in new ways (Duffy, 2008). Particularly, Web 2.0 enables users to create content and add a value to the

web site by uploading images, participating in forum discussion, etc. From the language learning perspective, these activities can be seen as a good opportunity for learners to contribute to their skills in the target language. According to the findings of UK Council for Child Internet Safety (UKCCIS), children and young people use social networking and interactive sites since they do not necessarily distinguish between the online and offline environments (*Good practice guidance for the providers of social networking and other user-interactive services*, 2010). They like to be members of an online community which enable them to contact and to communicate easily with other children. It is also attractive for them to be able to publish on the website their own content.

Social networking is becoming more popular among children and young people. There are a number of popular social networks for children under 13 years old ("Club Penguin," 2015, "Edmodo," 2015, "Fanlala," 2015; McClelland, 2012). (Gibson, 2012) recognizes social media as a great tool for language teaching, which however, is currently underused: "*By ignoring social media we are missing out on a world of opportunities*." As the article states, it is hard to find a children's language learning website, which include social media features.

Figure 5 shows some of the social media features of "LearnEnglish Kids", a children's English language learning website. Registered members of the website can rate learning materials, comment across the site, and answer questions. From language learning perspective, one of the greatest benefits from social sites is the possibility to practice communication skills in the target language and to strengthen the educational community.

(Clark et al., 2009) discusses the learning potential of school children in using social websites. First, chatting and interacting with people over a distance contribute to inter- and cross-institutional collaboration. Watching videos or listening music motivates children to write reviews, discuss, debate, and comment learning-focused materials. Using

Web 2.0 technologies for learning languages extends curriculum and discussions between teachers and learners across in- and out-of school contexts. Finally, using forums enable learners to cooperate, communicate, and receive peer feedback and support.

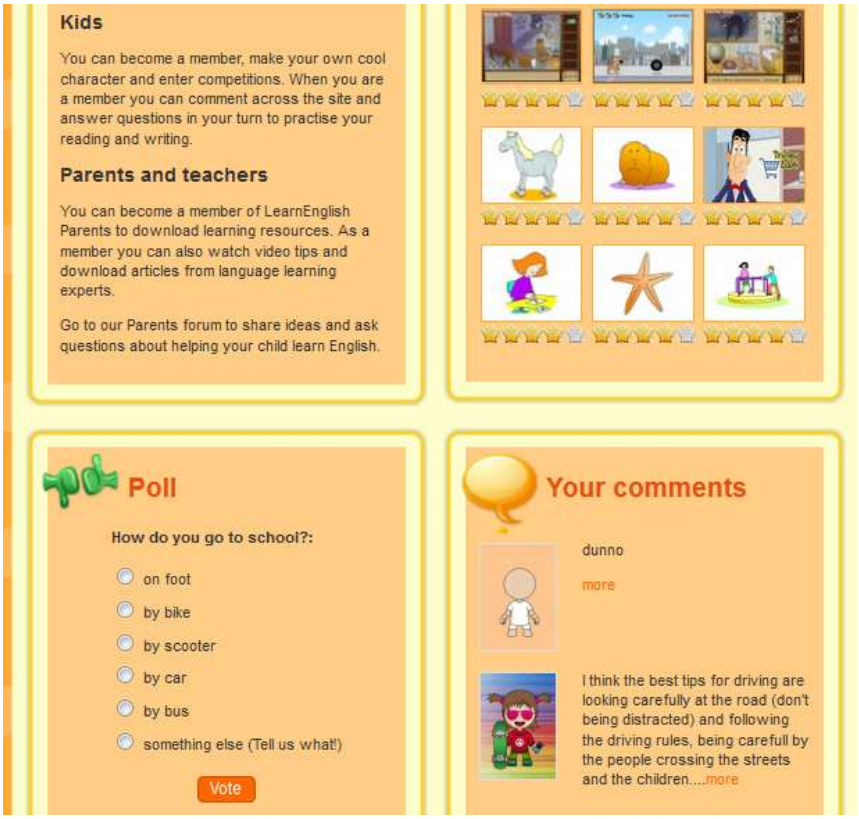

Figure 5. Social media features on children's language learning website ("LearnEnglish Kids," 2015)

To summarize, Web 2.0 features can increase the effectiveness of language learning web applications by creating a motivating environment and a community of learners with similar interests and goals.

Chapters 2 – 4 provide an overview of how to design a language learning web application for children and what learning materials and activities to include. Next chapter presents the design and development process for RussianForKids and how the discussed design guidelines and principles were utilized.

5. DESIGNING AND DEVELOPING RUSSIANFORKIDS WEB APPLICATION

This chapter discusses the design and development process of my web application RussianForKids following the four phases of designing interactive products for children:

1. Specify the context of use
2. Define requirements
3. Create your design solutions
4. Evaluate your design (Idler, 2013b).

These phases and how they looked for the web application RussianForKids are discussed in Subsections 5.1 - 5.4.

5.1 Context of Use

The first phase of designing interactive products for children is to specify the context of use, i.e., to identify the application users and their goals and needs, and under what conditions they will use the product. The main target user group of my web application are children ages from nine to twelve who learn Russian as a foreign or second language and have already sufficient reading and writing skills in the target language. Other potential user groups include the language teachers and parents of the children using the application. Only parents with some command of Russian would be able to use the application. Additionally, children younger than nine may also be able to use the application with or without external help. Children older than twelve can use the web application but they are considered as teenagers who typically prefer environments specifically designed for them.

The target user group would mainly have learning and entertainment goals. A typical user is learning Russian language and seeks for an entertaining way to practice the

language. The application could be used as an additional resource in schools or by parents to encourage their kids to practice the language.

Teachers can use the web application as an extension of curricula. RussianForKids could also provide a useful learning opportunity for children who do not have the possibility to interact with native speakers. Children could also connect with other children learning Russian and thus, build a sense of community. For parents it would be easier to have language learning activities that children enjoy, e.g., watching cartoons or listening to songs, and to use the materials with a learning purpose in a fun way. RussianForKids creates an educational community by fostering communication among learners, educators, and parents (Light and Polin, 2010).

The value to the developer of RussianForKids consists of commercial value, learning value, and altruistic value. First, there is some commercial value involved. Some of the advanced materials could have a small charge. If RussianForKids was successful, its user base could be potentially expanded by developing smart phone/table app that could have a small fee. At the moment, the most important value for me is learning. Finally, there is altruistic value. The purpose RussianForKids is both to help and motivate children to learn Russian and to provide a useful tool for Russian language teachers.

5.2 Functional Requirements

The second phase of designing interactive products for children is to define the functional requirements based on the user goals and needs that are specified in the first design phase. The functional requirements for the web application RussianForKids are discussed next.

Selecting learning materials: Users choose learning materials by selecting a topic from the menu bar. Having chosen a particular topic a list of available items with title and picture is displayed. The page of the selected cartoon and the respective activities are displayed.

Watching video: “Song” and “Cartoon” pages offer video watching possibility that is implemented with the YouTube API. This features makes the interaction with RussianForKids more enjoyable and benefits to learner’s comprehension in target language.

Translations: All the song, story, cartoon, grammar topic, etc. pages include a Russian-English-Russian words/phrase translator that is implemented with the Yandex.Translate API. The translator makes the web application more attractive removing the need for using separate translation web sites.

User Account: Users can create an account to use some of the restricted functionalities such as writing comments, liking, and participating in forum discussions. These advanced functionalities promote long-term use of the web application.

Liking: Users can see the number of likes of items and thus get a picture of other users’ preferences. This feature also provides highly useful feedback about the user preferences and thus, helps to adjust the content accordingly.

Quiz: Users can perform tasks associated with the content of a selected item. The answers are displayed by clicking the button “Answers”.

Commenting: The users can comment on items. This feature makes the web application more interactive, helps to build an active community, and motivates students to practice their language skills in an entertaining way by cooperating and connecting to other users.

The discussed functional requirements capture main activities and features that the web application should include. Next subsection discusses the design and implementation of the web application.

5.3 Creating Design Solutions

The third phase of designing interactive products for children is to define the design the user interface based on findings from the first two design process phases.

5.3.1 User Interaction Design

Modeling tools were utilized to design user interactions and implement a prototype of the web application. First, a use case diagram shown in Figure 6 was created to capture how the users interact with the web application. Use case diagram models the functionality of the web application from user point of view (Britton and Doake, 2005) by showing the main tasks that the users can perform. The actors in the use case diagram are the children learning Russian as well as their parents and Russian language teachers. The determined use cases include select a topic, watch a cartoon, read a story, use dictionary, etc.

