2021

**Faculdade de Design,
Tecnologia e Comunicação**
Universidade Europeia

Felipe João Gheno

**História Viva: Sketch-based system for
interactive folk storytelling**

Faculdade de Design,
Tecnologia e Comunicação
Universidade Europeia

2021

Felipe João Gheno

HISTÓRIA VIVA: SKETCH-BASED SYSTEM FOR INTERACTIVE FOLK STORYTELLING

Felipe João Gheno

HISTÓRIA VIVA: SKETCH-BASED SYSTEM FOR INTERACTIVE FOLK STORYTELLING

Dissertação apresentada ao IADE - Faculdade de Design, Tecnologia e Comunicação da Universidade Europeia, para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Design de Interação realizada sob a orientação científica do Doutor Edirlei Lima, Professor Auxiliar do IADE, Universidade Europeia e da Ana Viseu, Professora Associada do IADE, Universidade Europeia.

Lisboa

I dedicate this work to my mom and my brother, storytellers who use tales to make the world more creative, inclusive, and diverse.

palavras-chave   Design de interação, narrativa interativa, histórias folclóricas, crianças da Geração Z, interações baseadas em esboços, História Viva.

resumo   A tecnologia está mudando a dinâmica global à medida que se torna cada vez mais presente na vida das pessoas. As novas tecnologias permitem que as histórias sejam contadas em diferentes formatos à medida que as interações digitais proporcionam novas experiências que podem ser atraentes para as crianças da Geração Z. Histórias são contadas desde o início dos tempos e, como parte do folclore, contribuem para a perpetuação de valores e comportamentos. Hoje em dia, a narrativa folclórica tradicional pode ser considerada antiquada, especialmente quando as crianças estão expostas a mais distrações digitais do que nunca. Para se adaptar à era digital contemporânea, a narração de histórias folclóricas precisa abraçar novas tecnologias para atrair as crianças da Geração Z que estão digitalmente conectadas e interessadas em novas formas de interação. As crianças gostam de contar histórias tanto quanto gostam de desenhar e as interações baseadas em desenhos podem ser um componente capaz de despertar o interesse das crianças pela narrativa folclórica. O objetivo principal deste estudo é avaliar a usabilidade de desenhos digitais como forma de interação em contos populares. Para avaliar essas interações, este projeto visa desenvolver um protótipo de um sistema de narração interativo baseado em uma história folclórica portuguesa que permite às crianças usar a criatividade através de desenhos para interagir com o sistema à medida que afeta a história. Esta dissertação utiliza metodologias mistas que incluem a pesquisa e análise de dados qualitativos e quantitativos.

keywords

Interaction design, interactive storytelling, folk stories, Generation Z children, sketch-based interactions, História Viva.

abstract

Technology is changing global dynamics as it becomes increasingly present in people's lives. New technologies allow stories to be told in different formats as digital interactions provide new experiences that can be attractive for Generation Z children. Stories have been told since the beginning of time and, as part of folklore contribute to the perpetuation of values, and behaviors. Nowadays, traditional folk storytelling may be considered old-fashioned, especially when children are exposed to more digital distraction than ever before. To adapt to the contemporary digital era, folk storytelling needs to embrace new technologies to appeal to Generation Z children who are digitally connected and interested in new forms of interaction. Children like to tell stories as much as they love to draw, and sketch-based interactions can be a component capable of arousing the interest of children in folk storytelling. The main objective of this study is to evaluate the usability of digital drawings as a form of interaction in folk stories. To evaluate these interactions, this project aims to develop a prototype of an interactive storytelling system based on a Portuguese folk story that allows children to use creativity through drawings to interact with the system as it affects the story. This dissertation uses mixed methodologies which includes the research and analysis of both qualitative and quantitative data.

Table of Contents

Table of Figures

1. Introduction

The influence of digital technology on human dynamics is steadily on the rise. From economics to politics and culture, technology is changing human behavior by becoming so incorporated in the new generation's life that children are evolving into digital natives. The study of interactions between children and computers has been getting more attention over the past few years, especially because members of Generation Z[1] (Gen Z) are growing up using and knowing the verbal and visual world of the internet, which means that they handle short, up-to-date, real-time information with images (Törőcsik et al., 2014). The relationship between children and technology has different perspectives, however, this study focuses on its positive aspects, like the potential that technology has to hold children's attention while interacting with stories (Muñoz et al., 2012). Stories have been told since the beginning of time and, as part of folklore, it contributes to the perpetuation of values and behaviors. As a natural extension of the current era, storytelling has to embrace new technologies to be appealing to an audience that is digitally connected and interested in new forms of interaction. Scholars recognize that folklore is one of the building blocks of children's literature and it is therefore an important social asset which represents culture and conditions behavior (Celik et al., 2012). In this context, the European Literacy Policy of 2016 suggests that information and communication technology activities for education are not very common in Portugal. A drop of interest in reading has also been noted among children from the ages of eight years old and up, especially with boys (Arqueiro et al., 2016).

The Covid-19 pandemic necessitated the adoption of digital habits by increasing the amount of time that Gen Z children spend interacting digitally (Bona et al., 2020). In this scenario, where mobile phones are an extension of the self, Gen Z and Millennials are more likely to communicate digitally than in person (Franzese, 2020). Not all folklorists have been keen on studying folk stories[2] in the digital field as they prefer to research oral traditions which are observed face-to-face (Owen, 2014). Therefore, an opportunity has been identified to study new types of digital interaction and how folk stories are presented. The evolution of technology has

---

[1] Generation Z: First global generation in the world, those who were born between 1991-2010 (Törőcsik et al., 2014).

