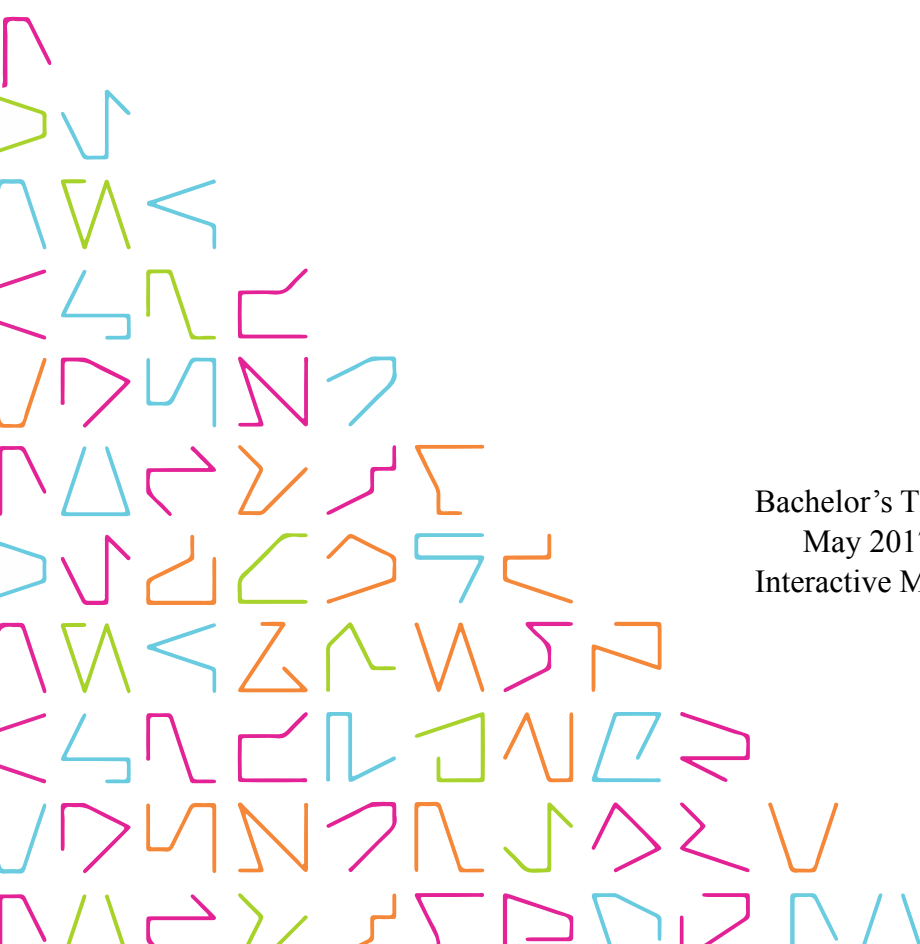


Validating UX and UI elements for Serious Children's Language Learning Games

Case studies: Lola's Alphabet Train and
Kids Learn To Read

Laura Räsänen

Bachelor's Thesis
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Interactive Media



ABSTRACT

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Bachelor's thesis

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Digital games as tools in children's language learning have great positive potential. They provide an alternative to traditional learning methods and challenge them and studies show that they have worked successfully in teaching kids a specific problem. They can be used as tools in schools and in preparation for school depending on their educational content and even be integrated into the curriculum.

The choices in graphic design in serious games have a large impact on the usability, playability and the way the player gets immersed in the language learning game. The purpose of this thesis is to research what a graphic designer has to take into account when designing of imagery, user interfaces and animations for children's language learning games and how the development stage of the target age group affects the complexity of the design and how the specific educational purpose, in this case learning to read, needs to be taken into careful consideration in the graphic design process.

Two language learning games designed for the examined target group of 4 to 6 years old children, Lola's Alphabet Train and Kids Learn To Read, are tested within the target group and analysed from the perspective of how successful the graphic design, user interface design and general imagery is in delivering the educational content of the game and engaging the players to the game. The test determines if the design principles for designing graphics for language learning games for 4 to 6-year-old target audience that are researched and examined in the thesis hold true in practice.

The purpose of this thesis is to validate the choices in the user experience and user interface design used in Lola's Alphabet Train and Kids Learn To Read based on research and testing.

Key words: games, serious games, graphic design, language learning games

CONTENTS

1. INTRODUCTION.....	5
2. THE DEVELOPMENT STAGE OF THE TARGET GROUP.....	6
2.1. The development stages of children of ages four to six in relevance to language learning	6
2.1.1 Language development	6
2.1.2 Fine motor skill development.....	7
2.1.3 Social-emotional development	8
3. DESIGNING GRAPHICS FOR A CHILDREN’S GAME.....	12
3.1. Designing for adults and children	12
3.2. Simplicity in user interface design in children’s applications	13
3.3. Using colors and visual hierarchy to put emphasis on visual elements	14
3.4. Highlighting the interactive elements	15
3.5. Themes	17
3.6. Visualisation of feedback	18
3.7. Hiding content from the players behind locks	20
4. APPLYING THE DESIGN PRINCIPLES IN CHILDREN’S LANGUAGE LEARNING GAMES.....	22
4.1. Introducing the case study games	22
4.1.1. Case Study 1: Lola’s Alphabet Train (Beiz Oy)	22
4.1.2. Case study 2: Kids Learn To Read	31
5. TESTING WITH THE TARGET GROUP	43
5.1. Test results.....	44
5.1.1 Lola’s Alphabet Train	44
5.1.2 Kids Learn To Read	46
6. CONCLUSION	51
REFERENCES	53

ABBREVIATIONS AND TERMS

TAMK	Tampere University of Applied Sciences
cr	credit
UI	User interface
UX	User experience
Game mechanic	Constructs of rules or methods designed for interaction with the game

1. INTRODUCTION

Digital games as tools in children's language learning have great positive potential. They provide an alternative to traditional learning methods and challenge them. They can be used to maintain a person's attention and provide an innovative and interactive way of learning. Dr. Mark Griffiths has studied the benefits of digital games in children's education in his article "The Educational Benefits of video games" (2002), where he determines that video games can add entertainment value to problems and there has been considerable success when games are designed to address a specific problem or to teach a certain skill.

According to Griffiths, playing computer games (irrespective of genre) produces reductions in reaction times, improved hand-eye co-ordination and raises players' self-esteem. Furthermore, video games can assist children in setting goals, ensuring goal rehearsal, providing feedback, reinforcement, and maintaining records of behavioural change and can be used when examining individual characteristics such as self-esteem, self-concept, goal-setting and individual differences. Video games also allow participants to experience novelty, curiosity and challenge which may stimulate learning.

According to Griffiths, the objective of the learning game should be clear. Professional helpers and developers should have a known goal in mind for the players of the game. The outcomes they are seeking should be clear to the teacher and to the player.

This thesis includes case studies that are focused on a target group of children of ages four to six. It is important to take into account the development stage and abilities to understand and put together words and meanings in these age groups when designing the graphics and structures of language learning games.

2. THE DEVELOPMENT STAGE OF THE TARGET GROUP

2.1. The development stages of children of ages four to six in relevance to language learning

2.1.1 Language development

The target group of the case study games varies from 4 to 6 years old. Taking the developmental stage and the reading, image recognition and problem solving abilities of the target age group into account is essential in designing language learning games. According to Carla Fisher (Designing games for children : developmental, usability, and design considerations for making games for kids, 2015) we as adults are far removed from the hallmarks of childhood experiences and don't remember what it is like to sound out words and put together the meaning of a sentence bit by bit as it is for children.

Carla Fisher emphasises that these stages are only guidelines to understand a child's development and wide ranges in these development milestones are perfectly normal. Myriad factors to these differences are for example gender, birth order, parenting style, environment and culture. For a developer that means designing with a wide range in mind and having to take into account that every child is an individual of their own with abilities and technical understanding varying degrees. 3-5 year old children (pre-school age) are developing common-knowledge scripts on how to interact with the world. They are driven by curiosity and eagerness to learn and to show off what they have learned. They learn through repetition and experimentation. Their world view is egocentric and they are still struggling to understand another person's perspective. They are also impulsive and acting quickly rather than thinking things through.

Carla Fisher writes that at approximately 3-years old, the child starts to group words and their vocabulary grows by categories that broaden as they're learning. They also start to listen and understand stories and their listening comprehension is very high. At 4-years old they start learning to write letters and understand that letters go together to create the sounds of words. According to kidshealth.org website some of the relevant reading

skill development milestones for 3 to 4 years old are: reciting the alphabet, beginning to sing the alphabet song with prompting and cues, making continuous symbols that resemble writing, recognising familiar signs and labels, making up rhymes or silly phrases, recognising and write some of the letters of the alphabet, naming beginning letters or sounds of words, matching some letters to their sounds and using familiar letters to try writing words.