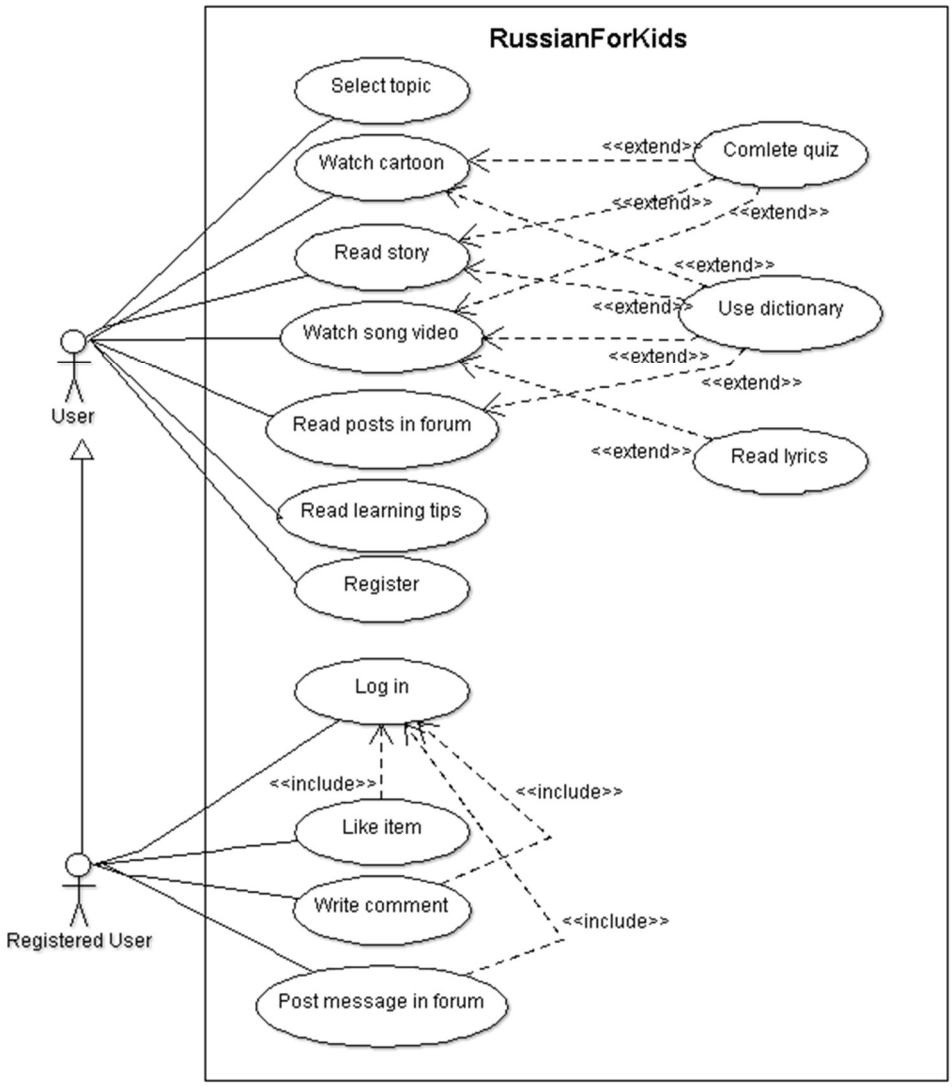

Figure 6. The use case diagram for RussianForKids

Next, a state transition diagram shown in Figure 7 was drawn to visualize how the users can interact with the web application. The diagram includes states and events, which trigger a state to change (Greenberg et al., 2012). State transition diagram gives an idea about possible screens (pages) of the app and how to navigate them depending on the user's action. State transition diagram is a well-suited modeling technique especially for small applications for which all the possible states or screens can be defined.

In RussianForKids, the states represent the different pages that are displayed to the user and the events are received from the user. For example, when the user selects the topic "Songs" from the home page, the application transits to the "ListOfSong" screen. Further, by selecting a song from the displayed list, the application transits to the "Song" screen displaying options the user can do with the song including watching the video, reading or translating the lyrics, etc.

These diagrams were utilized in the development process, e.g., to create a prototype of the application.

5.3.2 Implementation of the Web Application

To leverage my previous experience, I decided to develop RussianForKids with Visual Studio 2013 as the IDE, Visual Basic for the server side code, ASP.NET as the web application framework, Microsoft Access Database for storing data, and Bootstrap for styling. I have utilized these technologies in the projects of my previous modules. To avoid duplicating effort, I used extensively available third-party APIs.

To visualize my idea of RussianForKids, I drew a paper prototype based on the use case and state transition diagrams described in the previous subsection. The paper prototype, which is shown in Appendix 2, was chosen over software prototyping since it is easy and quick to make. The use case diagram was helpful for drawing the screen view of the home page including the menu bar and the page structure. The menu bar includes elements corresponding to the use cases and presenting topics of the main activities:

Cartoons, Stories, Songs, Tips, Forum, Contacts, Register, Login, and the Home Page. With the help of the state transition diagram, I realized that many of these pages, e.g., Song and Cartoon, have a similar structure. I utilized the prototype with the diagrams also as a guide in the actual implementation process.

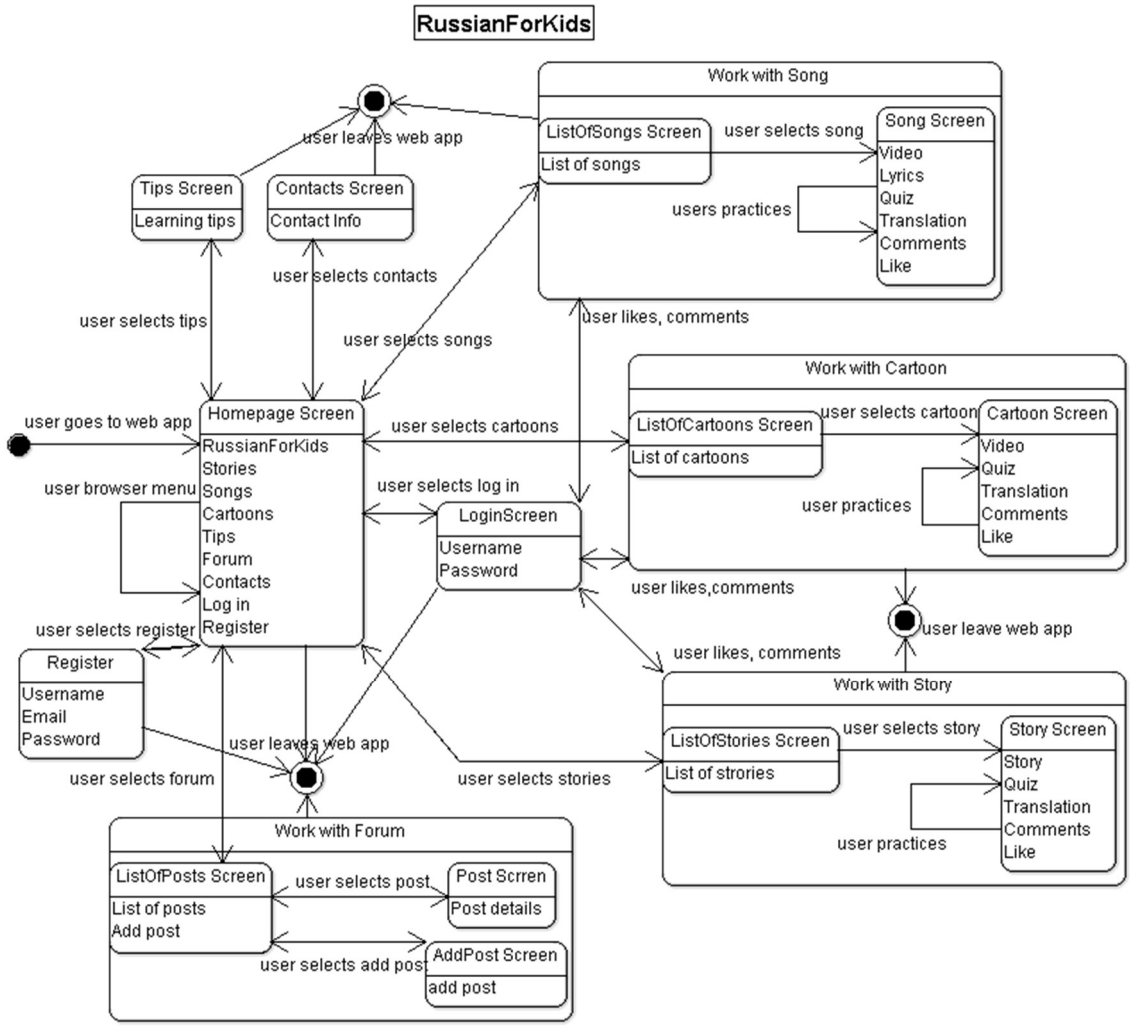

Figure 7. The state transition diagram for RussianForKids

Yandex.Translate API was included to provide translation services and Youtube IFrame Player API was added for video content. These APIs allowed embedding highly advanced video and translation services with very little coding effort. The pedagogical

advantage resides in merging different types of language presentation such as text, pictures and video in one place, which is beneficial for supporting various ways of learning preferences of different individuals (Harding et al., 2009; Levy, 2009). The embedded YouTube player via the <iframe> HTML element allows playing a video of the song or cartoon directly on the web page. The IFrame Player API allows controlling the song via Javascript, e.g., to pause the song, or to increase volume. The Youtube IDs of the song and cartoon videos in the RussianForKids are stored in the Access database to guarantee that the right song is displayed at each time. The Yandex.Translate API is utilized for text translation by calling the translate method with the input parameters: API key, language group, and text that are then passed to the HTTP GET request.

The entire web application was designed for various devices and screen sizes. Bootstrap features were leveraged to automatically scale the page width for different screen sizes. Currently, the scaling works well on table sized screens and to some extend also on mobile phones. Specifically, the screen has been divided into 12 columns to present the information with the same scaling on different screen sizes. The screen scaling is an increasingly important feature for the RussianForKids, since many children are likely to access the web application with mobile devices. However, the web application includes many activities that require typing, which is easier for children to do with a physical keyboard. Therefore, the focus device type were laptop and desktop computers with regular screen sizes.

After all the desired functionalities and navigation had been implemented, the application was shaped to meet the design principles and guidelines discussed in Chapter 3 and 4.

5.3.3 Applying Design Principles for Children's Web Applications

Chapter 3 and Chapter 4 discuss the literature review on design principles for children's language learning web applications. A summary of the most important

principles is listed in Table 2. The table summarizes both guidelines for making the web application user-friendly for children and recommendations for language learning web applications.

The design principles in Table 2 were used to guide the entire design process of the web application. Next, I link the features of RussianForKids to these principles.