[2] Stories told for maintaining values and tradition as a form to preserve cultural heritage Dunes (Dundes, 1969).

also brought different possibilities in the manner in which people interact with stories. Children enjoy telling stories and they love to draw (Druin et al., 1997). As an element of a new type of storytelling, interactions based on drawings are a strong visual component capable of arousing the interest of children, since sketching is one of the first forms of human expression (Kim et al., 2013). Digital interactive storytelling, as part of a contemporary legacy, provides a field of rich cultural elements to study and are therefore an essential topic to explore since it combines the technology and folk interactive storytelling based on drawing. Drawing can be an attractive form of expression for children and it is thus important to analyze how this interaction keeps up with current technology and how children interact with it (Paulson et al., 2008).

The motivation for this project was based on the observation that Gen Z children are immersed in digital systems and are fluent users of online interactions (Matos, 2015). At the same time, children are reading less (Ferguson, 2020). The loss of interest in traditional folk stories is eminent as folk stories are not updated with the new technologies available. Nowadays, traditional folk storytelling may be considered old-fashioned, especially when children have more digital distractions than ever before and parents are regularly told that they are missing out on bedtime moments to share classic childhood stories (Barnett, 2017). An opportunity exists to provide folk stories with a new approach through sketch-based digital interactions and the use of interactive design to generate new types of experiences (Hartson & Pyla, 2012).

1.1 Objectives

The main objective of this work is to evaluate the usability of digital drawings as interaction in folk stories. The specific objectives are to develop an interactive narrative that adapts to the drawings, to create an animation based on a Portuguese folk story that will serve as a base for the system, and to propose the design of a complete product, even though the prototype will focus on the role of sketch-based interactions.

Several products allow children to interact digitally. These applications can involve the user as they stimulate different senses and skills. Some of the applications are used in education and include sketch-based interaction, such as Draw Your Shape! (Paulson et al., 2008) and Easysketch (Kim et al., 2016). Draw Your Own Story (Lima et al., 2014), for example, considers storytelling and sketch-based interaction while providing an immersive experience to

the user through augmented reality (AR). Other systems like Opera Maker (Interactive Media Foundation (IMF), 2020) and Folklore Digital (Soloaga & Marotta, 2020) bring a fresher experience to cultural objects, where children can learn and interact with different elements. None of the commercially released digital systems studied allow children to interact with folk stories by sketching and thereby changing the story as they draw.

1.2 Methodology

The present work was developed using a combination of different methodologies. First, an exploratory study centered on contextual research that helped set the theoretical chapter of this project, going through references within specific fields: (1) Interactive design and usability, (2) Storytelling and folk stories, and (3) Sketch-based interactions. A mixed method approach was also used to evaluate the interactions as the research will benefit from combining elements of qualitative and quantitative research approaches (Schoonenboom & Johnson, 2017). The theoretical study used a literary review of academic articles, journals, books, and the study of other systems and applications which supported the creation of an interactive prototype, based on a folk tale, which allows children to interact through digital drawings.

Since sketch-based digital interaction is the focus of this study, low fidelity wireframing would become limiting (Hartson & Pyla, 2012) when creating a prototype for the examination of the function and structure between the interactions and the system (Gero, 1990). The intention of creating a prototype is to have a "first draft" version that could be developed into a complete digital system to entertain children and also to have a basic product for testing its usability. This approach relates to a user-centered design (IxDF, 2020b) and allows the project to be focused on the users and their needs as the design gets refined. The development of the prototype takes into consideration Norman's (2013) principles of interaction design and uses the creation of personas to help understand the user's habits, pain points, and journey (Barnum, 2011).

The qualitative study used a moderated usability test, validated by the Think-Aloud protocol (Nielsen, 2012b). Moderate testing is applied by a moderator who is good with people and has knowledge about the project to make the test run well. This type of test provides more control over the process and improved quality with the feedback, once the user has a chance to offer instant thoughts about the usability and design (Babich, 2020). According to Markopoulos and

Bekker (2002), a list of parameters helps to set a fairly accurate description of any usability testing. As they provided a study comparing different usability methods when testing with children, this dissertation uses their proposition to establish user testing. They are divided into: (1) Purpose of the test; (2) The artifact tested; (3) The interaction tasks; (4) Participants; (5) Facilitators; (6) Environment/context; (7) Procedure; and (8) Capture of data. The results of the usability test and questionnaire will also be documented. The quantitative study used semi-structured interviews with an adapted questionnaire based on a System Usability Scale (SUS) for user testing with children that complemented the prototype test (Putnam et al., 2020). The system, developed by John Brooke (2013), is a method of measurement of how people perceived the usability of computer systems on which they were interacting.

1.3 Structure

This work is divided into three main parts. The first part is dedicated to the theoretical framing of this project by going through relevant references within specific fields of research namely interactive design and usability, storytelling and folk stories, and sketch-based interactions. The second part is related to História Viva, the creative process of developing the sketch-based interactive prototype that uses Portuguese folk stories for children. The third part discusses the usability testing of the system, the methodology of the test itself, and the analysis of the results, followed by the conclusion and final considerations. Although the subject of this study is related to interaction through drawings, the focus remains on the usability of the system. It will not analyze the drawings created by the children and their meanings (even though it would be possible once the system allows the user to save and share their drawings).