A five-year old's comprehension of stories has advanced to the point where they can understand stories and concepts that they were not personally part of. kidsheath.org lists a five-year old's reading skill development milestones as: recognising and producing words that rhyme, matching some spoken and written words, writing some letters, numbers, and words, recognising some familiar words, identifying initial, final, and medial (middle) sounds in short words, decoding simple words in isolation (the word with definition) and in context (using the word in a sentence), retelling the main idea, and arranging story events in sequence.

2.1.2 Fine motor skill development

Another development area that needs to be considered when designing the graphics and structure of a learning game in the fine motor skills of the target group. The abilities of 4 to 6 year-old children can vary wildly. According to Fisher, children at that age may spend a lot of time colouring, tracing and refining their fine motor skills and their ability to accurately hit targets with a mouse or on a touchscreen improves with practice. This is something to be taken into account when designing touch-screen user interfaces for this age group. When developing games for touchscreen it should also be kept in mind that the players might use their right or their left hand and may be obscuring part of the screen and key information with their hand.

This is the typical behaviour of the case study games target groups player and it has to be considered when designing the structure and the interface of the game. The purpose of language learning games for 4-6- year old children is to prepare them for elementary school by teaching them to recognise common letters, to form simple words and connect meanings of simple words to images. Preschool age children are not able to read

and understand meanings in the same way that adult players are which is why the UI and the flow of the game has to be designed to fit the mind of the target audience. It is important to take into account the development stage of language skills combined to their understanding of the world and behaviour of the age group in the design process of the game's graphics in order to create an effective and enjoyable playing and learning experience.

2.1.3 Social-emotional development

How young children emotionally respond to digital games and what benefit digital games are to them depend on their social-emotional development stage. In the study *Emotions and Technology Communication of Feelings for, with, and through Digital Media*, volume *Emotions and Technology And Digital Games*, edited by Sharon Y. Tetegah and Wenhao David Huang, 2016, it is stated that as more and more children interact with digital media, it is important to identify the components that might support greater social-emotional development. The study defines social-emotional development as a multidimensional construct that includes a number of inter- and intra- personal processes related to fundamental social-emotional competencies such as the ability to understand, recognise and label one's own and other's emotions, appropriately express and control one's feelings and behaviours, effectively establish, maintain and manage relationships and make responsible decisions and choices. Social-emotional development is important in its own right and in relation to cognitive development and has a positive connection to a child's academic success.

According to the study the social-emotional development begins very early in life, as infants demonstrate basic emotions and react differently to the emotions of caregivers. Researchers name social competence or relationship skills and emotional regulation as two areas of social-emotional development that greatly contribute to preschoolers' school readiness.

According to research, social-emotional skills emerge early in life and evolve with age, through contexts and interactions with others. Children begin with learning basic skills and then advance and develop more complex skills through social contexts and situations. Young children take an interest in people, crave personal attention, participate in coordinated interactions, and acquire some emotion-regulation by learning to self-soothe with the help of trusted adults. Young toddlers tap into social relations by participating in group play and playing alongside their peers. They also expand on emotional knowledge by discriminating “good” and “bad” emotions, and widening the repertoire of expressive emotions, such as guilt, shame, and empathy. Their social-emotional development rockets during preschool years, when they begin to express “blended” emotions, understand expressions and Social-emotional learning opportunities and exhibit more independent emotion regulation. These social-emotional skills continue to develop as children mature.

As modern children are born into and are growing up in a world saturated with digital media, it contributes in shaping their social, emotional, cognitive, and even physical development. Jackie Gerstein, Ed.D. writes in her article Video Games and Social Emotional Learning that there are multiple social-emotional benefits to gaming when it comes to young children. According to her, Self-awareness is accurately assessing one’s feelings, interests, values, and strengths; maintaining a well-grounded sense of self-confidence and video games, by their very nature, provide ongoing feedback about personal performance.

Gernstein explains that self-management is the ability to regulate one’s emotions to handle stress, control impulses, and persevere in overcoming obstacles. Digital games help to form emotional connections and from the gamer managing those emotions as he or she works towards achieving the game’s goals, meanwhile learning to to handle stress, control impulses, and persevere in overcoming obstacles, set and monitor progress toward personal and academic goals and to express emotions appropriately. According to her research, emotion in games is extremely important or somewhat important to about 50% of gamers regardless of their age or gender.

Gernstain writes that while players involuntarily express emotions such as bliss, relief, personal pride, surprise and curiosity, they have also figured out how to spark them and

feel them whenever they want. She uses players with even difficult conditions as an example, for example children in the hospitals who use digital games to control their anxiety and points out that games can be used for treating mild to moderate depression. With the increase in gesture-based games, there is also an increase in potential for video games to help identify and regulate emotions as numerous studies have shown that movements or postures generate cues the mind can use to figure out how it feels, which is a phenomenon known as the physical-feedback effect.

Social awareness is being able to take the perspective of and empathize with others, Gernstein writes. According to her research it has been proposed that video games with a pro-social theme can promote compassion and altruism among the players and help to build relationship skills.

Gernstein states that digital games can help in advancing responsible decision-making skills and problem-solving skills. Problem-solving is a central theme to many video games, and kids of all ages are taught to recognise patterns and strategise in order to win. She also points out that video games are often an opportunity to walk in someone else's shoes and to experience other perspectives when making moral decisions. According to her research, video games can and often are designed to encourage altruistic behaviour.

Social-emotional skills are reported to be an important focus in children's digital media, according to the research in *Emotions, Technology, and Digital Games (2016)*, in which it is stated that at least some social-emotional skills are present in most games digital games designed for preschoolers.

Digital games for preschoolers provide opportunities to improve in many social-emotional tasks or master them. Being stuck at the same level of complexity and not being challenged may lead players to lose interest in learning social-emotional skills through the game. It is suggested in *Emotions, Technology, and Digital Games (2016)* that the game should have a nice balance of success and challenge. Lacking increasing complexity might diminish motivation to play.

It is beneficial to take the social-emotional development of children into consideration when designing children's serious games.

3. DESIGNING GRAPHICS FOR A CHILDREN'S GAME

3.1. Designing for adults and children

Tanya Udinge writes in her article *Building Apps for Kids: The definite guide* (www.invisionapp.com) (2017) that the main difference between designing for kids and designing for adults comes down to the goals of the users. She points out that an adult more often than not just wants to accomplish their task as quickly and easily as possible whereas a child, playing a game, enjoys challenges and conflicts along the way because it makes their accomplishment more significant in the end.

Udinge writes that because children can't predict or understand the consequences of their actions ahead of time, they're typically much more trusting than adults. This means that the designer is responsible for knowing this and building safeguards like content meant for adults behind locks into your app. She says that when designing apps for children it is beneficial to take into account that kids develop much faster than adults and as the target groups differ in level, an app designed for a 4-year old might not be suitable for a 6-year old depending on their level of development. According to her it is a good rule to concentrate on a maximum 2-year age range. The main differences between adult and child users that need to be considered are that kids need a good challenge or conflict, kids are more trusting than adults, kids need constant feedback on every interaction and that kids develop much faster than adults.

Udinge also brings up that there are still quite a few similarities between designing for kids and designing for adults. Children and adults both expect design patterns to be consistent and get annoyed by design elements that seem random and unnecessary. According to her, the common design principle to keep interactions and feedback consistent so that users are able to learn the app quickly stands true for adult and child users.

Both adults and children need a reason to use an app. Udinge reminds that children, too, will quickly become bored with just exploring the app if it doesn't give them a reason to do it. The purpose of your app should be clearly articulated to both adult and child users before the user has a chance to become bored with it.

Neither child or adult users don't want to be surprised when the app behaves another way than they expect, Udinger says. They expect feedback from interactions based on their previous experience and don't want to be inconvenienced by unexpected patterns. However small, unexpected interactions as a little extra delight are something both adult and child users enjoy.

Tanya Udinger states that like when designing for adults, you must understand your users and where they are cognitively, physically, and emotionally so your app resonates with the target audience.

3.2. Simplicity in user interface design in children's applications

According to Senior UX Researcher at Mutual Mobile Becky White in her article *Designing For Kids Is Not Child's Play* (2016), children are naturally drawn to simple, recognisable objects. White, the biggest challenge in designing applications for kids is that designers aren't kids, but adults, filled with adult life experiences, adult technology preferences, and loads of adult bias about what they liked growing up. An application suitable for adults can be too difficult or boring for toddlers to use.

Large design elements such as large typography, large buttons and large call-to-action areas are commonplace in modern children's games UI design. It is encouraged to use design interactive elements with a clear characteristic that indicates they are tappable, such as buttons with outlines or drop shadows and interactive elements that draw the users attention with animations and effects.