Table 2. Summary of design principles for children's language learning web applications

Category	Design Principles
General Interaction	1. Provide a consistent page layout 2. Select bright colors 3. Use a solid background consisting of one plain color 4. Ensure that all links work 5. Group items and display lists 6. Present instructions in an age-appropriate easy-to-remember format 7. Present instructions in more than one format, for example in text and picture 8. Use icons that are easy to understand and become familiar with 9. Post frequently asked questions and answers 10. Consider carefully member-only features since many users might never see them 11. Separate information directed to adults from the children's content 12. Include contact information of the web site administrator 13. Provide copyright information
Text	14. Use a short text with subheadings 15. Use rather over labeling rather than under labeling 16. Use simple and large fonts, the size of 12 point 17. Provide good contrast between the text and the background 18. Adjust the vocabulary to reflect children's level of education
Multimedia	19. Provide entertaining activities to keep children's motivation and engagement at a task 20. Give control of the audio and video player to children to enable them to stop or skip some parts 21. If including animations, make sure that they are short (10- 20 seconds) and funny/surprising 22. Avoid using too many animations that can cause difficulties with scanning and parsing web sites
Navigation and Search	23. Provide simple navigation which is easy to comprehend and remember 24. Avoid using extensive menus and sub-menus 25. Use preferably graphics than text-based navigation 26. Provide a search option
Graphical User Interface	27. Prefer images over text 28. Include animated figures, even the ones who do not provide any interaction 29. Make clickable items, e.g., buttons and links, look clickable by adding visual effects 30. Limit the use of promotional elements that can take the child away from the application
Language Learning Materials	31. Use the age-appropriative content of materials 32. Provide a clear instructions regarding the materials 33. Provide instructions in the native language of the learner 34. Specify the level of materials, e.g., easy/middle/difficult 35. Avoid providing too many choices, e.g., too many topics or sub-topics, which can be confusing for children 36. Use authentic materials 37. Group materials under appropriate titles 38. Use simple and descriptive words for identifying topics 39. Present information in different formats such as text, images, audio, and video to contribute to different language skills and to attract different types of learners 40. Include materials about the culture of the learned language 41. Offer various learning activities, e.g., watching videos, reading text, etc. 42. Include the possibility for users to interact with each other 43. Provide online dictionary 44. Provide transcriptions of the audio and video files 45. Include learning tips on ways how to improve language skills

5.3.3.1 General Interaction

Figure 8 shows the homepage of RussianForKids that provides the different users (children and adults) with information regarding the purpose of the web application and ways to interact with the application. The home page lists the possible activities (reading, singing, listening, writing, and learning) and links for accessing them.

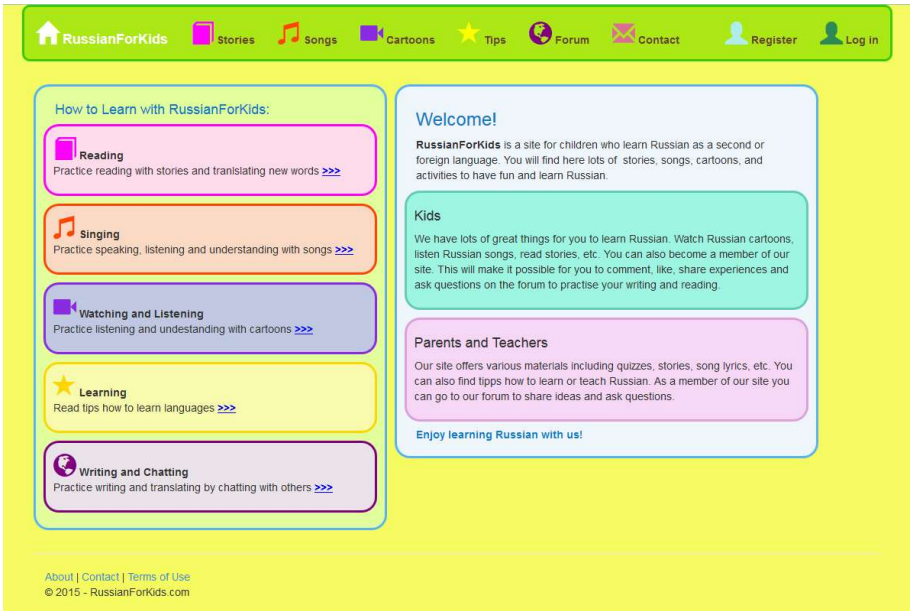

Figure 8. Homepage provides information for users about the application

For consistency and to provide the users with an easy access to the alternative activities, the information about the offered activities is presented in a similar format on all application pages excluding “Register” and “Log In” pages (Principle 1). Figure 9 shows an example of how the activity information is presented on other pages. The menu bar in the figure also shows that items are grouped based on their common features (Principle 5).

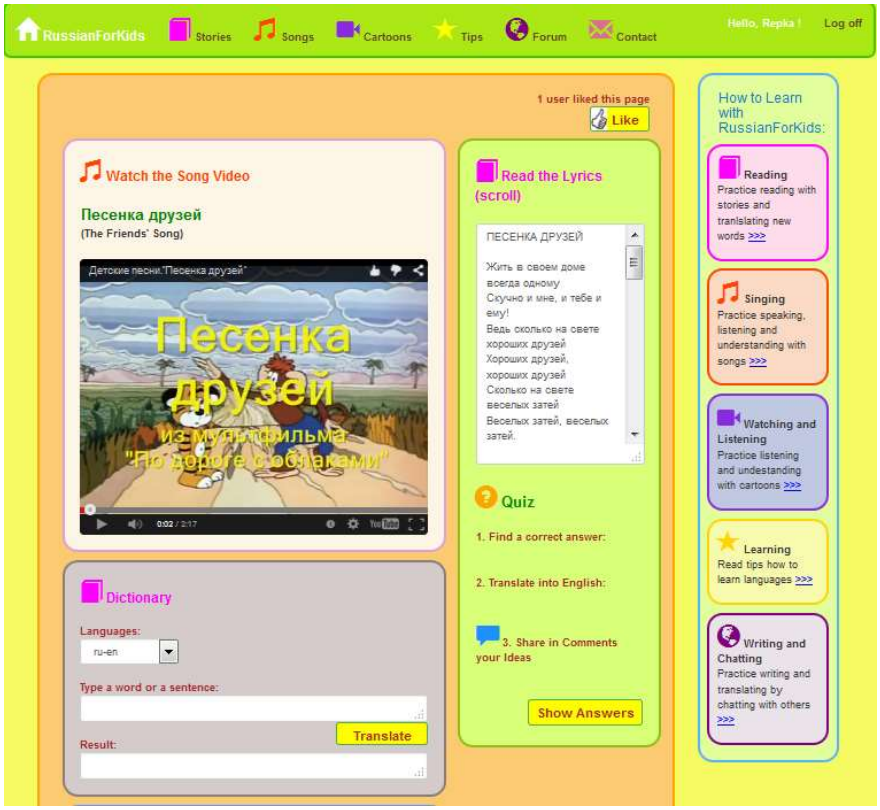

Figure 9. Alternative activities with the web application (on the right)

The activities are also displayed using the same appropriative look on every page, e.g., the different page sections always have the same look (Principle 1). Content section has a light violet background, quiz section has a green background with a question mark icon, comment section has a blue background with a speech bubble icon and translator section has a grey background with a book icon. Using the same look for the same activity and interaction enables the users to quickly become familiar with the application. Figure 10 shows an example of the look of activities.

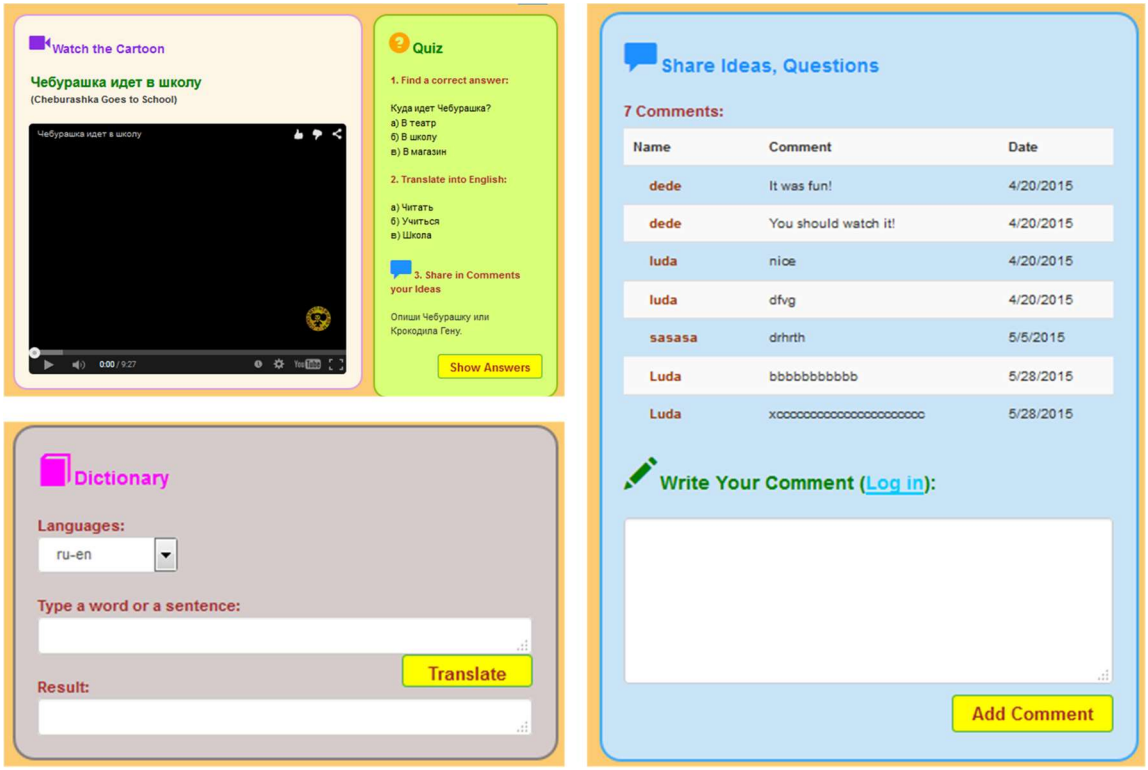

Figure 10. Consistent look of activities

Throughout the application, a number of bright colors are utilized to make the application more appealing for (Principle 2). Additionally, colorful and meaningful icons were used to complement text instructions (Principle 8). Figure 11 highlights how these two principles were applied to the menu bar.