2. Theoretical Framework

This dissertation was constructed on a linear structure that is based on three main pillars namely, interactive design, storytelling and folk stories, and sketch-based interactions. The effort to study the digital world is very contemporary. This chapter of the dissertation aims to provide a better understanding of the subjects previously mentioned by providing a deeper context to build the theoretical base for this project.

2.1 Interactive Design

The concept of interaction has changed over the past few years. From desktops to mobile devices, to wearables and smart home assistants, the concept of the internet of things is not a novelty anymore. Hartson and Pyla (2012) turn to the English dictionary to define interaction as "mutual or reciprocal action, effect, or influence". Interaction involves exchange and applying it to a digital context, one that will happen between the user and the system. According to Miller (2004), interactivity is a participative way to relate to content. The user can manipulate and influence the matter. As the word indicates, there is an active experience between (indicated by the prefix "inter") user and content. It is a two-way relationship of action and reaction between the content and the user.

Interactivity is a central subject explored in *The Design of Everyday Things* (Norman, 2013). Norman's idea is that artifacts (physical objects or digital devices) should be intuitive and functional. He proposes a framework to understand how people select and evaluate their interactions, leading to pleasure or frustration. This model is called the Action Cycle and is divided into three parts: (1) The gulfs of execution and evaluation; (2) The seven stages of action; and (3) The three levels of processing. When people are using something, they try to understand how it works (gulf of execution) and try to figure out what happened (gulf of evaluation). The two gulfs (Figure 1) are in between the goal (what the user wants to achieve) and the world (everything the user perceives) (Batterbee, 2020).
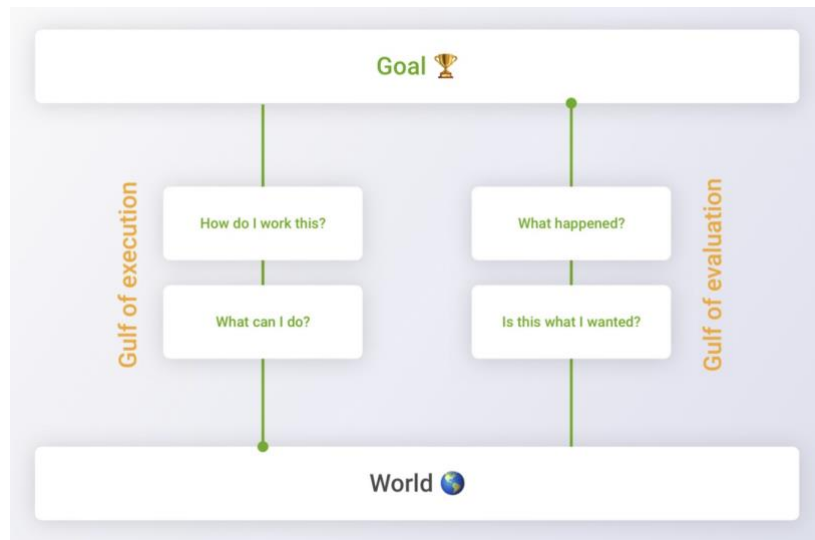
Figure 1. The gulfs of execution and evaluation (Batterbee, 2020).

Design can help users bridge the two gulfs. For that, Norman (2013) divides these two parts (doing and interpreting) into The Seven Stages of Action (Figure 2) which is a valuable design tool that can provide a checklist of questions to ask (Batterbee, 2020). According to Norman (2013), The Seven Stages of Action are:

1. Goal (form the goal)
2. Plan (the action)
3. Specify (an action sequence)
4. Perform (the action sequence)
5. Perceive (the state of the world)
6. Interpret (the perception)
7. Compare (the outcome with the goal)

For example, imagine a scenario where the user wants to reheat food using a microwave. The stages could be defined as:

1. The goal: Quickly heat food because the user is hungry.
2. Plan: Put the food inside a microwave to be heated.
3. Specify: Select the appropriate microwave functions.
4. Perform: Physically press the microwave buttons to execute the specific action sequence.
5. Perceive: Observe the microwave's display and its feedback.
6. Interpret: The food is heating according to the noise, smell and the time passed inside the microwave. The display shows the food is done.

7. Compare: Trying the food and noticing the task was successful.

Figure 2. The seven stages of action (green) situated in the gulfs of execution and evaluation (Batterbee, 2020).

The three levels of processing are the last part of the Action Cycle. These are based on the cognitive and emotional processing as the user interacts with a product (Figure 3). They can be related to the Seven Stages of Action. According to Norman (2013):

1. Visceral — a subconscious reaction, immediate perception. Like standing on the edge of a cliff, for example. The styles matter as they can provide pleasant experiences or negative ones. Appearances, whether sound or sight, touch, or smell, drive the visceral response. It is not about usability but attraction or repulsion.

2. Behavioral — a subconscious action based on well-learned skills like walking, opening your mouth, and so on. without the conscious perception. Every action is associated with expectation. Feedback is very important to manage expectations and the lack of it creates a feeling of lack of control that can be damaging when teaching users new skills.

3. Reflective — as a conscious cognition, it is where understanding and decision making happens. It differs from visceral and behavioral states, the reflective state is not that immediate, and it is where high levels of emotions come from.