Catalina Naranjo-Bock writes in her column *Effective Use of Colour and Graphics in Applications for Children, Part I: Toddlers and Preschoolers* (2011) that designing for smaller screens on mobile devices calls for a higher emphasis on graphics for the main navigation elements, cleaner layouts and backgrounds, and less complex conglomerations of features. According to her, toddlers and preschoolers are very literal in their interpretations of the icons and images that provide calls to action in interactive ap-

plications, as well as in their expectations of what will happen when they click or tap them. Navigation areas can be oversimplified for easier use. Having a low barrier to entry is useful. Very simple, step-by-step, silly instructions make the user more willing to interact with the app. Navigation should be encouraged by positive feedback along the path in game and contextual help should be provided by the game if the user is not advancing. Visual cues that encourage advancement in the game should be provided. White writes that while adults understand that when scrolling, there are more content than is visible on the screen it is learned behaviour that might not come naturally to the children of the specific age group. Children might not be as familiar with technology and do not necessarily recognise the visual cues that adults have already learned. They might not automatically scroll down when visiting a website.

It should always be carefully considered whether or not the scene requires more content than fits on the screen or can it be avoided. When it needs to be indicated that there are more content beyond the screen it can for example be indicated with large, button-like arrows or content that's partly shown on the screen, hinting that the content can be fully seen if you scroll further. If there are hidden elements, include a visual indicator (such as arrows a partial view of the next item, or an example animation) to signal that there is more to explore. In adult-facing sections, a fade-out of content and a visible scroll bar are also effective. Young children are still developing their memory and if they're required to scroll and concentrate on solving the game, it might be too much for them to handle at once. Naranjo-Bock reminds that scrolling vertically below a page fold is conceptually difficult for children and horizontal scrolling is more intuitive and that preschool-aged children tend to hold a tablet in landscape view with two hands. Important interactive elements should be on screen upon initial load. Testing within the target audience is required to verify that the correct meanings of the instructions come across clearly.

3.3. Using colors and visual hierarchy to put emphasis on visual elements

Colours make a big impression on children's minds and bright colours will easily capture and hold a child's attention for long periods of time, Louis Lazaris (2009) writes in his article *Designing Websites for Kids: trends and Best Practices*. He states that colour

choices used in children's game design would likely be rejected in games designed for adults. With colour choices the developer can design a mood for the game that draws children back to it. Lazaris writes that children want to play a game with a happy, cheerful mood and bright, vivid colours can be used to aid in creating that. Smiling faces and happy, cheerful characters with energetic gestures (animations) will help create a fun and friendly experience that encourages the child to proceed and perform well in the game to achieve the goal of learning.

White (2016) also states in her research that kids expect their apps to be bright and engaging. White encourages the use of bright, vivid colours but reminds that it is important to make it explicitly clear which elements are interactive. Hot-spot items need to look active and touchable. For example, having a strong visual highlight behind an active icon helps children know it is interactive. Animating interactive elements helps them to pop out and is generally recommended. Naranjo-Bock writes that while colourful layouts and background illustrations create an immersive and exploratory experience for children it is still important to maintain a visual hierarchy and emphasise the interactive elements.

3.4. Highlighting the interactive elements

White also encourages using large hotspots regardless of whether you're developing for mobile or computer screen. The younger the child, the larger the hotspot need to be. The size of the hotspot depends on the size of the interface but it should be taken into consideration that the application will most likely work on multiple devices and in required to adapt to the size of each interface. If there are multiple hotspots on the screen, White recommends to leave plenty of space between them so that the child whose fine motor skills are not fully developed yet can easily touch the right one without confusion.

Naranjo-Bock also states that conventional graphics such as pencils, books, and arrows that go back and forth are well understood by children, while arrows can be somewhat abstracted. Common media icons such as Play, Pause, and Stop buttons are also generally understood by children, mostly because of their familiarity with media players and their widespread use of media Websites like YouTube. She writes that short action

words like Play and Go are also generally understood by younger users, although text-based navigation is not as effective as clear visual cues for an age group that is only learning to read and should be avoided when possible. It is important to keep the designs basic functionality and icons familiar and consistent. For example in traffic signs green means go and red means stop and the meanings are understood around the world. The meaning may slightly vary but generally the message remains and kids will connect green to mean yes and red to mean no.

Sesame Street Workshop Article “Best Practices: Designing Touch Tablet Experiences for Preschoolers” (Sesame Workshop - a nonprofit educational organization behind Sesame Street) states that since preschool-aged children typically cannot read, text-based “Help” sections are not useful. Instead, the article recommends help in the form of context-specific dialogue and visual reinforcement and using consistent, representational icons that follow standard convention. Contrary to mouse-based interactions, kids expect something to happen when they touch an element on a touchscreen. Their hands are going to wander and press on places where interaction is not intended. It is important that the user gets immediate feedback when they tap an element that does something. Their motor skills are still developing and they need feedback to know if their touch was registered or not. A good way to do this is to add audible sound or an effective visual element when an interactive object is pressed, an animation or a particle effect. Children don’t always intuitively lift their finger when an interaction happens but they need an indicator to let them know that something is happening. The Sesame Street Workshop article suggests that touch-able objects should be highlighted or glow, and actions should be delineated with a path

or animation of what gestures to use. If a child should drag a character or object along a path, you could create an animation of the path while highlighting the object that needs to be moved to make it clear what they are to do. In the article it is also pointed out that due to the weight and size of tablets, children tend to rest their wrists along the bottom edge of the screen. If active icons are placed there, children are likely to accidentally touch them and potentially “bump” out of the activity which means strategic positioning of the icons away from the bottom of the tablet will likely minimize frustration and quick game fatigue.

The most intuitive input gesture for children is a simple tap. It is important to allow for taps to occur, even when they are touching other components of the screen. Zones where touches will be ignored around the bottom of the screen and focusing touch interactions for the top half of the screen and toward the center are one effective way to prevent that.

General guidelines for apps designed for children who are not yet able to read can be summed up to balancing engagement and education, providing clear, manageable, chunked instructions with icons that guide the user into the app and highlighting areas with which the user can interact.

3.5. Themes

One way to get young children interested in the games visuals is using themes, which in this context means a specific recurring topic or setting in the game. Children do not have a lot of life experiences and they are drawn by familiar, recognisable elements and themes such as nature and animals or objects from home environment. For example stylised, animated, speaking characters are a way to grab and hold a child's attention. Characters that are designed to fit the environment of the game create a consistent world that the player can get interested in. The themes can be visible in the designs of the UI elements and menus of the game. Depth to the world can be created with details such as fitting backgrounds, background object and shadows.

Successful children's applications implement a number of elements and design principles that create an environment suited for a child's personality and interest. A successful design will hold a child's attention while they get immersed in a world that feels real. In the Sesame Street article the importance of familiar faces in children's apps to help the users get immersed in the world is brought up. The article states that the use of familiar characters creates a stronger bond between the child and the app and leads to increased comprehension of what to do. The characters of the game are the guides or instructors, teaching the child to use the app in usually an audio narration designed specifically for children who are only learning to read.

3.6. Visualisation of feedback

In a children's serious game as in any learning game it is important that the game gives the player clear feedback on whether or not their answer was correct. Feedback should be a combination of audio and messages in color and effects. The use of colors that are generally understood as negative (red) and positive (green) and color effects such as greying out the wrong answers are effective methods. Character animations can give a lot of feel to the experience and when used right they help the player navigate through the game by for example having the character give a positive gesture such as cheering or a negative gesture such as frowning depending on if the answer was correct or not. The animations should have a lot of expression and be more on the positive side to always encourage the player to keep on going.

According to the Sesame Street article research you should be careful to not be too negative when wrong answer selections occur to keep the player motivated and to give them hints to keep proceeding. The game should simply instruct them with small hints and tutorials so the player will know exactly what they need to do. Sesame Street Workshop article states that it can be good to consider a wrong answer to be an opportunity for a "learning moment." and the use of audio and visual feedback should be encouraging and incremental. Here are some of the guidelines and suggestions the article has listed:

- First Wrong Answer: Identify a wrong choice and offer encouragement. Example: "That's not it. Try again!" - can be achieved for example by character animations, visual hints such highlighting the wrong answer with a colour that's generally considered to mean wrong (red).

- Second Wrong Answer: Identify a wrong choice, restate the objective, offer a hint, and provide - The second hint can point towards the right answer. Can be achieved with highlighting the right answer with an effect or character animation.

- encouragement. Example: “That’s not right. You need to find a triangle. It has 3 sides and 3 angles! Try again!” - In a language learning game this can be done by spelling out the wrong answer (“that letter sounds like A! Try again”) and by highlighting the letter in question. This way the player learns differentiate the wrong letters from the right ones.

- Third Wrong Answer: Identify a wrong choice, restate the objective, offer a hint, and highlight the correct answer. Example: “That’s not right. You need to find a triangle. It has 3 sides and 3 angles! After which the triangle highlights. “Tap on the triangle!” This should be repeated until the correct answer is selected. In some cases it is suggested to move a child forward if he/she is struggling for a determined period of time.