Figure 11. Use of colors and icons in the menu bar

All the instructions are given using both illustrative icons and text (Principles 6 and 7). Figure 12 depicts the use of these principles through the simultaneous use of icons and text titles.

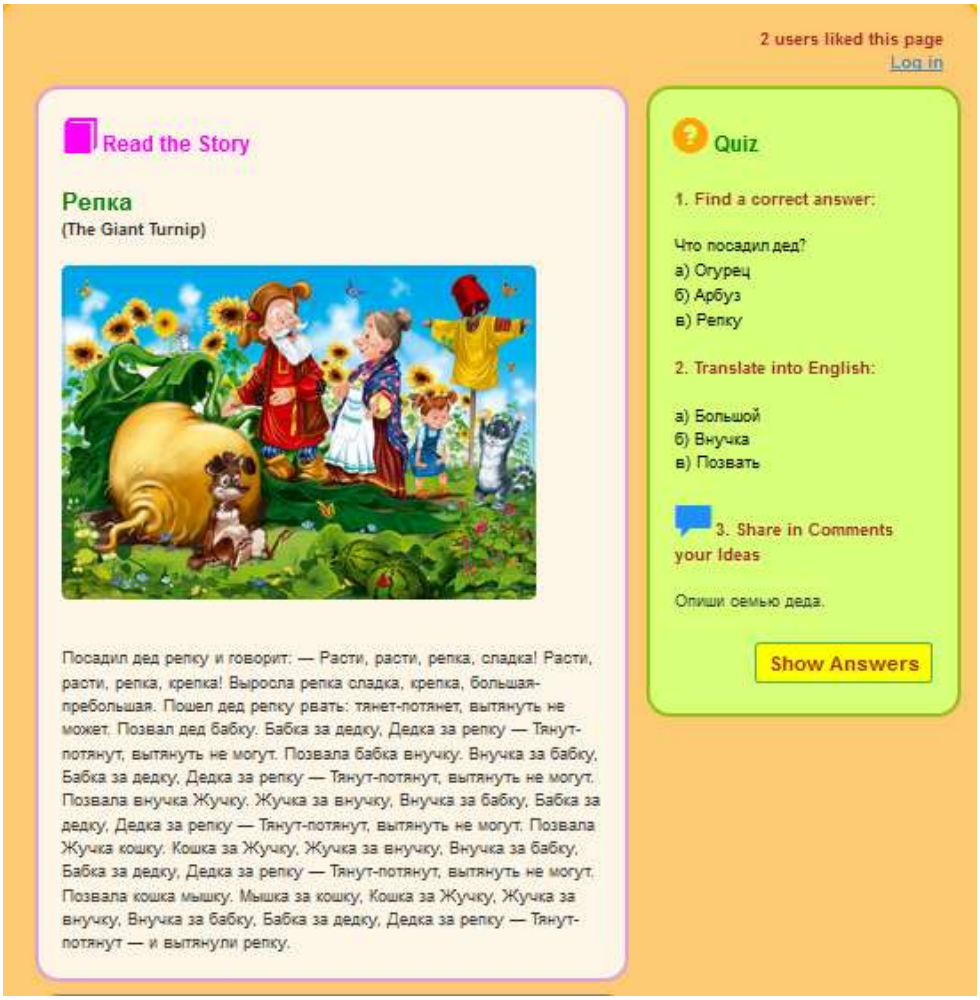

Figure 12. Instructions provided in multiple formats

To make RussianForKids more interactive, registered users are allowed to like, comment, and post information. Only registered users can do these tasks but all users can see the number of likes, comments, and posts (Principle 10). Figure 13 illustrates how liking feature is shown in a different way for registered and unregistered users.

Contact information is provided to enable users to email their questions, complaints, and suggestions (Principle 12). The copyright sign and information are presented to ensure the site creator's rights to the content (Principle 13). The implementation of these features is shown in Figure 14.

Figure 13. Display of likes for registered users (top) and unregistered users (bottom)

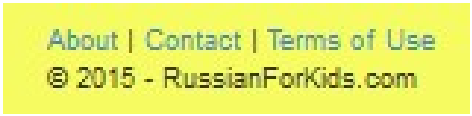

Figure 14. Copyright information

5.3.3.2 Text

Figure 15 shows an example of the text design principles of a story page where the main content text is displayed on a solid single-color background (Principle 3 and Principle 17) and the text is displayed using font size 14px and larger for headings (Principle 16). The figure also shows that all the activities are over-labeled (Principle 14 and Principle 15), e.g., the story title has a larger font size and a different color than the following story text. The figure also illustrates the age-appropriate use of vocabulary (Principle 18), e.g., the instructions "Read the Story" or "Watch the Cartoon" are short and simple directly pointing to the activity.

5.3.3.1 Multimedia

To make the application use more enjoyable and fun, RussianForKids uses a combination of text, still image, and video content (Principle 19). Figure 16 shows an example of the simultaneous use of video and text for a song content. As the figure shows, the user can control the video player, e.g., by adjusting the volume, pausing the video, changing to full screen, etc. (Principle 20).

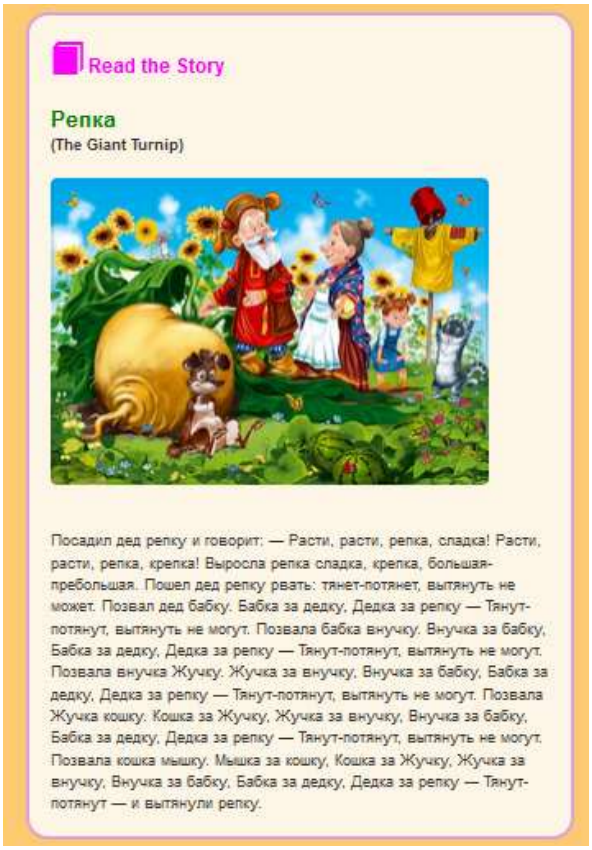

Figure 15. Use of text design principles

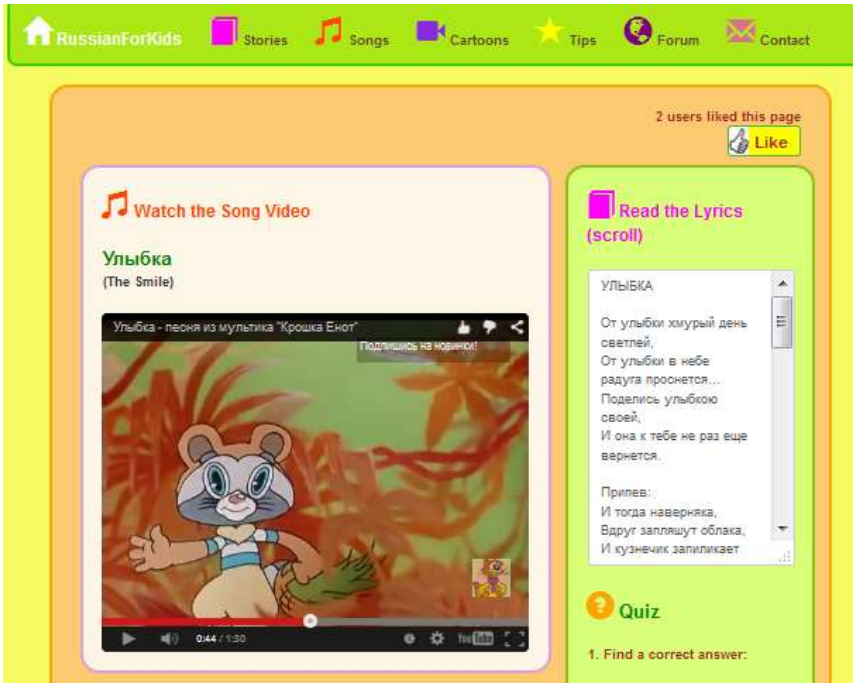

Figure 16. Use of various content formats

5.3.3.2 Navigation and Search

RussianForKids has a simple navigation that uses both pictures and text and does not include any sub-menus (Principle 23 - 25). Only two simple steps are needed to access any learning materials. Figure 17 shows an example of finding a selected story. First, the user clicks “Stories” on the menu bar that brings the user to the “ListOfStories” page that displays all stories. Then, the user simply selects a desired story that brings the user to the detailed page with the story text and the related activities. The song and cartoon navigation is similar allowing children to quickly learn and remember how to find something.