12
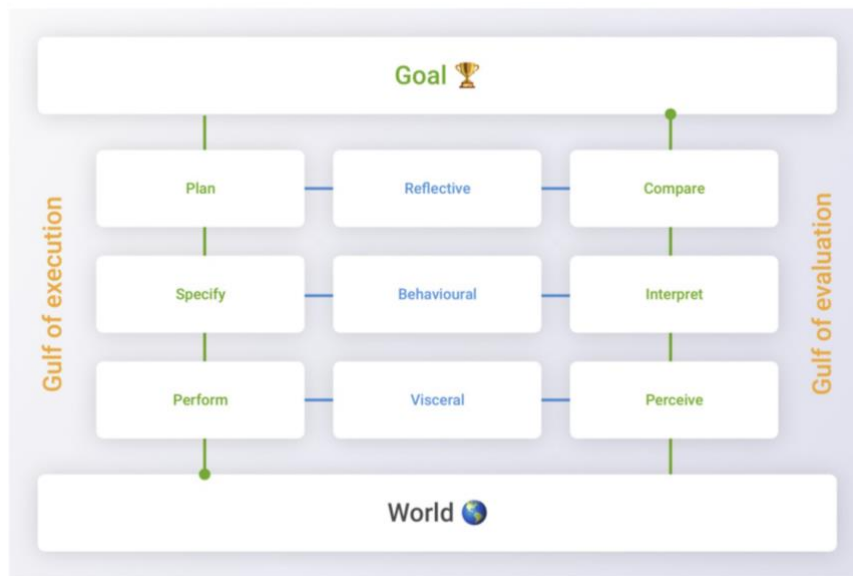
Figure 3. The three levels of processing (blue) associated with the seven stages of action (Batterbee, 2020).

For Norman (2013), Human Centered Design (HCD) is an approach that puts human needs, capabilities, and behavior first. In order to design products to accommodate those needs, capabilities and ways of behaving and to help users to navigate between the gulf of execution and gulf of evaluation, Norman's Six Principles of Interaction are used. According to Rekhi (2017), these principles are still relevant when designing digital products today as they provide a method to reassure good usability. Rekhi (2017) gives a clear perspective of each one of the six values as described below:

1. Visibility: Users need to have a clear view of the options that they have for interaction. If an element is hidden, it is harder for the user to use it. As simple as this first principle might be, it can be tricky for the designer, especially designing for mobile devices where the tendency is to clean everything up or hide everything inside the hamburger menu (Enginess, 2014).

2. Feedback: Users require an indication that their interactions have caused reactions on the system. Different forms of feedback are used like animations, sounds or simple visual cues and messages.

3. Constraints: If the user has too many interactive options, they tend to get lost. This means that the interface must display limited information and interaction for the user to provide them with a better experience.

4. Mapping: Mapping is about the relationship between controls and their actions.

5. Consistency: System cohesiveness can help facilitate better usability. Keeping consistency in mind during the designing process helps the user recognize patterns of

colors, elements, and behaviors which can help the learning curve of the system usage since it becomes coherent and familiar to the user.

6. Affordance: This provides the user with clues on the usage of the element. It is an indication to the user on how to use the system properly.

To define interaction is important because it is key to studying the concept of usability and experience. Hartson and Pyla (2012) describe Human-Computer Interaction (HCI) as the result of the action between humans and the system to accomplish something. Therefore, usability is that aspect of HCI that makes the interaction effective, efficient and satisfying. In this context, "Usability includes characteristics such as ease of use, productivity, efficiency, effectiveness, learnability, retainability, and user satisfaction" (ISO 9241-11, 1997; Hartson & Pyla, 2012). Furthermore, Hartson and Pyla (2012) consider usability as important, but they argue that experience is more than just usability. Nowadays, where a wider audience of people has more access to digital interaction, usability is still essential but is not sufficient. Since the focus of the design is still human centered, the term "User Experience" (UX) indicates a concern beyond the usability point. According to Baxter, Courage and Cane (2015) usability is more objective and product-based as it focuses on creating a problem-free interaction, where the experience is subjective, holistic, or human centered. The definition of UX from The User Experience Professionals Association (UXPA) is that "Every aspect of the user's interaction with a product, service, or company that make up the user's perceptions of the whole (…) is concerned with all the elements that together make up that interface, including layout, visual design, text, brand, sound, and interaction" (Baxter et al., 2015).

For Tullis and Albert (2013), UX refers to the interaction between a user and a system, application or product. It can be measured to help improve the product itself. UX and usability are often very closely associated. On the one hand, usability is considered to be the capacity of the user to use an object to perform a task successfully. On the other hand, UX has a broader focus, examining the dynamics of the overall interaction between the user and the object. Usability is not about using a website; it plays a wider role in people's everyday lives. Usability is present in the most varied situations like setting up a tent, turning on the heater, or trying to figure out a tax form (Tullis & Albert, 2013).

Lately, UX has become a popular term that embraces different design and usability disciplines. Immerged in these fields, interaction design proposes designing the behavior of complex

interactive systems (Cooper et al., 2007). UX provides the entire user journey, including aspects of branding (IxDF, 2020a), where interaction design is the result of a process that involves behavior, creates a flow between action and reaction (Silver, 2007), and influences experiences that will affect how the user interacts with a product. UX embraces three main fields which include form, content, and behavior. Interaction design is focused on the design of the behavior (Figure 4) but, at the same time, also the relationship between behavior, form, and content (Cooper et al., 2007).
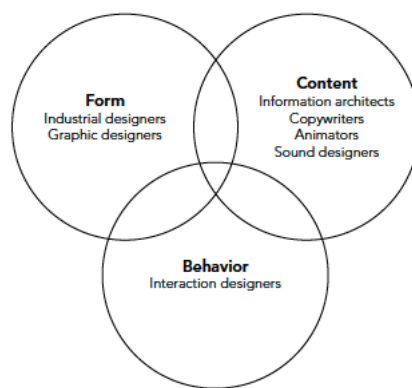
Figure 4. The three main areas of UX (Cooper et al., 2007).