The article reminds that it is also important to children that they know they did the right thing. This can be communicated to the player with rewards and effects that can be encouraging, even dramatic. There is nothing wrong with being extremely over the top with rewards in any app, and especially in a children’s apps. Great in-game rewards is motivating and exciting for young players. Visuals can be used in various ways to communicate this. The Sesame Street Workshop article suggests a few ways:

“Correct Answers: Payoffs are very important to children. They keep them motivated and invested. If possible, payoffs should reflect the curricular concept and user choice (e.g., “Nice job choosing the letter A!”). For audio payoffs, include sound effects (e.g., trumpet blare, ding-ding-ding, etc.). When possible, also include a visual payoff via animation or light movement.”

The article encourages the use of animations in pay offs. This can mean positive gestures such as cheering character animations or effects and colours that reflect correct answers accompanied with audio that encourages the player with positiveness. The correct answer should be visually emphasised. If the audio is “Nice job choosing the letter A!”, letter A should be highlighted to be visible with effects or colours.

In a photo.io article 8 Tips for Designing Mobile Apps for Children (2017) by Angelica Valentine it is said that a good timeframe for giving the a hint (audio or visual) is three seconds. The pause can be extended if the question appears again during the game. In

the design of the application's interactivity it should be taken into consideration that if you want the user to replay the game or have them play the next level, it should guide them to do that at the end.

3.7. Hiding content from the players behind locks

In mobile games designed for children it is common for the games to have hidden content that's only supposed to be accessible for adults who supervise the children's usage of the games. The content is generally paid extensions like full versions or subscriptions for free-to-play games behind ads or the game's main menu. Young players are not necessarily able to distinguish advertisement and promotional content from the real content as it is stated by Jakob Nielsen in his research article *Children's Websites: Usability Issues in Designing for Kids* (2010).

Different games go different ways about this but the goal is that the content is behind an obstacle that the child is not able to surpass because of their current level of development but an adult is. A player in the particular age group of 4 to 6- years old is statistically not able to read long, complex sentences, solve mathematical tasks beyond simple adding or control their motor skills in a specific way without learning it first. These are all patterns that can be used in the design of the lock for paid content.

A good practice that's commonly used in children's mobile games is adding the locked content in the menu but in a spot that is not attractive for young players to tap on. That means taking into account the rules and recommendations for guiding the player to the right place in the user interface but using them for the opposite effect of attracting the child's attention to other items in the user interface and diverting it from the specific items on the menu. If you want the players attention to go towards a specific item, a general recommendation is to make it flashy and popping with high- lights and animations with as little text as possible, possibly only words that are recognisable from context (START on arrow or EXIT on red X-mark.). For an item that you want to be only recognised by adults it needs to not stand out from the background. It needs to look uninteresting for a child so even if they try to tap on it and get the lock puzzle they will immediately feel like it is not worth it to pursue it because of how uninterestingly it was

presented to them and they'll already know there was nothing of importance and rather move on to the items that clearly lead to advancement in the game. The lock puzzle should also look like it is not part of the game and there's no need to add animation, characters or anything that you'd generally use to attract the players attention.

The player shouldn't feel like they are missing out on any content when they are not able to solve the lock, better yet they shouldn't understand that there is a lock or anything to solve in the first place. This can't always be achieved with there being a lot of pop-up adverts that lead to paid content in the middle of the play but the content behind the ads is usually locked as well and there is a clear path for the child to surpass the ad and continue/start over the free-to-play-version.

4. APPLYING THE DESIGN PRINCIPLES IN CHILDREN’S LANGUAGE LEARNING GAMES

4.1. Introducing the case study games

The case study games are language learning games designed for children of ages of 4-6. The children of the target group are not yet necessary able to read and according to Carla Fisher they are just learning to write letters and understand that letters go together to create the sounds of words. These games are meant to give the players some tools to recognise letters and words before starting elementary school. In the following chapter the graphic design choices of the case study games are analysed from the perspective of making graphics for the target group of 4-6 year old children and based on the research of the target groups’ abilities and development stage. Some improvement suggestions are presented to make the games better fit the guidelines of good children’s serious game’s graphic design but the changes are not implemented.

I work as a graphic designer at Beiz Oy and have made some of the recent graphical changes as well as promotional materials for Lola’s Alphabet Train (since 2015).

4.1.1. Case Study 1: Lola’s Alphabet Train (Beiz Oy)



PICTURE 1. Screen capture of Lola’s Alphabet Train Main Menu on iPad

Lola's Alphabet Train is a serious language learning game designed to teach alphabet for children of ages 4-6. The target group consists of children who may be starting school and cannot yet read. The game's purpose is to help children prepare for elementary school. After playing through Lola's Alphabet Train the goal for the player is to be able to recognise both vowels and consonants and form and recognise simple words. The game is available for mobile devices (Android, iPad and iPhone) as a free version and a premium version. The free version only includes easy difficulty setting. In this thesis the premium version will be examined. Lola's Alphabet Train is developed by Beiz Oy, a game company located in Tampere, Finland. The company is focused on developing children's serious games for mobile and smart TV platforms and it has 11 published educational games. The target audience ranges between ages from two to eight years old. The games are available as separate purchases or as educational packages, designed to fit a specific purpose in a school curriculum.

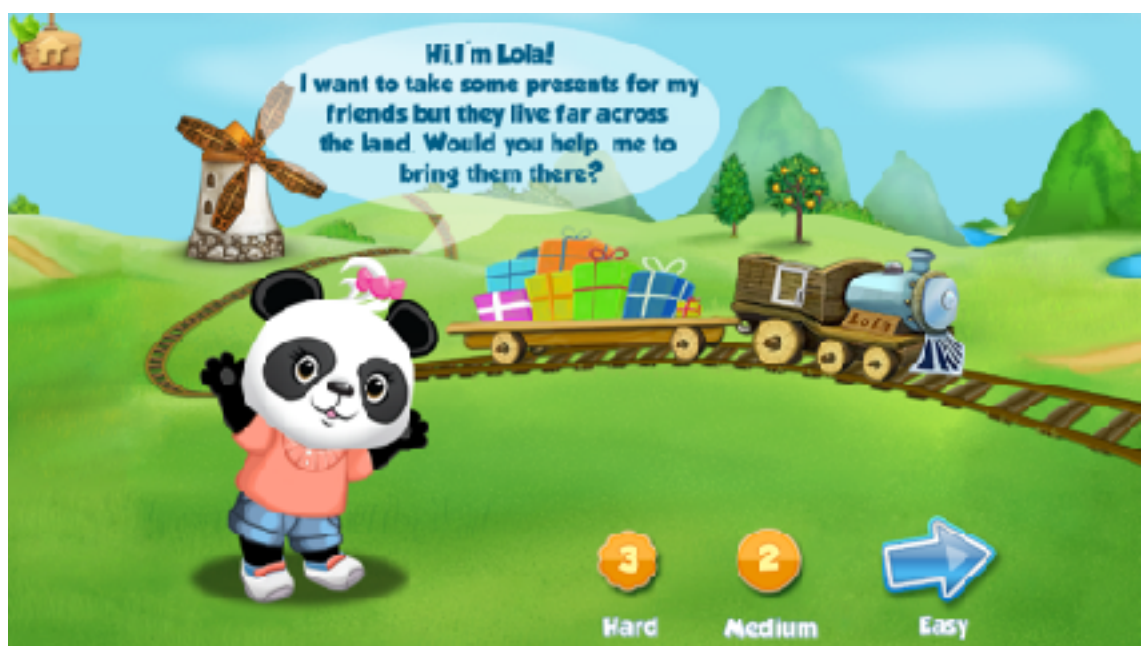
The tasks inside the game include a simple letter recognition task where the player has to connect the letter with a sound, a memory game where the player has to match two words with one another according to the audio of the words, a task where the player has to drag a missing letter to form a complete word and a task where the player needs to match the whole word with the sound. The difficulty level of the game gets higher as the player progresses and it is possible to choose from 3 different difficulty levels at start (easy, medium, hard). To finish a level the player must defeat several letter and word recognition tasks and get every answer correct. The game gives the player an audio hint if the player keeps choosing the wrong answer until the right answer is chosen.

The starting screen, as seen in picture 1, consists of a simple UI. The blue arrow button that leads to the into screen of the game does not require text. It is clear that the next logical step is to press it to proceed forward. An arrow is a recognisable object even for small children and they will know it to mean advancement. The button is large, it pops out and it has a small glowing animation to emphasise its interactivity. It is located in the down-right corner, which has been tested to be a logical location for a start-button and a child will naturally forward their attention to that corner. The other interactive elements are somewhat hidden in the background, a common practice in games for small children when you don't want the child to pay attention to the buttons that are

only meant for adults. The content behind those buttons and ads are locked from children with a simple math task.

The background of the start screen sets the mood and the general theme for the game. The player can already tell what to expect from the game by looking at the screen - a train ride through the countryside. The main character, Lola Panda is already introduced here. The player's attention is drawn to the character with a simple animation of her hands moving and the smoke coming out of the train's chimney. The player will already know that the train plays a big part in the game.