5.3.3.1 Graphical User Interface

As shown in Figure 8- Figure 17, RussianForkids uses many pictures to attract children’s attention and to simplify the navigation and instructions (Principle 27). However, pictures were used in combination with text since the text clarifies the meaning of the images and the target user group is expected to have good reading skills. Where appropriate, images are also presented next to the text learning materials for visualization purposes. As shown in Figure 18, visual aspects were also added to buttons and links to make them to appeal clickable (Principle 29). If a commercial version of the website was implemented, the use of animated promotional elements or active links to other websites should be avoided since children might not be aware that by clicking these items they will leave the application (Principle 30).

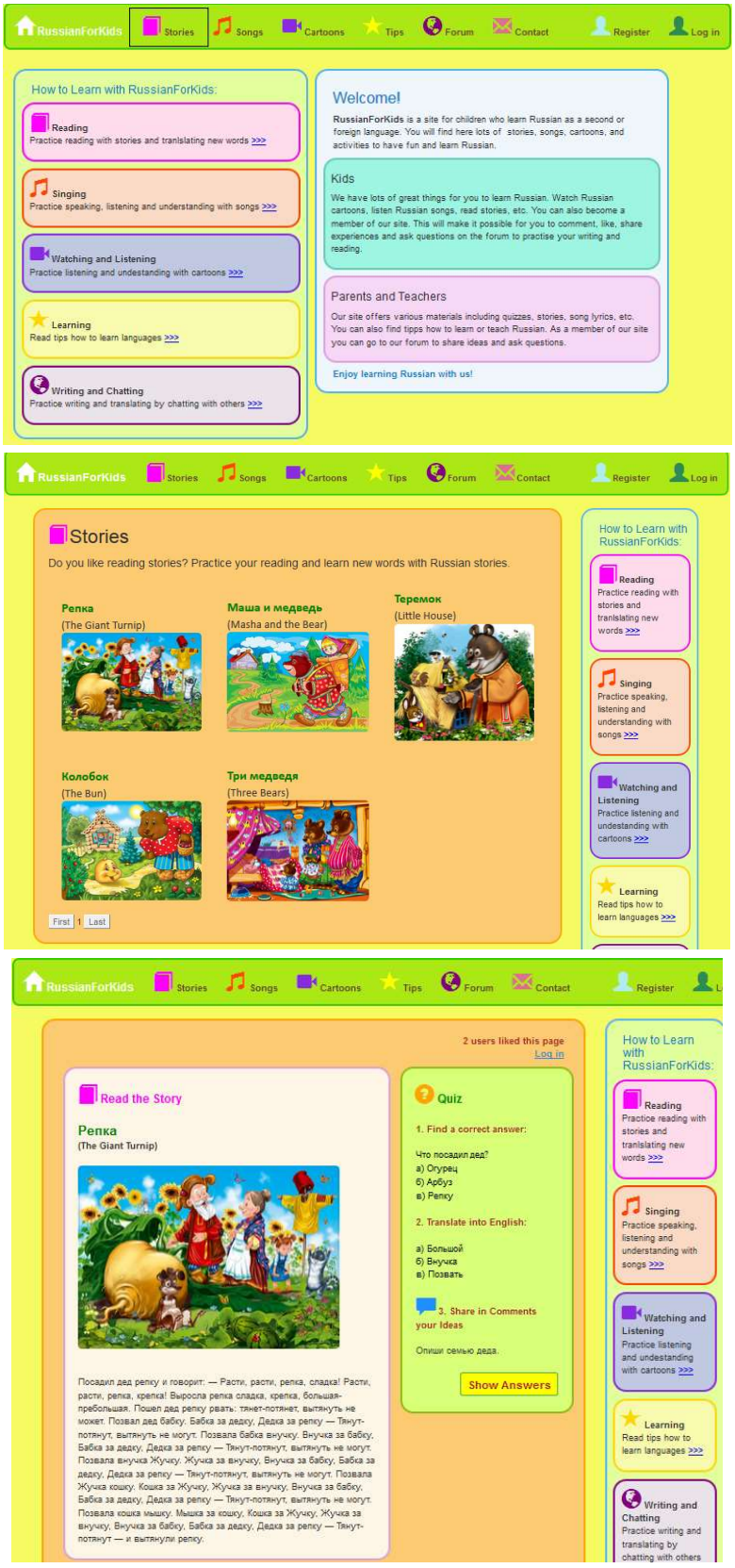

Figure 17. Navigation

Figure 18. Clickable links and buttons

5.3.3.2 Language Learning Materials

The main purpose of RussianForKids application is to learn Russian language. To make the application effective, the design principles of language learning materials were applied. All materials in RussianForkids are grouped in five appropriate titles using simple descriptive words such as Stories, Songs, Cartoons, Tips, and Forum (Principles 35, 37, 38). To inform the users of offered activities and materials and to provide the users with tips of the use of different materials (Principle 32), the section "How to learn with RussianForKids" is displayed on all pages excluding "Log In" and "Register" pages. Additionally, the section "Tips" educates the users of different ways to learn a foreign language (Principle 45). To ensure the young user can understand what to do, all explanations and instructions are clearly given in English, the assumed native language of the target user children (Principle 33). As shown in Figure 19, an interactive dictionary is included to make the language learning more efficient by avoiding the need to constantly access an external dictionary (Principle 43).

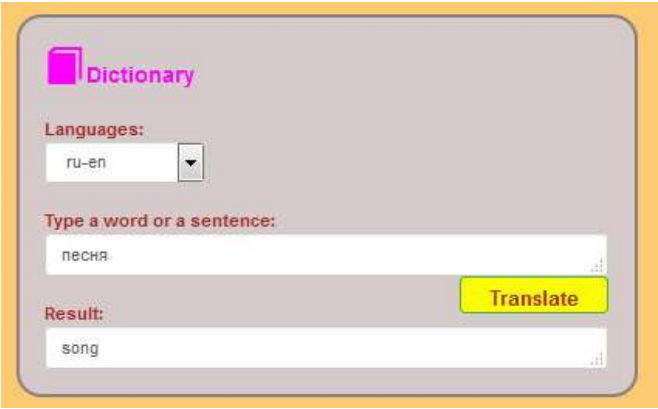

Figure 19. Dictionary for text translation

The included learning materials (stories, songs, cartoons) are both authentic and age-appropriate. Using authentic materials both benefits the language skills and contributes to the cultural skills (Principles 31, 36, and 40). To support different learning styles and learner types, various learning material types are utilized, e.g., text and pictures for stories and video and text for songs (Principle 39).

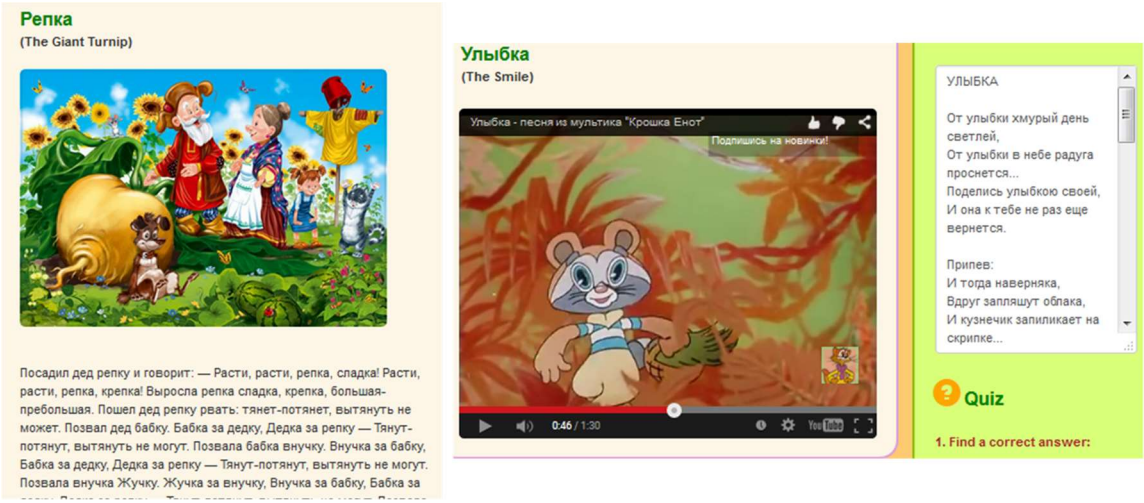

Figure 20. Use of different formats of materials: picture and text for stories (left) and video and text for songs (right)

RussianForKids offers various activities to make learning more interesting (Principle 41). For example, Figure 21 shows the various activities offered to a song

(watching the video, reading lyrics, translating, commenting, and answering the quiz). Transcriptions are provided for the song video files to make comprehension easier (Principle 44).

RussianForKids enables users to interact with each other by writing comments or posting on the forum as shown in Figure 22. These features contribute to the communicative skills of the users and allows sharing ideas, asking questions, and receiving support (Principle 42). Thus, it helps to create a language community by gathering people with similar interest and needs.