According to Kolko (2011), interaction design is a dialogue between a person and a product. This dialogue is set on a proper "language" unique to interactive technology since it embraces both the physical and emotional nature as it manifests in the interplay between form, function, and technology (Kolko, 2011). For Smith (2006), these languages can be categorized in their four dimensions. The first dimension (1D) is represented by meaning – words and texts such as labels and hints that help the user navigate through the product. The tone of voice and consistency of the text display is also embraced in this dimension. Typography, icons, diagrams, infographics, and other visual elements are part of the second dimension (2D) that aids the user to understand complex content. 3D is represented by the physical forms in which the user will interact with an object. The trackpad and keyboard, for example, gives the user the physical interaction needed to act upon a system. 4D refers to time as a digital product that is composed of sound, animation, or other elements that are affected by time. A fifth dimension (5D) is added by Silver (2007) that includes behavior as a dimension, action, and reaction regarding the user and their relationship with the previous dimensions. These dimensions can provide a method for designers when developing a product to have a complete view of the user that results in a fluent interaction.

15

2.2 Folk Stories and Storytelling

In a world where digital media is increasingly becoming more incorporated into everyday life and integrated into daily objects, technology has become an important ally for cultural conservation (Sideris, 2003). While digital technologies contribute to changing behaviors, they also bring a new approach to the way cultural heritage is practiced and passed on (Alsina, 2010). As cultural heritage is passed on by people, generation to generation, it is important to frame children as part of the communication process. It is asserted by Kate and Pascoe (2013, p. 2) that "Children and teenagers can constitute up to, or even more than, 50 percent of any given society, and the range of their experiences are as determined by the spectrum of social, economic, legal, and environmental factors as those of adults".

As part of people's intangible culture, folk stories are a traditional form of maintaining social knowledge. Folklore is a reflection of culture itself, manifested in different forms such as myths, tales, games, dances, and stories and it helps us to make sense of behavior and the human condition (Blank & Bronner, 2009). According to Dunes (1969), folklorists of different countries aimed to keep values and traditions alive in their stories as a form of cultural heritage preservation, for example, the Grimm Brothers who, in the nineteenth century, used nationalism and romanticism to recreate the tales that they collected to influence their versions of the stories. This retouching of oral tales continues in contemporary children's literature and gets labeled as genuine folktales. The definition of folklore can be as vast as well-known tales. According to Ben-Amos (1971), folklore is an organic part of culture. It relates to a specific period of time, place, and social context. Any changes in its settings would inject different elements into it. Thus, this process of adaptation brings similarities in stories from different places.

The new way of consuming media requires storytellers to review the format for creating content and to adapt to a new method of telling stories. This new type of media can give its audience an active part in the interaction with the content itself which is different from the old unidirectional type of content consumption. In other words, Digital Storytelling (DST) can be defined as a story (event or experience) told through digital technology interaction (Evangelista et al., 2009). In this context, a quick view of the past becomes necessary to provide a better understanding of digital storytelling. Myths were the oldest type of storytelling and deeply involved the community (Alexander, 2011). Instead of the story being told by a storyteller,

ritual ceremonies required all participants to act upon it, producing a rich experience. These stories were related to life passages and mostly recounted death-rebirth themes (Handler Miller, 2004). According to Handler Miller (2004), the model for the description of myths and the participation of the whole community is more aligned with interactivity than the campfire stories hypothesis (where the storytelling would take part around campfires of prehistorical people) and would give helpful insights regarding interaction and stories. Religious services and entertainment, such as games, provide an immersive practice to the participant, capable of giving the user a cathartic experience, emotional relief, or another type of positive outcome when passing through difficulties.

As part of culture itself, the evolution of technology affected the way storytelling is created and performed. New devices created possibilities for the audience to have an active voice, participating in the development of the story itself (Cavazza et al., 2002c). Currently, traditional storytelling might be considered old-fashioned, especially when there are many games that benefit from giving the player more participation in the story's composition. According to Lebowitz and Klug (2011), traditional storytelling can still be used to create excellent stories, but will hardly lead to a progression in the art of storytelling itself. If traditional storytelling fails to provide a progression in the manner that stories are told, then designers and writers need to focus their efforts on new technologies to support the creation of different forms of storytelling, instead of being attached to the past. Interactive storytelling provides writers with more freedom when it gives different possibilities for them to explore the story themselves. This leads to the development of a more creative and participative scenario for both the writer and the user (Garzotto, 2014). Users can also benefit from having an interactive part in the development of the main character where their actions will influence the character's choices. This can lead to a bigger player-character bond, which is one of the most important aspects of the storytelling itself (Lebowitz & Klug, 2011).