The story of the game is introduced in the intro screen, which can be seen in picture 2. The character tells that she needs to travel far across the land to bring the presents for her friends and it is the player's job to help her. The story is presented with a text as well as audio, since the player will likely not be able to read that much text at their assumed skill level. The scenery of the image further supports the story; you can see the presents in the train's car and the train looks ready on the track for you to hop on the journey. In a small scale game like this, where the story is very simple and straightforward and the game follows only a few game loops that repeat until the end of the game it is a good idea to keep the theme of the game present at all times, in this case the train. The player knows they are going to get on the train and they expect an adventure.



PICTURE 2. Screen capture of Lola's Alphabet Train Intro Screen on iPad

The anticipation is created with the sound effects of a train as well as the scenery, through which the train tracks are laid. Some elements that are introduced in this screen will again be present in the actual game, such as the windmill, the lakes and the rivers.

The UI of this screen is very similar to the one in the start screen. It helps to keep the player from being confused since they have already encountered the blue arrow in the down-right corner and they already know pressing it means advancement in the game. In this screen it is also possible to choose from three different difficulty levels. The “easy” level is purposefully made to pop-out from the others because it is the first difficulty setting for a new player and by starting from the easy-level the game automatically advances to medium and hard difficulty-levels.

The storyline features the character, Lola, riding the train through the countryside while solving problems with letters. Again, the rule of simplicity is applied in the whole user interface. The main task is located in the middle of the screen and the letters are made to pop out of the background with colours and effects. Since children of the target age group don't always have the same experiences in using a mobile user interface and they don't necessarily understand how interaction with the interactive objects work it is important that there are indicators for the user to guide them to act correctly. In this case it is the centred elements that are hard to miss; the player will intuitively start tapping on the objects that pop out and the game gives feedback right away if it was the correct thing to do.

The most important interactive elements are kept larger than the less important ones. The player has to choose the right letter from the three options and if they choose the wrong letter, the game performs a colour changing animation and audio hint. The sound is a negative one to let the player know the answer was not correct. This is further indicated by an animation on the character. The player can try tapping as long as they choose the right letter but there is a pause after choosing a wrong answer to eliminate the possibility to tapping mindlessly until finding the right letter. If they tap the right letter, an animation and an encouraging audio sound plays to indicate that the answer was correct. The game also repeats the correct answer to the player. No unnecessary el-

ements are added into the user interface and to advance in the game, the player does not need to interact with the interface but the advancement happens automatically by choosing the right answers. The home button is located in the side, away from the main gameplay area to avoid the player tapping it accidentally if they don't know where to tap. Their attention is drawn to the middle of the screen, where the game consistently happens.



PICTURE 3&4. Screen capture of Lola's Alphabet Train gameplay on iPad

The rule of familiarity is used in the feedback animations that can be seen in pictures 3. and 4. The character frowns or shakes her head and a large pop-up with a surprised face appears when the player chooses the wrong answer (picture 3.). Like the Sesame Street Workshop article "Best Practices: Designing Touch Tablet Experiences for Preschoolers" suggests, the feedback from the wrong answer is not too negative but rather encouraging. The character looks surprised but not sad and the audio tells the player in an encouraging tone to try again. These are easily recognised by the young player as negative gestures that they have likely experienced in their own life. When the answer is correct, the character cheers and smiles, again a reaction that the player would expect to see in a positive situation (picture 4.).

The same pattern in the interface design is consistent throughout the game in every task and the player does not have to learn new patterns for the interaction, only the mechanic of the task will differ.

The game switches between tapping and dragging. Only one task uses dragging as a mechanic, which is the mechanic showcased in picture 5. The rest of the tasks use tapping as a game mechanic.

The colours and themes in the game are again dealing with familiarity. The environments are recognisable. The game starts with a mundane countryside with hills and trees and rivers and changes into a few different environments as the game advances. The change is subtle and designed to not draw attention away from the game but to give the player a feeling of a fun world and an adventure. They are on a journey on the train and the subtly changing environment emphasises that as the theme of the game; the journey has a destination that can be reached by advancing in the game.



PICTURE 5. Screen capture of Lola's Alphabet Train gameplay on iPad

The gradual change of environment is demonstrated in picture 6. The new and the old back- ground themes blend together between the tasks. The colours are kept bright and natural, close to nature. Nothing in the environment pops out from the background to draw attention from the gameplay. The environment is made believable and immersive with little details like animals, flowers and animated backdrops. The animations are small and subtle but still create life to the scene. The moving elements aside from the character feedback gestures are the moving clouds and the turning of the windmill.



PICTURE 6. Screen capture of Lola's Alphabet Train gameplay on iPad

Lola's Alphabet Train went through changes in a recent facelift. In the previous version the colour of the sky was significantly darker and there was no animations in the background. After the changes were made they were applied to the promotional material as well such as screenshots in the play store/app store and advertisement in other games. The effects of the changes were visible in the increased sales of the game within a few months. It is beneficial to keep the overall atmosphere of the game's world bright and cheerful with vivid colours and so inviting to the child as it is suggested by the research of Carla Fisher and Catalina Naranjo-Bock. The changes in graphics were implemented by me in the spring of 2016. I was the graphic artist who implemented the changes.

In Lola's Alphabet Train the player gets a reward after finishing a level consisting of several tasks. The reward system is interactive and follows the same dragging mechanic as the rest of the game, keeping the interactions consistent and easy to follow. The player gets to choose a reward item from eight options and the item will appear in one of the train cars for the rest of the game. The player can at all times see how many levels they have completed and it helps them see how much of the game they still have left to play. There are more than six items to choose from, which is the number of the cars and thus the maximum amount of reward items the player can get in one game, meaning that it can be exciting for the player to play the game again so they can choose different rewards than previously. They can also see their chosen rewards at all times in the train cars, which relates to the story of the game they have heard at the beginning.

It can be difficult for a young child to have different game mechanics mixed together and having to switch between tasks can be difficult to understand. In some tasks the mechanic is tapping and in others it is dragging. The game does not provide animated tutorial for the player to know which mechanic they are supposed to use in the gameplay part of the game (there is an animated tutorial at the prize screen).

An animated tutorial would make it easier for the player to understand what mechanic they are supposed to use. The tutorial could appear when the player is trying to use the wrong mechanic or when a certain amount of time has passed without the player interacting with the screen, indicating that they have gotten confused.

The prize scene is the only scene where a tutorial is provided. This seems inconsistent as two different mechanics are used throughout the game and the dragging mechanic is introduced already before the prize scene.

An animated tutorial similar to the hand icon in the prize screen demonstrating tapping or dragging movement would be helpful for the player to figure out which mechanic to use for each task. In pictures 7. and 8. an alternative is featured, tailored to work specifically for the task in hand. For the tutorial to demonstrate tapping movement an animation would play on top of the right word. This would only happen in the first play-through as the player would then learn the right movement from then on. This is a method suggested by the Sesame Street Workshop article “Best Practices: Designing Touch Tablet Experiences for Preschoolers”.



PICTURE 7. Edited screen capture of Lola's Alphabet Train reward screen on iPad (Laura Räsänen, 2017)



PICTURE 8. Edited screen capture of Lola's Alphabet Train reward screen on iPad (Laura Räsänen, 2017)

The suggested changes were not included in the testing and the pictures 8. and 9. are edited screencaptures of Lola's Alphabet Train and only there to demonstrate improvement suggestions.

4.1.2. Case study 2: Kids Learn To Read



PICTURE 9. Screen capture of Kids Learn To Read main menu screen on iPad (Intelli-joy)

Kids Learn to Read is a language learning game designed for children of ages four to seven. The game is available for Android, iPhone and iPad. The lite version of the game consists of 3 mini games that all tie up to a storyline, the character Tommy the Turtle trying to assemble different sports/outdoor items in the garage of his home and set them up outside in the yard. The full version of the game consists of 6 mini games but in this case study only the lite version is examined. The game is developed by Intellijoy, located in Russia. The company has published 26 children’s serious games for mobile platforms and each one of their games is dedicated to one specific part of preschool curriculum. Their target audience ranges in age from two to ten-years-old. Their games have over 50 million downloads worldwide.

Kids Learn to Read starts with a starting screen that gives the player some options on how to proceed (picture 9). The “PLAY” button is the controlling element of the screen and it pops up. Even if the player can’t read at all, the button is inviting and the player is likely to go directly at it. Everything else on the screen encourages pressing the play button; it is the centre of the whole scene, the characters and backdrops are located to surround it, the trees in the background emphasise it (the bush line falls towards the button). The rest of the buttons are made less obvious for they are not meant for the player

but for the adult (parent etc.). The buttons meant for the player are all simple and their meanings are communicated to the player by symbols rather than words. The first scene already introduces the main character that the players will interact with in the game.