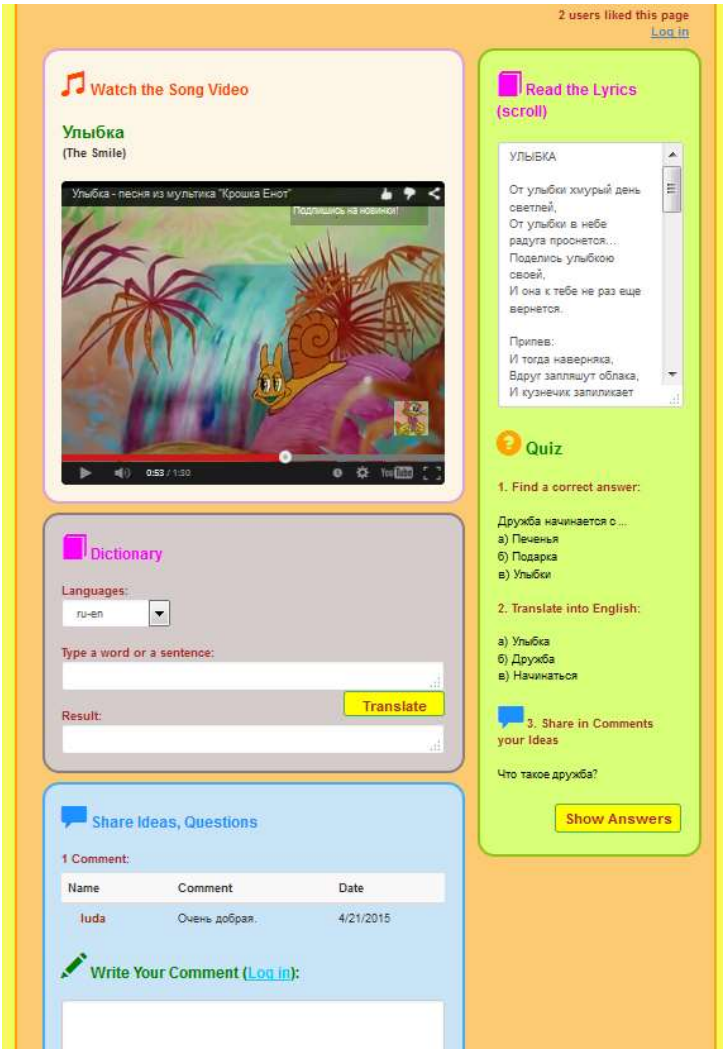

Figure 21. Various activities

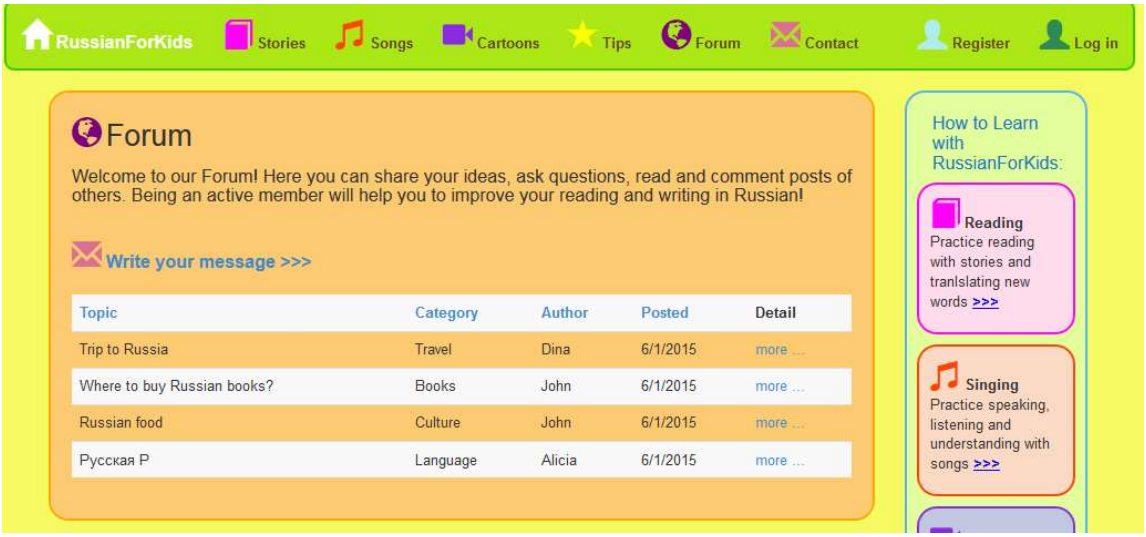

Figure 22. Forum

To conclude, many of the design principles listed in Table 2 have already been applied to RussianForKids while other principles are still not considered. Before launching the web application, further design principles to add include animations or animated agents (Principles 21 and 28), searching (Principle 26), and frequently asked questions and answers.

5.4 Evaluation

The fourth and the last phase of designing interactive products for children is to evaluate if the created application is easy to use, how swell it corresponds to the requirements, how appealing it is, etc. (Rogers et al., 2011). The main purpose of the evaluation process is to improve the product based on user's abilities and preferences. There are many ways to perform evaluating: through observing users interacting with the product, interviewing users, involving users in the design process, through written questionnaires, etc.

Table 3 lists the three evaluation types discussed by (Rogers et al., 2011).

Table 3. Three types of evaluation (Rogers et al., 2011)

Type of Evaluation	Description	Main Methods
Controlled setting involving users	Evaluating is performed in laboratories or living labs under control to test user's behavior while interacting with a product	- Usability testing - Experiments
Natural setting involving users	Evaluating is performed in online communities and public places with little or no control of users' activities to define the use of the product in a real life	- Observations - Interviews - Field studies
Any setting not involving users	Evaluating is performed through consultants' and researchers' critic, prediction and modelling how an interface is likely to be used	- Inspections - Heuristics - Walkthrough - Models - Analytics

All evaluation methods have advantages and disadvantages. For example, some methods can be expensive or difficult to perform while others can miss usability problems or give subjective results. Since adults cannot easily predict children's preferences, even based on childhood memories, it is highly valuable to involve children in the evaluation of children's web applications. Children usually have a clear idea of what they like or dislike and are very honest about it. On the other hand, it can be challenging to perform the evaluation involving children due to the fact that their social skills are not well developed. The evaluation methods should be applicable to the particular target user children age group. The main target user group of the RussianForKids application are children from nine to twelve years old. Based on Piaget's theory of cognitive development, four methods are recommendable for conducting a user experience study with this age group: qualitative interviews, user testing, small focus groups, and guided surveys (Piaget, 1970). Older children have already relatively good reading and social skills and can express their opinion with greater details (Watson, 2014). (Hanna et al., 1997) classify children's abilities and behavior based on the school system. The target user group of RussianForKids are children attending the last years of elementary school or first classes of middle school. According to the paper, children of this age are already able to sit at a task, follow teacher's directions, and are comfortable with new people.

Additionally, they are most likely experienced with computers. For the evaluation process, it means they are be able to critique a web application, answer questions, try new things, and be involved in usability testing. However, (Hanna et al., 1997) points out that children of the same age group can behave differently based on their personal features. For example, some may be able to "think aloud" during the evaluation process, while others can be self-conscious about being observed.

The different methods that used for evaluating children's interactive products in the literature include: observation (Diah et al., 2010; Sim et al., 2006), interview (Baauw and Markopoulous, 2004; Donker and Markopoulos, 2002), usability testing (Markopoulos and Bekker, 2003), think-aloud interaction (Als et al., 2005; Baauw and Markopoulous, 2004; Donker and Markopoulos, 2002), questionnaire (Donker and Markopoulos, 2002), peer tutoring (Edwards and Benedyk, 2007), and constructive interaction (Als et al., 2005). Each method has pros and cons. (Khanum and Trivedi, 2012) conducted a study to compare how successfully different usability evaluation methods can be applied to children. According to their research, the think-aloud method is recommendable for children from eight to fourteen years since it corresponds to their verbalization level. Surveys, interviews and questionnaires can however hide some problems since children answer only asked questions.

The methods discussed above are intended for evaluating the usability aspects of an application. However, RussianForKids should also be evaluated for its learning materials and activities. Since no existing evaluation criteria for children's language learning web applications was found, existing evaluation criteria for adults' language learning web applications were considered. (Liu et al., 2011) propose evaluation criteria for English learning websites concerning web usability, learning materials, functionality of assisting language learning, and technology integration. Evaluating the comprehensive

set of 58 evaluation criteria would require interviewing language teachers and experts since children would be unable to answer to the complicated questions.

Another set of evaluation criteria for English learning websites suggested by (Yang and Chan, 2008) includes 92 criteria divided into six categories: general information, integrated English learning, listening, speaking, reading, and writing. This set is recommendable for evaluating web sites by language teachers and experts as well as for web designers. The former can give a valuable feedback what should be improved regarding language learning part of the website, while the latter can use this set as a guide what a language learning website should include besides graphic design navigation, and organization. The authors also suggest using these criteria for evaluating the website with the users. However, the authors involved high school students, who have more advanced social and comprehension skills compare to our target user group, to the development of the criteria. It would be too challenging for children to evaluate the web application using this set of criteria. Many changes would be required to the criteria description to make them understandable for children. Additionally, children might not have the patience to go through all the 92 questions.

Due to the limited time and resources for this project, it was impossible to evaluate RussianForKids with children or with any other user group. Instead, the recommendations for evaluating RussianForKids are discussed.

First, it is recommendable to use a combination of different evaluations methods to get a more objective and holistic picture. Ideally, the main target group of children ages nine to twelve should be involved in the evaluation. This would deliver valuable feedback from a child's perspective and enable to see how young users interact with the web application. Additionally, the target user group should be interviewed about usability aspects such as navigation, font size, colors, page structure, instructions, multimedia, etc.

It would also be worthwhile to observe how the children would interact with RussianForKids and perform different tasks with the application.

Second, Russian language teachers should be involved to get an objective feedback of the learning materials. This could be done with a survey that could be based on the evaluation criteria proposed by (Yang and Chan, 2008) . These criteria should be modified to address children's language learning.

RussianForKids was designed and developed following the design principles from the literature. Many of the design principles have already been considered in the application while others should be addressed before launching the application. In order to further improve RussianForKids, a thorough evaluation involving both users and language teaching professionals should be conducted.

6. EVALUATION AND CONCLUSION

The aim of this project was to study the design principles for children's language e-learning and to design and develop a web application for children to learn Russian as a foreign language. The original project plan listed the following objectives:

1. Finish literature review of child-computer interaction and language e-learning for children.
2. Analyze the key design differences for user-friendly children web applications.
3. Summarize ideas and techniques of how to create easy and funny online environment for learning foreign languages.
4. Create a use case diagram and state transition diagram for the web application.
5. Implement the first draft of the application.
6. Add APIs to the application.
7. Compile necessary demonstration materials for the website.
8. Complete and polish the application.
9. Write the final report.