It is essential to include video games when talking about digital storytelling. Games offer the user an escape from everyday routine to be immersed in another world, a fantastic one where limits often do not exist. They provide users with a chance to enact different roles and be different people without putting themselves in real life danger. The player has the sensation of control, adrenaline rushes, and if things get too difficult, there is always the pause button (Handler Miller, 2004). Additionally, new technologies allow the user to play games from different devices. Mobile phones and other wireless devices allow games to reach more and

more users. At first, digital games and interactive storytelling may appear very similar but there are differences between them. Games are built with gaming components, such as a competition that leads to achieving goals passing through obstacles. While interactive stories also display those components, there are more subtitles, with a focus on other aspects like character development and relationships, emotional cues, and so on. While games stimulate competition among players, interactive stories do not contain the win-lose outcome that is common with games but focuses purely on entertainment (Handler Miller, 2004). According to Lebowitz and Klug (2011), games do not necessarily need stories to be fun and allow people to play; however, more and more games are using storytelling to provide a better gaming experience.

Different techniques with engaging narratives allow for better experiences for users. The characters and the plot are two of the main elements of a story and guide them into two directions namely, character-based and plot-based storytelling (Cai et al., 2007). A character-based approach allows the dynamic interaction between characters to generate the actual plot of the storyline, accordingly to real-time interactions (Cavazza et al., 2002b). This model allows the user to intervene in the story at any time, providing the user with more freedom. At the same time, there is no way to know beforehand how these actions will affect the plot of the story (Cavazza et al., 2002a). The second model is the plot-based approach, where characters act according to plot points in the story. The author defines the interaction points in the script to develop possible story lines. The interaction is made by the users who act like semi-autonomous agents since they need the story to reach an interaction point to act upon (Magerko, 2005). According to Lima (2014), interactive storytelling can be divided into three main research areas namely, story generation, user interaction, and story dramatization. Story generation aims to develop coherent and diversified stories, while user interaction studies the ways that users interact with the stories, such as traditional graphical user interfaces, speech recognition, body movements, and hand-drawn sketches. Story dramatization investigates ways to represent interactive narratives visually, for example, text, 2D-3D computer graphics, augmented reality, and videos (Lima, 2014).

Stories can present different types of narratives. According to Lima (2021), narratives can vary from fully traditional stories, interactive traditional stories, multiple-ending stories, branching path stories, open-ended stories, and fully player-driver stories. Fully traditional stories are the classical form of storytelling. They are linear and they have beginning and end, they go from point A, passing to B, C and ends in D (Figure 5). For example, books and plays, among others.
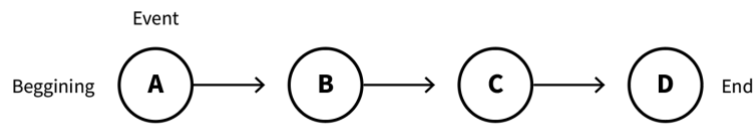
Figure 5. Fully traditional stories flow.

Interactive traditional stories combine the controlled quality of the fully traditional stories with some level of interactivity. They are the most common type of video game story. The flow follows the same structure as fully traditional stories (Figure 5) since the control of the user is minimal and the interactions do not affect the storyline in a significant way (Lebowitz & Klug, 2011).

Multiple-ending stories follow the same structure as the fully traditional stories but allow the user to choose multiple endings (Figure 6), for example, the movie *Run Lola Run* (Tykwer, 1999).
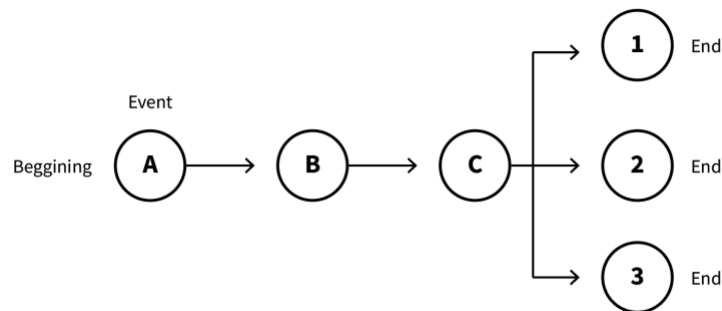
Figure 6. Multiple-ending stories flow.

While multiple-ending stories allow the user to only choose the ending, branching path stories allow interaction at different decision points along the narrative (Figure 7), allowing the player to make choices which affect the development of the story (Smed et al., 2019). Netflix's *Black Mirror: Bandersnatch* is an example of this type of story (Roettgers, 2018).

19

Figure 7. Branching stories flow.
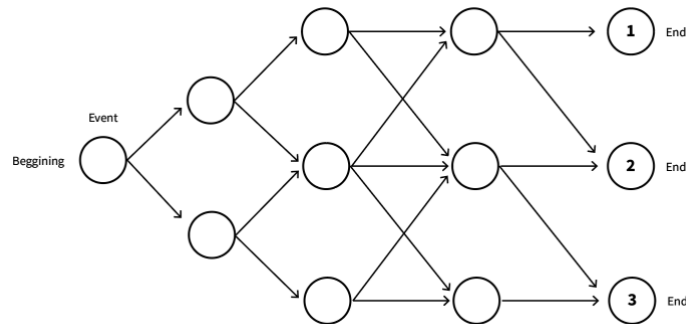
Open-ended stories are an evolution of branching path narratives. Since branching path stories present a controlled written structure, open-ended stories are usually generated by a computer algorithm and provide more player freedom, for example, in the game Grand Theft Auto IV (Lebowitz & Klug, 2011). Finally, fully player-driven stories do not have a main plot as the narrative develops with the interaction of the characters and the environment, for example, The Sims (Lima, 2021).