PICTURE 10. Screen capture of Kids Learn To Read intro screen on iPad (Intellijoy)

The character is further introduced in a short transition animation where there is a close-up of Tommy the Turtle's face and an animation of him waving to the player (picture 10.). The audio of the scene simply states "Help Tommy to build things by playing the games here". The story and the goal of the game is communicated to the player by showing the room where the building will happen. This short screen is an important one, for it introduces the character to the player and allows them to get to know him and his motivation. This way getting immersed in the gameplay of the game will happen easier.

The player chooses the mini game they want to play from the game selection screen (picture 11.). The game selection screen however does not indicate what skill level the games are for or what they are about, the player needs to know this in advance (they need to have played the game before) to be able to choose. The UI consists of only a few buttons that pop out from the background. There's no unnecessary text and it is easy for a child to know which elements are interactive without having to read instructions. There's enough to look to keep the player interested but not too much to confuse them.



PICTURE 11. Screen capture of Kids Learn To Read game selection screen on iPad (Intellijoy)

Only three of the six available games are playable in the free version of the game, the rest of the games are unplayable which is indicated by them being greyed out, as it can be seen in picture 11. It is an universally understood sign that an element not yet available. The lock icon further indicates that there's more content that can somehow be unlocked for playing. In this case it is by purchasing the full version of the game. This is easily communicated to the player when they try to click on the greyed out buttons, an ad screen for the full version appears.

The first game teaches letter sounds to the player by moving the character, Tommy the Turtle, across the letter bridge as the audio sound of each phoneme is played and a word is formed and pronounced. The player has to equip the character by choosing from three options and depending on which equipment you choose, the faster the character moves. With choosing the stick, the character walks and the letter sounds are slow and very clear. If you choose the shoes, the character walks faster and the letter sounds become faster and start blending with each other. If you choose a skateboard, the character moves very fast and

every letter blends together to form a word. The mechanic is tapping the equipment and then the character. The second and the third choice of equipment are only available if

you have already used the previous ones, encouraging the player to go through the learning curve in a sensible way.

The buttons are designed in the same style to the ones in the the starting screen and are easy for the player to recognise. Again no text is used for the UI and the number of buttons has been kept at minimum. The colour green is used at the buttons indicating that something positive will happen (advancement in the game) as well as to indicate which letter is being pronounced at the moment (picture 13.). The buttons are located in the upper corners of the screen and the bottom of the screen is free of interactive areas like suggested in the Sesame Street Workshop article.



PICTURE 12. Screen capture of Kids Learn To Read gameplay on iPad (Intellijoy)

The element of simplicity is consistent throughout the game. The main UI elements are centred and pop out with bright colours and simple designs. It is clear that the player is supposed to concentrate on the letterboxes and their attention is further drawn to them by having the character walk over them. The problem is that there is no interaction with those large elements but instead in the smaller icons that do not pop out as effectively.

The learning element of the game comes from listening to the letter sounds when the character walks over them. The letters that are being played turn green when the sound is on. The colour changing animation of the letters draws the players attention to look at the letter in question exactly when they are supposed to and they will be able to connect

the letter and the sound together. The faster the sounds become, the faster the character animations and letter animations become.

Throughout the whole game there's a progress tracker at the bottom of the screen, indicating how much of the level there is still left to play. The purpose of the progress tracker might not be instantly clear to the player but whenever the player makes progress, an animation and a sound play, indicating that a something positive has happened and the player will register it as progress.



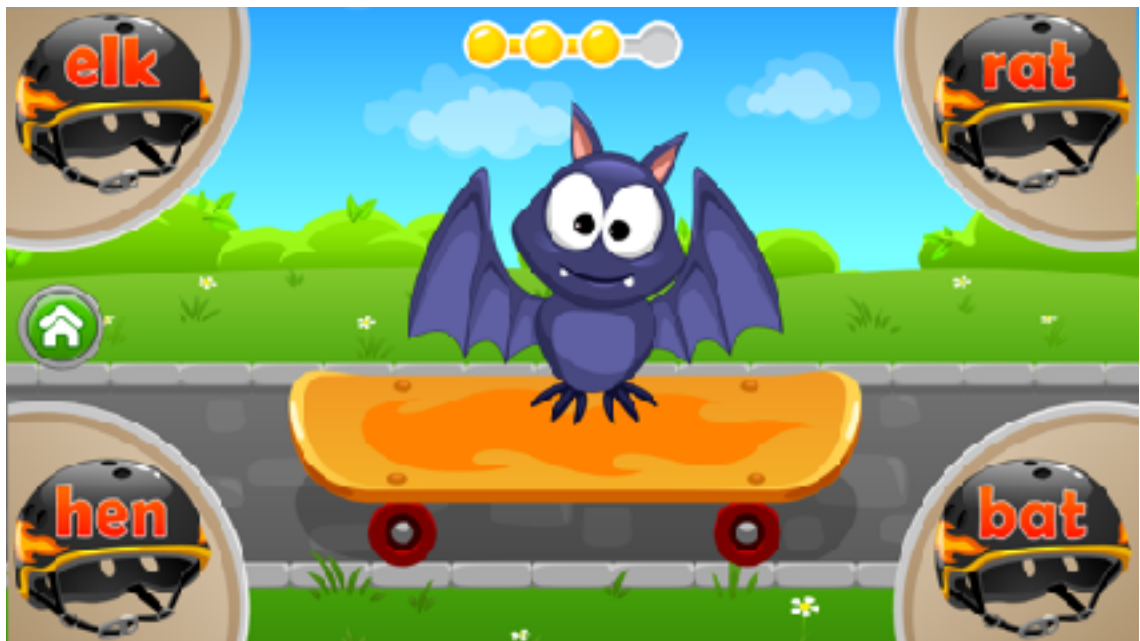
PICTURE 13. Screen capture of Kids Learn To Read gameplay on iPad (Intellijoy)

The animations are simple and support the gameplay mechanics. When a word is completely finished, an airplane flies across the screen presenting an image of the word (picture 13.) There is an overlap with the environment which makes the perspective look strange but it is not too distracting and barely noticeable with what is going on in the attention center). The progress tracker will play a short animation accompanied with a sound effect and another dot appears to the tracker, indicating that the task is finished.

One main theme of Kids Learn To Read is outdoor activities and sports and the theme is present in this mini game in the design and the character animations.

The absence of cheerful reward-feedback can be discouraging to the player, according to the Sesame Street Workshop article. It is important to get the player to feel a sense of achievement to keep them engaged to the game. This could be achieved with a simple animation for the character (cheering etc.) or an effect of the progress tracker (confetti, sparkles etc.). It is suggested by the Sesame street workshop article to have the feedback for successful performance be a little over the top is effective for this particular age group.

The second game consists of two parts. Both of them continue teaching letters and sounds but are adding the element of having to read the words to proceed, so the difficulty is already significantly higher than in the first game. The player has to recognise the word in the middle of the screen and connect it to the right animal. All the letters are tappable and give the sound of the letter. It is possible to listen to the sounds until the player is able to make out which word it is.



PICTURE 14. Screen capture of Kids Learn To Read gameplay on iPad (Intellijoy) Second Game, Part 1

The UI of both parts of the game can be seen in pictures 14. and 15. The second part continues directly from the first one. This time the player has to recognise the right word from four options that are written on helmets in the corners of the screen. The animal is in the middle standing on the skateboard as a reference point. An audio hint is available when the player chooses the wrong answer.



PICTURE 15. Screen capture of Kids Learn To Read gameplay on iPad (Intellijoy) Second Game, Part 2

The UI is consistent with the rest of the game. The progress bar has the same design and is located in the middle, only this time above the gameplay area. The game uses animation and audio together as a reward feedback. When the loop is completed, the animal character wears the helmet and skateboards away while a catchy, light-hearted encouragement audio clip plays. The whole game exists in a story within a story and it has a clear beginning and a clear ending but it does not get too complex and the narrative does not distract from the learning elements. The whole narrative is communicated with graphics. There is no text to read but the player is able to comprehend the story aspect from just the graphics.

The overall theme of outdoor activities is presented in the form of a skateboard and skateboarding animals.

In the third game the player has to learn to write simple words. The scene consists of an image and some cubes that the player can turn by swiping. Some of the letters are hidden and the player has to find the right missing letters to form a word. The further the player advances, the more letters are hidden in the beginning. The hint that the player is given is an image and an audio of the word.



PICTURE 16. Screen capture of Kids Learn To Read gameplay on iPad (Intellijoy)

The mechanic in this game is rolling the letters by dragging. The mechanic is completely different from any other method introduced in the game and adds a 3D element to the gameplay. The missing letters are indicated by a large, green question mark that easily attracts attention to the cubes (picture 16.).

When the player thinks they have found the right answer, they still have to tap “ok” on the right side of the screen. After that they get feedback on whether or not the answer is correct or not. If the answer is wrong, they’ll get an audio message to try again. If the answer was right, they get an encouraging audio message and the correct word is

spelled out letter by letter, while the letters are visually emphasised with a 3D animation of the blocks enlarging. The message that the answer was correct is clear and encourages learning.