Objective 1. An extensive literature review on child-computer interaction and language e-learning was performed and the results are discussed in Chapter 2 – Chapter 4 whereby each chapter aims to answer one of the research questions in the original project proposal:

- Question 1: Why web applications need to be designed differently for children ages from nine to twelve compared to adults? (Chapter 2)
- Question 2: What are the key design principles for user-friendly web applications for children ages from nine to twelve? (Chapter 3)
- Question 3: What are the key features for an effective language learning web application? (Chapter 4)

Objective 2. Chapter 3 discusses design principles for children's web applications. The discussed areas are general interaction, text, multimedia, navigation and search, graphical user interface, and content. Chapter 3 also discusses the design principles for children from nine to twelve. A summary of the most important of these principles are is provided in Chapter 5.

Objective 3. Chapter 4 summarizes the key features of effective language learning web applications. Based on the literature review and best practices of existing websites, the chapter discusses types and formats of learning materials that should be included to create a useful online language tool for children. Chapter 4 discusses Web 2.0 features and how they can be used to increase the effectiveness of the language learning web application for children. Chapter 5 includes a summary of these aspects.

Objective 4, 5 and 6. Chapter 5 shows the use case diagram and state transition diagram and discusses how they were utilized for designing and implementing the RussianForKids web application. The implemented diagrams were utilized to create the prototype of the RussianForKids web application as discussed in Chapter 5. The chapter also discusses in detail the implementation of the web application functionality including the added APIs.

Objective 7 and 8. Based on the suggestions in the literature, relevant demonstration content was added to the web application. Chapter 5 shows some of the selected and created materials as well as some of the features of the final version of the web application.

Objective 9. This report completes the list of objectives.

Originally, I also had two advanced objectives of creating an additional German language user interface and adding animations. However, due to the time constraints, these objectives were left out.

Chapter 5 summarizes the design principles for children's language learning web applications and thus, also provides a summary answer for the research questions. This

design principle summary was used as a guide to create the RussianForKids web application.

The following aspects could be addressed in the future work:

- Make the web application user interaction more appealing for children by adding animated figures that explain the main activities.
- Implement a search feature for easier filtering of content.
- Add support for user interfaces in other languages to reach a bigger audience.
- Perform a thorough evaluation of the web application involving both children ages from nine to twelve and Russian language teachers. Use a combination of different evaluation methods consisting of usability testing, interviews, observation and surveys.

To conclude, it is necessary to consider the special features of child-computer interaction to design and develop successful children's web applications. Children's language learning web applications, which consider the special aspects of both child-computer interaction and language learning, can be useful tools for young learners, their parents, and teachers. The results of the work contribute to the research area of CCI and language learning and motivate researchers to conduct studies focusing on designing language learning applications for children.

REFERENCES

Als, B.S., Jensen, J.J., Skov, M.B., 2005. Comparison of Think-aloud and Constructive Interaction in Usability Testing with Children, in: Proceedings of the 2005 Conference on Interaction Design and Children. ACM, New York, NY, USA, pp. 9–16.

Baauw, E., Markopoulous, P., 2004. A Comparison of Think-aloud and Post-task Interview for Usability Testing with Children, in: Proceedings of the 2004 Conference on Interaction Design and Children: Building a Community, IDC '04. ACM, New York, NY, USA, pp. 115–116.

Britton, C., Doake, J., 2005. A Student Guide to Object-Oriented Development, 1st ed. Elsevier Butterworth-Heinemann, Burlington, MA, USA.

Bruckman, A., Bandlow, A., Forte, A., 2002. Human-computer Interaction for Kids, in: The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications. Lawrence Erlbaum Associates.

Buckleitner, W., 2008. Like taking candy from a baby: How young children interact with online environments. (An Ethnographic Study for Consumer Reports WebWatch). Mediatech Foundation, Flemington, NJ.

Chiasson, S., Gutwin, C., 2005. Design Principles for Children's Technology (White paper No. HCI-TR-2005-02). University of Saskatchewan.

Chow, A.S., Smith, K.M., Sun, K., 2012. Youth as Design Partners: Age-Appropriate Websites for Middle and High School Students. Educ. Technol. Soc. 15, 89–103.

Clark, W., Logan, K., Luckin, R., Mee, A., Oliver, M., 2009. Beyond Web 2.0: mapping the technology landscapes of young learners. J. Comput. Assist. Learn. 25, 56–69.

Club Penguin [WWW Document], 2015. URL www.clubpenguin.com/ (accessed 5.26.15).

Common European Framework of Reference for Languages: Learning, Teaching, Assessment, 2001. . European Council Language Policy Unit, Strasbourg.

Diah, N.M., Ismail, M., Ahmad, S., Dahari, M.K.M., 2010. Usability testing for educational computer game using observation method, in: International Conference on Information Retrieval Knowledge Management. pp. 157–161.

Dirksen, J., 2011. Design For How People Learn, 1. ed. New Riders, Berkeley, CA.

Donker, A., Markopoulos, P., 2002. A Comparison of Think-aloud, Questionnaires and Interviews for Testing Usability with Children, in: MSc, X.F.B.P., PGDip, Dphil, J.F.B., Ms, Détienne, F. (Eds.), People and Computers XVI - Memorable Yet Invisible. Springer London, pp. 305–316.

Druin, A., Bederson, B., Boltman, A., Miura, A., Knotts-callahan, D., Platt, M., 1998. Children as Our Technology Design Partners.

Druin, A., Solomon, C., 1996. Designing multimedia environments for children / A. Druin, C. Solomon. John Wiley Sons Ltd.

Duffy, P., 2008. Engaging the YouTube Google-Eyed Generation: Strategies for Using Web 2.0 in Teaching and Learning. Electron. J. E-Learn. 6, 119–129.

Edmodo [WWW Document], 2015. URL www.edmodo.com/ (accessed 5.20.15).

Edwards, H., Benedyk, R., 2007. A Comparison of Usability Evaluation Methods for Child Participants in a School Setting, in: Proceedings of the 6th International Conference on Interaction Design and Children. ACM, New York, NY, USA, pp. 9–16.

Fang, Z., Luo, W., Xu, J., 2011. A structure for children-oriented Human Computer Interaction, in: International Workshop on Advanced Computational Intelligence. pp. 205–208.

Fanlala [WWW Document], 2015. URL www.fanlala.com/ (accessed 5.20.15).

Fisher-Price [WWW Document], 2015. URL www.fisher-price.com (accessed 5.20.15).

Gaffney, G., Hunter, J., 2011. Designing for Children.

Gallavin, G., 2015. UX for Kids' Products: Designing for the Youngest of Users.

Gelman, D.L., 2014. Design For Kids, 1. ed. Rosenfeld Media, New York, NY, USA.

Gibson, R.O., 2012. Using social media as a language learning tool [WWW Document]. the Guardian. URL www.theguardian.com/teacher-network/teacher-blog/2012/apr/10/language-teaching-social-media (accessed 5.21.15).

Gilutz, S., Nielsen, J., 2002. Usability of websites for children 70 design guidelines. Nielsen Norman Group, Fremon, CA.

Good practice guidance for the providers of social networking and other user-interactive services, 2010. . UK Council for Child Internet Safety.

Greenberg, S., Carpendale, S., Marquardt, N., Buxton, W., 2012. Sketching User Experiences. Amsterdam ; Boston: Elsevier/Morgan Kaufmann.

Hanna, L., Risden, K., Alexander, K., 1997. Guidelines for Usability Testing with Children. Interactions 4, 9–14.

Hanna, L., Risden, K., Czerwinski, M., Alexander, K.J., 1998. The Design of Children's Technology, in: Druin, A. (Ed.), . Morgan Kaufmann Publishers Inc., San Francisco, CA, USA, pp. 3–26.

Harding, J., Szakacs, J., Parry, B., 2009. Children playing and learning in an online environment: a review of previous research and an examination of six current web sites. Young Consum. 10, 17–34.

Idler, S., 2014. Comparing Usability for Kids and Adults (part 2) [WWW Document]. UXkids. URL http://uxkids.com/blog/comparing-usability-for-kids-and-adults-part-2/ (accessed 5.12.15).

Idler, S., 2013a. 5 Key Criteria Of A Good User Experience For Children [WWW Document]. UXkids. URL http://uxkids.com/blog/5-key-criteria-of-a-good-user-experience-for-children/ (accessed 2.21.14).

Idler, S., 2013b. Child-Centered Design is User-Centered Design, But Then Different [WWW Document]. UXkids. URL http://uxkids.com/blog/child-centered-design-is-user-centered-design-but-then-different/ (accessed 3.27.14).

Jenkins, H., Cassell, J., 1990. From Barbie to Mortal Kombat, Gender and Computer Games. MIT Press, Cambridge.

Jochmann-Mannak, H., Lentz, L., Huibers, T., Sanders, T., 2012. Three types of children's informational web sites: an inventory of design conventions. Tech. Commun. 59, 302–323.

Kartal, E., Uzun, L., 2010. The Internet, Language Learning, and International Dialogue: Constructing Online Foreign Language Learning Websites. Turk. Online J. Distance Educ.-TOJDE Volume: 11.

Khanum, M.A., Trivedi, M.C., 2012. Take Care: A Study on Usability Evaluation Methods for Children. ArXiv12120647 Cs.

Kır, E., Kayak, S., 2013. The Evaluation of Websites Teaching English as a Foreign Language. Procedia - Soc. Behav. Sci., 4th International Conference on New Horizons in Education 106, 2788–2795.

Koohang, A., Harman, K., 2005. Open Source: A Metaphor for E-Learning. Informing Sci. J. Volume 8.

LearnEnglish Kids [WWW Document], 2015. URL http://learnenglish.britishcouncil.org (accessed 5.20.15).