In 2018, an interactive title for their successful *Black Mirror* series. *Black Mirror: Bandersnatch* (ANO), by David Slade, was released after Netflix had experimented with a kid's adventure interactive story called *Puss in Book: Trapped in an Epic Tale* (2017), where the children could choose the path that the story develops along, choosing from multiple choice questions that were answered using the tv remote (Elnahla, 2019). In *Black Mirror: Bandersnatch*, the approach was to provide adult users with the same control as in the kid's adventure. The story starts in 1984 and follows the journey of Stefan, a young computer game programmer. The plot provides an immersive experience to the viewers and gives them the ability to control the path of the story, making the users deeply committed to see the change of events. In each interaction, the viewer has 10 seconds to choose between two options, otherwise, the story proceeds on its own. According to Sukhraj (2019), head of editorial content for impact, as an active agent to the story, the viewers become emotionally involved in the plot as they see their actions changing the story immediately as it moves forward.

While younger audiences are fine with simpler storylines, for the adults it is more challenging. The story for *Black Mirror: Bandersnatch* required more complexity to engage adult audiences to participate throughout the entire story. That is why Netflix created its own script tool to assist Brooker and Jones in this journey, dubbed Branch Manager (Roettgers, 2018). This tool allowed the writers to create complex narratives and loops that guide the main character. *Bandersnatch* has five possible endings. The average time required to complete the story is 90 minutes, but it can be done in 40 if the user selects the quickest path (Roettgers, 2018). Other design decisions were between storytelling and product design once the creatives understood the pace for an interactive story of this magnitude. On the one hand, too many choices and interactions may tire the user, while on the other hand, a lack of choices may bore the user. As the story progresses, the viewers start to question if they are really in control and if their decisions actually change the story. In the words of Colin Ritman, video game genius and Stefan's mentor, "how one path ends is immaterial" (Roettgers, 2018). According to Roettgers, Netflix vice president of product Todd Yellin, the company has plans to try developing interactive stories with other genres like comedy, romance, and even horror. When asked if the plan for Netflix was to expand into video games, Yellin added that they "don't think of this as a game" as they were telling a story. Ultimately, the goal was to advance storytelling, offer creatives new ways to express themselves, and give viewers a lot more things to talk about (Roettgers, 2018).

The use of interactive storytelling can have many advantages for education. Kids are stimulated to learn when they interact with technology (Evangelista, 2009). New interactive technologies can be used as a facilitator for children to tell their own stories and learn from them (Muñoz et al., 2012). Since ancient times, storytelling has helped children to develop their own creativity and skills using their expressions and imagination to create their narratives, solve problems, and build social relationships. According to Wang (2014), compared to traditional linear storytelling, digital interactive stories allow narrators to have more freedom and explore their creativity, giving the user different plots and possibilities.

Interactive Stories for Children (ISC) is a result of a multidisciplinary field based on technology, narratives, and children issues. As reported by Garzotto (2014), ISC pulls elements from two other more consolidated disciplines: Interactive Digital Storytelling (IDS) and Interaction Design for Children (IDC). Understanding these disciplines is important to define ISC as a discipline itself. IDS has two main pillars namely, interactivity, based on HCI focused on the end-user experience and how this interaction shapes the narrative, and authorship, immerged in

the Artificial Intelligence (AI) field, where the user and author's roles are not clearly defined as the user has a co-creator role. Authorship is different in interactive stories since the author and the system define the rules of the interactions and the user plays an active part. As Garzotto (2014, p. 4) stated, "While this process can be deemed to be an activity of co-creation, we cannot speak of children as story authors in the field as delimited by the use of AI technology".

Furthermore, Garzotto (2014) argues that IDC allows children to have an important place in authorship as these materials are built with the focus of children having an active role creating, telling, and sharing their own stories. Additionally, Garzotto (2014) concludes the importance of further exploration on ISC subjects, especially regarding the context of use (to distinguish between formal learning for example in schools, and informal, like households); social issues in children's storytelling (if interactive storytelling provides collaborative interaction among children, it is important to understand the social values); inclusion and special needs (the inclusion of the technology among the users who want to do so and have special needs and the important role of interactive storytelling in the digital inclusion process); and evaluation which indicates to the importance of having a wider understanding regarding children's storytelling tools and the learning process (short-term and long-term benefits).

Currently, systems use folk stories are used to develop attractive products for children. An example is Opera Maker, an app that has won several awards by allowing the users the opportunity to place themselves in the character's shoes and create, direct, and sing their own operas (Opera Maker, 2020). Once the user has chosen and customized his/her own avatar, they can take a picture of their faces and insert it in the character. It provides a variety of scenarios to choose from and after setting up the basic story, it allows the user to record their voices and play along with the opera. The application was developed in Germany and is only available in German. Opera Maker was received with great reviews and awards. The opera genre is very particular, and the application is very successful in introducing opera to a younger audience. According to Livingstone's review, "Too many sites seem to put effort into keeping children quiet and absorbed and amused. But we should be more ambitious for them. They want to participate. They want to create" (IMF, 2020).

A successful project of two Brazilian artists, Ygor Marotta and Ceci Soloaga, uses technology to create an immersive experience of digital storytelling based on Brazilian folk stories (Soloaga & Marotta, 2020). The Folclore Digital project presents Brazilian folk tales with animations in

rich colors, the sounds of nature, indigenous drums, and other elements. There is no interaction by the user as the children passively receive the content, but the project created a multisensorial space that attracts the viewer and gives a fresh approach to folk storytelling. Children are invited to be immersed in the story and experience the magical feeling of nature and the celebration of joyful characters of Brazilian folklore.