The user interface of this game is not as intuitive as the previous games as there are several steps the player has to take to complete the task. The player has to tap and drag in the same game and mixing different input methods together should generally be avoided.

The theme is present in this game as well. The main elements are blocks and since the game environment is outdoors it creates a feeling of playing with blocks outside. It is consistent with the first two games.

The improvement suggestions are for the feedback system. Visual feedback for a wrong answer should be clearly presented to emphasise that the letter the player chose is wrong and that they should try a different letter, which is the direction the Sesame Street Workshop Article suggests. This could be done with having the wrong letter briefly turn red or a cross appearing on top of it, a clear sign accompanied with audio that the answer was not correct and the need to keep trying.

The layouts of all three games are not entirely consistent. The progress tracker changes place after the first game to the bottom of the screen. While the position is alright at the bottom for there's no interaction with the tracker, it would always be better to keep consistency to avoid having the players get confused. Some of the icon hotspots could benefit from being larger in size and easier to accurately use for a child who is still developing their fine motor skills.



PICTURE 17. Screen capture of Kids Learn To Read game selection screen on iPad (Intellijoy)

Animated tutorials are provided throughout the game every time it takes the player a while to tap on the screen (picture 17.). The animated tutorial is clear and guides the player if they don't know how to proceed in the game. The tutorial is also provided in the beginning of each different game. The controls are simple enough so that there does not need to be more than one kind of tutorial and the player won't get confused.

The animated tutorials are simple and consistent in how they look like but the problem with them is the fact that the game uses several different touch mechanics, which can be confusing for a young player. The tutorials that are provided are always the same, indicating that the mechanic is the same. They could be improved with very small changes, such as track paths to hint drag or tap movement.

Kids Learn To Read has a distinct theme. The environment is a forest, a familiar setting for a lot of the players. The environment stays the same in every game throughout the game. The theme is already set in the start screen of the game, which features a forest with a large tree in the middle. The environment is nature -centric, with a lot of green grass, leaves and flowers, a familiar setting that the player will easily get immersed. It is also an easy environment to develop further in case you want to use seasonal themes, which Kids Learn to Read does.



PICTURE 18. Screen capture of a Kids Learn To Read seasonal main menu screen on iPad (Intellijoy)

During Christmas time the whole setting of the game changes, as can be seen in picture 18. (compared to picture 9. on page 31) according to the season and the forest of the first game is covered in snow and in the second one the task background is a snowboard lying on a snowy field instead of the usual skateboard laying on grass.

The third game features the same forest setting as the first one, again covered in snow. There's a subtle animated snowfall in each game. The character is dressed in winter clothing instead of his usual cap hat. The Christmas setting relates to the player's life, whether or not they celebrate Christmas or encounter snow it is a well known phenomenon they will have very likely heard of. It is a familiar setting that can easily create a believable world for the player to get invested in. The Christmas theme is visible throughout the whole game in the environment changes, main character's outfit change and added decorations.

As it was stated earlier, in addition to the nature themes the whole game is centred around outdoor activities and sports. It is present all throughout the game and part of the narrative from the beginning to the mini games to the reward system. This theme is more related to the game design of the game but is present in the design of the graphics as a big part of the atmosphere of the game.



PICTURE 19. Screen capture of Kids Learn To Read reward screen on iPad (Intellijoy)

The reward for completing a level is a small game on its own. Interactivity in reward systems is an effective way to keep the particular age group interested. In Kids Learn to the reward system works so that in the beginning the player has to choose an item that they want to build, such as a bicycle or a roller skate (picture 19.). After completing a single mini game of one difficulty level, they get a part for the item as a reward. The player has to complete several games to build the item fully which creates continuity to the story of the game. After the item is built it appears in the intro screen of the game and the player is able to examine the yard with all the items they have built so far.

A good reward system keeps the player coming back to the game and creates motivation for them to complete the level fully. A reward system that works as a game on its own creates anticipation and variety to the gameplay and the desired effect is that the player will have as much fun with the reward game as they do with the game. The real reward is the item they get to add as an extra to the intro screen and because they get to choose in which order they build the items there is an element of customisation and the player feels like they have added their own touch to the game world, which is rewarding to look back at.

The reward screen is designed to look completely different from the gameplay screens. All of the gameplay is set outside in the nature and the reward screen takes the player inside to the garage, so it creates an idea that this is the home of the character, the base, where you always return. It expands on the world and gives it more depth with only one fairly simple screen.

The mechanic of dragging the pieces of the item works well enough as it is but there are some improvements that can be done with the graphics. The shapes available for the player are usually clear as to where they're supposed to go but in the roller-skate, the player has to know which wheel to put to which slot when all the wheels and slots are identical to each other. In the worst case they try dragging the wheel to three different slots and all of them are wrong in which case they can already easily think that the mechanic does not work.

The reward scene uses animated tutorials to point the player towards the right direction which makes the change in mechanic easier to understand.

5. TESTING WITH THE TARGET GROUP

In this section the case study games (Lola's Alphabet Train and Kids Learn to Read) are tested with the target group of children of ages 4-6.

A traditional think.aloud protocol can be used when doing usability testing with older children, but being more creative may be more exciting for your participants, Senior UX Researcher at Mutual Mobile Becky White in her article *Designing For Kids Is Not Child's Play* (2016), recommends. Asking the child to 'teach you' how to play a game, or observing one child teaching another child how to play are some of her suggested testing methods. In these invaluable testing sessions it is good practice to observe everything about the child's usage of the app. Is your app easy to use? Fun? Boring? Confusing? If it is a game, are the different levels, time limits and bonuses clear? You may learn something totally unexpected. One team of designers found that when children lost in a game, the noise and animation of a 'sad cat' was so funny to kids that they would lose on purpose, inciting unstoppable giggles. (White, 2016)

It should be assumed that the child will use the application without the help of an adult, Catalina Naranjo-Bock writes. She recommends that when testing the usability of a mobile app with the target audience it should be noted if the interactive elements are of an adequate size for a preschoolers's fingers and motor abilities, so they don't accidentally tap buttons that would take them away from their current experience and cause frustration.

The games are tested from the perspective of graphic design and usability, not from the perspective of the learning results.

The game testing was done on 14.2.2017 in International Early Education Center, Tampere. The testers were preschoolers of age six. Ten individuals were testing both games one by one. They spent around five minutes with Lola's Alphabet Train and played one full round and a few more minutes with Kids Learn To Read because it includes several smaller games and is therefore more time consuming, the time depending also on the player's speed and ability to read. They played each game for at least one full loop. The levels in reading ability in the test group varied and for some of them the games were

much faster and easier than to others. Their reading abilities did not seem to be relevant to how well they were able to interact with the UI and advance in the game.

5.1. Test results

5.1.1 Lola's Alphabet Train

Most of the players did not need help in navigating the start menu of Lola's Alphabet Train. The players' attention was brought to the important elements right away and they were able to start the right level without assistance. The downright corner is a good place for the start arrow as the attention of the player is easily directed towards it. It was a result of testing in the development phase that this placement is a natural indication of progression and it was apparent in this testing session as well. Only one test player needed assistance in finding where the game starts. Every player was eager to start the game right away and did not care for exploring the menu further. They were not interested in the locked content. According to Carla Fisher's research this is typical behaviour for the age group and differs from how adult players want to explore the menu of the game to see what options they have.

The navigation of the gameplay was also generally intuitive. The most trouble was at the memory game because the mechanic changes and suddenly there is no audio instruction. Most of the players waited for the audio instruction for some moments and seemed slightly confused when there was none. Every player was able to figure out how to continue on their own by just trying it out so it wasn't too distracting. One of the test players stated that the letters in the game where letters fall and have to be recognised are hard to see and indicated that they should be slightly bigger and pop out more. Others seemed to have seemingly no trouble in recognising the letters in the bubbles or outside of them and it was definitely helpful that the game assists the player with audio instructions.

One of the test players tried to touch the falling letter rather than the one in the bubble first after the audio instructions tell them to touch the correct letter. This is technically not wrong according to the instructions that do not state "touch the correct letter match-

ing the one that's falling" et cetera. The letter is not interactive so the player intuitively tapped on the letter in the bubble next so the game forwards them towards the correct path even if they try the wrong one first and thus it does not affect the gameplay too much.

The players of this age group were very quick to learn the game mechanics so even if they were slightly confused with some things the game generally forwarded them to the right path and during the next game loop they were able to use the UI with no problems.

The prize scene with the shop (page 22) was confusing to about half of the test players. The sudden change in mechanic from tapping to dragging was hard but because of the animated tutorial most of the players were able to figure out the mechanic. Half of the test players tried to tap first. Two players needed assistance because the mechanic was so precise and were not able to hit the dragged item in the right spot and they were getting seemingly frustrated. The others were able to get the item in the right car in one or two tries after they figured out how the mechanic has changed. In this screen you are able to choose into which car of the train you drag the item and this was also confusing to some of the test players. Most of them dragged the item to the first car as that is the most intuitive. This does not affect the gameplay and they were able to proceed forward.