Levy, M., 2009. Technologies in Use for Second Language Learning. Mod. Lang. J. 93, 769–782.

Light, D., Polin, D.K., 2010. Integrating Web 2.0 Tools into the Classroom: Changing the Culture of Learning [WWW Document]. Cent. Child. Technol. URL http://cct.edc.org/publications/integrating-web-20-tools-classroom-changing-culture-learning (accessed 2.2.15).

Liu, G.-Z., Liu, Z.-H., Hwang, G.-J., 2011. Developing multi-dimensional evaluation criteria for English learning websites with university students and professors. Comput. Educ., Serious Games 56, 65–79.

Markopoulos, P., Bekker, M., 2003. On the assessment of usability testing methods for children. Interact. Comput., Interaction Design and Children 15, 227–243.

McClelland, J., 2012. The Best Social Networks for Kids Under 13. Time.

Meloncon, L., Haynes, E., Varelmann, M., Groh, L., 2010. Building a Playground: General Guidelines for Creating Educational Web Sites for Children. Tech. Commun.

Mohammadi, N., Ghorbani, V., Hamidi, F., 2011. Effects of e-learning on language learning. Procedia Comput. Sci., World Conference on Information Technology 3, 464–468.

Naidu, _Shivashankar, 2005. Evaluating the Usability of Educational Websites for Children [WWW Document]. Softw. Usability Res. Lab. Wichita State Univ. URL http://usabilitynews.org/evaluating-the-usability-of-educational-websites-for-children/ (accessed 5.10.15).

Netflix [WWW Document], 2015. URL www.netflix.com/us/ (accessed 5.20.15).

Nielsen, J., 2010. Children's Websites: Usability Issues in Designing for Kids [WWW Document]. Nielsen Norman Group. URL www.nngroup.com/articles/childrens-websites-usability-issues/ (accessed 5.15.15).

Nusir, S., Alsmadi, I., Al-Kabi, M., Shardqah, F., 2011. Designing an interactive multimedia learning system for the children of primary schools in Jordan. Presented at the IEEE Global Engineering Education Conference, pp. 45 – 51.

O'Reilly, T.O., 2005. What Is Web 2.0 [WWW Document]. O'Reilly. URL www.oreilly.com/pub/a/web2/archive/what-is-web-20.html (accessed 5.20.15).

Papert, S., 1980. Mindstorms: Children, Computers, and Powerful Ideas. Basic Books, Inc., New York, NY, USA.

Peppa Pig [WWW Document], 2015. URL www.peppapig.com (accessed 5.20.15).

Piaget, J., 1970. Science of Education and the Psychology of the Child. Viking Press, New York, NY, USA.

Read, J., 2005. The ABC of CCI (Child Computer Interaction). Interfaces 62.

Read, J.C., Bekker, M.M., 2011. The Nature of Child Computer Interaction, in: Proceedings of the 25th BCS Conference on Human-Computer Interaction, BCS-HCI '11. British Computer Society, Swinton, UK, UK, pp. 163–170.

Read, J.C., Hourcade, J.P., Markopoulos, P., Iversen, O.S., 2014. Child Computer Interaction SIG: Towards Sustainable Thinking and Being, in: Proceedings of the Extended Abstracts of the 32Nd Annual ACM Conference on Human Factors in Computing Systems. pp. 1135–1138.

Read, J.C., Markopoulos, P., 2013. Child–computer interaction. Int. J. Child-Comput. Interact. 1, 2–6.

Rogers, Y., Sharp, H., Preece, J., 2011. Interaction Design: Beyond Human - Computer Interaction, 3. ed. Wiley, Chichester, West Sussex, U.K.

Šimonová, I., 2013. General Framework of CALL.

Smith, J., 2014. The Building Blocks of Designing UX For Kids [WWW Document]. Tuts+. URL http://webdesign.tutsplus.com/articles/the-building-blocks-of-designing-ux-for-kids--webdesign-17303 (accessed 2.20.14).

Smyk, A., 2013. Design Considerations for Little Fingers [WWW Document]. UX Mag. URL https://uxmag.com/resources/design-considerations-for-little-fingers (accessed 2.20.14).

Tse, E., 2013. Special Issue on Child Computer Interaction. Pers. Ubiquitous Comput 17, 1573–1575.

Watson, B., 2014. What Can Children Teach Us About UX Design? - The Usabilla Blog.

Yang, Y.-T.C., Chan, C.-Y., 2008. Comprehensive evaluation criteria for English learning websites using expert validity surveys. Comput. Educ. 51, 403–422.

APPENDIX 1 – PROJECT PLAN

The project plan is listed in Table 4.

Table 4 Project Plan

Objective	How	Deadline
Finish the literature review of child-computer interaction and language e-learning for children	- Research online databases - Summarize findings	03/20/2015
Analyze the key design differences for user-friendly children web applications	- List design recommendations for children age 6-12 - Shortlist the most important design considerations for the proposed web application - Evaluate existing children online language learning websites	03/25/2015
Summarize ideas and techniques in how to create an easy and funny online environment for learning foreign languages	- Gather and create examples of relevant materials, e.g., cartoons, stories, songs, poems, grammar rules, cultural aspects, etc.	03/30/2015
Create a use case diagram and state transition diagram for the web application	- Implement the diagrams using ArgoUML	03/20/2015
Implement the first draft of the application	- Implement the draft application focusing on content structure and the principles of functionality	04/01/2015
Add APIs to the application	- For further functionality, add APIs one by one following each API developer toolkit	04/10/2015
Compile necessary demonstration materials for the website	- Put together relevant demonstration content based on searched best practices	4/17/2015
Complete and polish the application	- Finalize functionality and appearance - Debug the application - Test application on different web browsers, screen sizes, and device types	05/05/2015
Write a final report	- Summarize completed work including the references in the final report.	05/29/2015

APPENDIX 2 – PAPER PROTOTYPE OF RUSSIANFORKIDS

The paper prototype of the web application RussianForKids is shown in Figure 23.

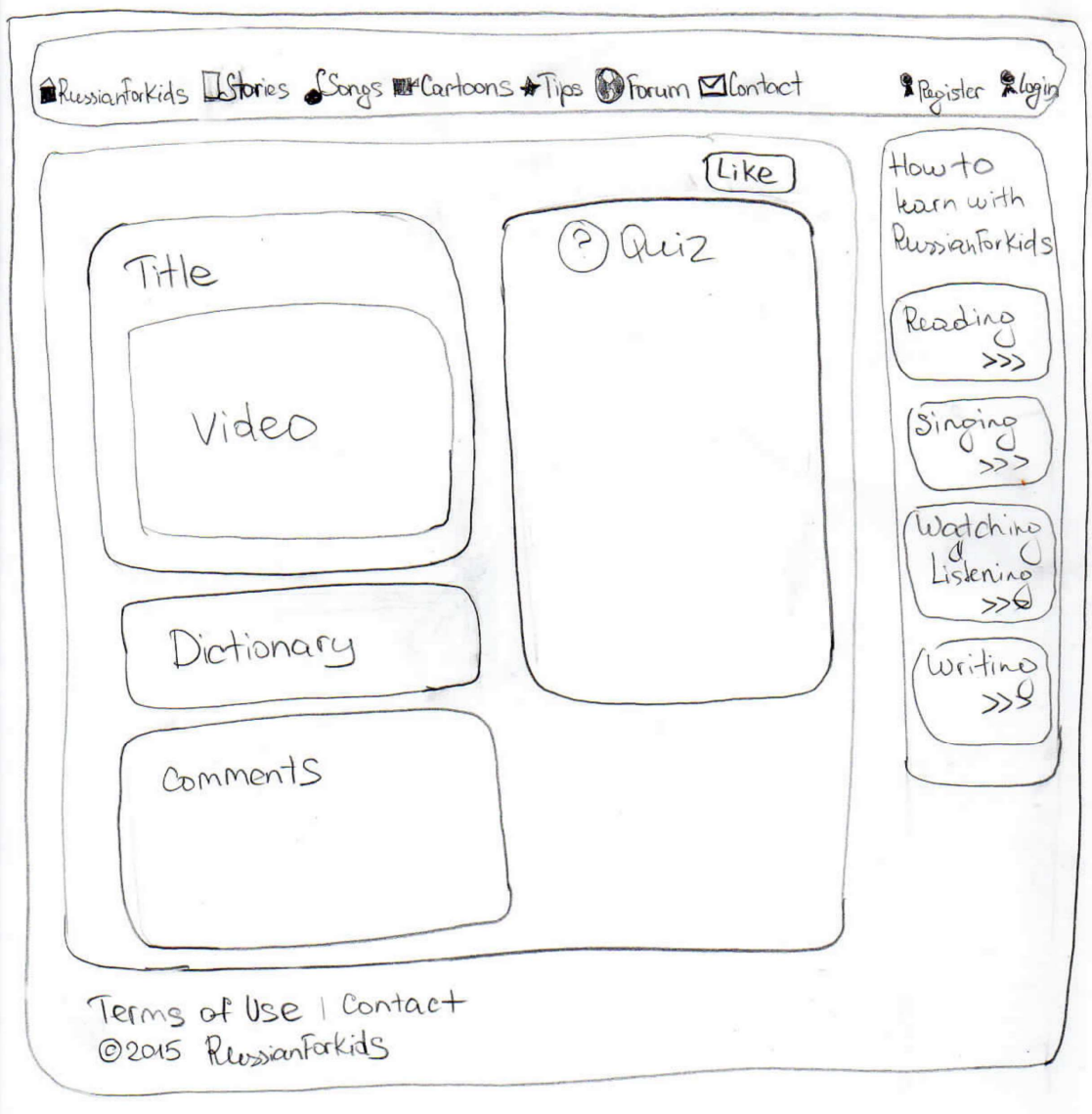

Figure 23. Paper prototype of RussianForKids