All the players enjoyed the game and seemed to have a good time with it. They did not get stuck or frustrated enough to want to quit at any point. The overall structure of the game UI seems to be simple and clear enough for a player at the development stage of a six-year-old to navigate without assistance. The game provides step-by-step instructions when they are needed in a subtle way so it still does not give the player the right answer as is encouraged by Catalina Naranjo-Bock in her column *Effective Use of Colour and Graphics in Applications for Children, Part I: Toddlers and - Preschoolers* (2011). The players are rather well guided towards the right direction and they are able to complete the game loops until the game is finished or gets too difficult for their reading skill level.

5.1.2 Kids Learn To Read

The starting screen of Kids Learn To Read is intuitive and all the test players were able to find the menu behind the PLAY button that leads to the game. The PLAY button is easy to find and there are no other clearly visible interactive elements on the screen. None of the test players wanted to explore the menu and locked content and were eager to get to the game just as they were when starting Lola's Alphabet Train as it is typical for a six-year-old player according to Carla Fisher (2016).

The second menu was more complex for the players as all the playable levels had been unlocked already and it wasn't completely clear to them where they should start. In Kids Learn To Read the game gets progressively more difficult the more mini games you play and it is designed to be started at the first, easiest game. Not all of the test players realised they have to start at the first game and about half of them tapped on a random game out of the three available ones. It seemed to usually be the one in the middle so the second hardest one, which is not surprising since there is no numbering or any indicator of which one is the first one other than the order of the images and as the player has just previously navigated through the starting screen, where the button to proceed in clearly in the middle their attention is easily drawn in the middle again.



PICTURE 20. Screen capture of Kids Learn To Read game selection screen on iPad (Intellijoy)

How easily the player got frustrated with the game seemed to be relevant to which game they start with: if they started with the first game, the game would get progressively more difficult as it was designed to and the player could adjust their skill as they went on in the game. If they start in the middle and then proceed to the first one, the game gets much easier for them and they become bored. None of the players tapped at the third game first. In picture 20, it can be seen that there is no indicator to which level is the first one for example numbering or color-coding. Only which levels already been finished once is visible from the prize symbol at the bottom.

About half of the test players were able to figure out the flow of the game UI in the first game but about half were confused how the game works and needed assistance to know where to tap to proceed. The confusing part seemed to be the icons after the character walks through the bridge for the first time (page 25). Even though there is a tutorial to point out where to tap many of the players still either did not notice it or tap it because it did not make sense to them. There is no clear indication that the game would continue with pressing on the icon. Even after finishing the game loop the players didn't seem like they had figured out the purpose of the game and seemed rather like they just knew where to tap so they were able to finish the game. It also was clear that since the game does not require reading skills and the educational element of the game comes from listening to the audio of the letter sounds it is rather boring for players who already have some understanding of letter recognition. The players were expecting to have to solve a problem of some sort but there was no such element to this game so there was no proper pay off for the players.

One UI problem in the game is that the animated tutorial gives away the correct answer instead of merely pointing the player towards the right direction. It does not give the player very much time to think of the correct word and a child might not have enough time to listen through all the four options before the game just gives the answer to them. This made the game too easy for all of the test players and they did not feel any challenge playing the game.

In conclusion the first game was slightly below the test players' skill level and for that reason they did not get engaged enough to it. The UI was also putting them off by being

hard to understand and the overall structure of the game did not make a lot of sense for the players. About half of them needed assistance in completing the game.

The second game was more in balance with the players' skill level and all of the test players connected with the game much better than with the first one. It was visible in their ability to stay focused and willingness to put effort into finishing the game. The structure of the game was easy to understand and they were able to understand what they're supposed to do without outside assistance. The game consists of two parts which are connected to each other. The players had no trouble with the flow of the game and were able to navigate the UI. The theme of the game with the skateboarding animals made them excited and most of the players seemed to be having fun with the game. The ending animation where the animal jumps on the skateboard and rolls away while the game gives a funny audio phrase seemed to be a rewarding conclusion for the game as it made a lot of the children laugh. The testing session concluded that engaging animations and fun characters are important in keeping the player interested.

Generally the UI is clear and there is no confusion about where to tap to proceed in the game. The flow of the game is natural and all the players were able to navigate through the game's two parts with no need for assistance. It is however possible for the player to tap on all four options continuously and it resulted in two of the players just quickly tapping through the options until they hit the right one without having to think which one is the correct answer. One solution for this problem is to have a short waiting period after the player taps on the wrong answer. The game could give further audio feedback such as "that animal is called cow, try again!" so the player would also learn from the wrong answer. According to Carla Fisher, a child in this age group is not always able to either remember or realise if they tapped on the wrong answer if it is not explicitly stated to them.

Again, the tutorial gives away the right answer in both parts of the game if enough time has passed. It happens after only a few seconds when the player might still be going through the options depending on their reading speed. This made the game too easy for some players. In a language learning game it is important to give them the opportunity to figure out the right answers on their own. The Sesame Street article suggests highlighting the right answer after a wrong answer is selected which is an alternative to giv-

ing the right answer to the player right away. In conclusion the UI for of the game is smooth and the players were having fun with the game. The tutorials make the game too easy and a balance is hard to find for if the player is a slow reader they are given the correct answers right away and if they're a fast reader the game might be below their skill level. The testing proves that fun characters and animations are an effective way to keep the players of this particular age group entertained and engaged.

The third game was the one with the highest difficulty level and it greatly depended on the players' motor skill level how well they were able to navigate through the game.

The change of input method caused some problems and a few rest players needed assistance in navigating through the game, especially ta the part where they have to select the right letter by turning the cube. The change from 2D to 3D was slightly confusing. Some players simply were not able to grasp the game mechanic. Many of the players were able to figure it out with the help of the animated tutorial and audio assistance in the game and were able to find where to tap to get the audio instructions on their own. The tutorial merely helps with the game mechanic without pointing out the correct answer so the challenge of the game wasn't eliminated. This is one reason why this game took much more time for all of the test players than the two previous games. The higher difficulty level and more complicated game mechanics were another reason.

Still the players didn't get get frustrated with the game and seemed to be interested and entertained until the end of the loop. For the players who had very easy time going through all of the previous games (Lola's Alphabet Train included) it was a welcome challenge as they were getting a little bored.

The test sessions with all of the games but especially with the third game of Kids Learn To Read confirm that there are major differences in the development of children at the age of 6. It shows in their abilities unrelated to the level of reading skill how they are able to use their motor skills and understanding of 3D spaces and logical thinking skills to navigate through the game UI just as Carla Fisher states in her research. Drastic changes in game mechanics such as a switch from 2D to 3D creates inconsistency and takes the players' attention away from the game and learning elements when they have to use energy to navigate the UI and is generally a good idea to avoid. It is also a good idea to avoid too complex UI mechanics where multiple taps are required to complete a

game loop. In a learning game the players' attention should be in the learning aspects of the game rather than UI navigation.

6. CONCLUSION

Making games for children is very different from making games for adults and while simplicity is a key element, it needs to be the right kind of simplicity to keep the players motivated and engaged throughout out to game. There are plenty of variations in the development stage of children in the age group of 4 to 6-years-old. In a language learning game the main goal is to keep the player interested in the learning aspects of the game and while good level and game design is important there are plenty of guidelines to follow in the design of the game graphics that help in achieving this. Game graphics are an integral part of the gameplay especially for a player in the age group of four to six years old. Good graphic design choices will leave an impact and create a comprehensive experience that the player is eager to get back into.

The design principles can be summarised as appealing, relatively bright colours and colour schemes that create a happy atmosphere, intuitive and clear user interfaces with large, visibly noticeable hotspots and pointers, an interactive and appealing world with memorable character design, themes and familiarity, animations and effects to highlight important parts of UI, and visual feedback from right and wrong answers that are always encouraging to proceed forward in the game. The placement of the buttons is important and should create a flow for the UI usage that the player is able to navigate without assistance. Animated tutorials are an essential tool to help the player in parts where they might get confused but they should not give right answers away and eliminate the challenge and the learning aspect of the game. The players of this particular age group are still learning to read and depending on their level of development are able to maybe recognise letters and simple letter combinations so it should be avoided to have text instructions. If there is text there should also be audio instructions to accompany it.

A testing session with ten children of age six playing two games, both structured differently but designed to teach simple reading skills and letter recognition confirms many of the methods to be true as well as that there are plenty of variations in the performance of test players of the same age group, depending on their level of cognitive development as there are between any age groups. Both Lola's Alphabet Train and Kids Learn to Read apply the most important design principles in their graphic and UI design to varying ex-

tents. All of the test players were engaged in both games and while having some navigation problems with the UI, enjoyed the experience and were seemingly excited to continue. When asked if they would play the games again all test players agreed.

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