New technologies provide children with ways to explore different platforms to enhance their creativity using storytelling. Interactive objects allow children to create their own narrative, different from movies, books, or toys (Wang et al., 2014; Jhala et al., 2008; Menegazzi et al., 2018; Stal, 2017). All these platforms bring different forms of interaction to the user. Among the main interaction methods for interactive storytelling, the use of hand-drawn sketches is showing promising results, especially for interactive storytelling systems. According to Cox (2005), the act of drawing allows children to construct sign and meaning through a constructive process of thinking. This type of interaction is the main focus of this study and will be further explored in the following segment. Even though it represents a vast field of interaction, this study will focus mainly on sketch-based interaction methods for interactive storytelling and games.

2.3 Sketch-based Interactions

Since the paleolithic era, humans have expressed themselves through drawings to communicate and therefore, to tell stories. Drawing is the form of expression used by children before they learn how to write. As contended by Cox (2005, p. 123), when children are drawing they are constructing signs and therefore meaning, and "Drawing thus becomes a constructive process of thinking in action, rather than a developing ability to make visual reference to objects in the world". Drawing also allows children to express their experience once they represent freely what they have lived or imagined. Sylla (2009) maintains that children's drawings are used to evaluate what they have learned, especially in kindergarten, because children retain more details when there is a drawing interaction as they can have more difficulty describing these elements in words. Sketching also allows children to develop finer motor control abilities, which is beneficial and connected with creativity and self-regulation skills. This helps children's cognitive development and skills that affect the learning process (Kim et al., 2016).

Interaction based on hand drawings is a subject of study for HCI researchers. According to Paulson (Paulson et al., 2008), creating sketch-based tools embrace the four main pillars of children's basic learning (auditory, visual, tactile, and kinesthetic). Auditory and visual disciplines are more frequently explored so drawings can bring tactile and kinesthetic methods while still in touch with audio and visual elements. As reported by Lima (2014), hand drawings can be used in interactive storytelling to keep the user interested, to increase the sense of authorship since the user's creation is helping with the development of the story itself, and also to provide the user with an immersive experience. Therefore, sketch-based interactions can contribute in a positive way to user involvement.

According to Lima (2014), sketch-based interaction has been used in different fields, from engineering to education and is still an interesting topic in academic research. One of the most historic examples cited by Lima (2014) is Ivan Sutherland's Sketchpad developed in the 1960s for his PhD thesis at MIT's Lincoln Labs. The system, which had a big influence on the HCI field, was the first digital sketch program. It allowed the user to draw in the computer screen using the light-pen, a predecessor of the mouse. The user would point to the screen and interact with drawing objects that were displayed on the computer's interface.

In the past, gadgets for digital interactions were expensive but today mobile devices with touch screens have made technology more accessible. Pen-driven devices, like tablets and mobile phones, have become more affordable with the evolution of technology (Kim et al., 2013). This allows children to take advantage of digital drawing technology to enhance their interactions through sketch-based systems. Kim et al. (2013) created a specialized sketch classification tool, called KimCHI, that uses digital sketching for helping children to develop their skills. Based on the drawings, the system can determine the user's age and gender, and also detect learning or development disorders. According to Paulson (2008, p. 134), "Sketching engages children in a kinesthetic and tactile manner, allowing them to use their hands to actively interact with a computer system". Through sketch recognition, automatic feedback is provided to children to improve and enhance the learning process.

The Lost Cosmonaut (Vogelsang & Signer, 2005) is one of the first interactive storytelling systems that used hand-drawn sketches as a form of interaction. This art installation provides narrative units (images and sounds) that interact through the user's strokes on a special paper. Nevertheless, the system only triggers narrative units as a response to pen strokes without

recognizing the meaning of the hand-drawn sketches. The actual recognition of hand-drawn sketches of objects as a form of interaction for interactive narratives is explored by Lima et al. (2014). Lima et al. (2014) present an innovative mixed reality interactive storytelling system called Draw Your Own Story, where the users can interact with characters in an AR environment as they draw objects that will help the main characters on a piece of paper, with a regular pen or pencil. The authors believe that mixing reality visualization with sketch-based interactions offers a more interesting and attractive form of storytelling. After testing it with the users, the study revealed that "the use of hand drawings as a form of interaction improves user satisfaction and experience and the system usability" (Lima et al., 2014, p.33). Their system was also extended by Franco and Lima (2017) to support the recognition of generic hand-drawn sketches of environmental objects, like clouds and walls, that modify the environment of the virtual world. The main limitation of this work is that the process of extending the collection of the recognizable drawings can be complex and time-consuming as it needs real photos in multiple angles for the sketches.

There are several examples of works where drawings are the main form of digital interaction between interface and user. Sketch-based interaction has also been explored in games. Hagbi et. al. (2014) created a tool that converts hand-drawn sketches to 3D models for gaming environments that use AR. This process of recognizing the sketches is done by computer vision algorithms that use predefined meanings according to each set of visual language rules. While Hagbi et al. (2014) explored the use of sketches for authoring game content, Williford et al. (2019) developed a game called ZenSketch, that uses gesture-based sketch recognition to translate features of line drawings. The characteristics of the drawn line influences the quality of the object drawn, like a bridge, for example.

A different approach is used for Draw Story!, a game by Gamejam that was launched in 2019 for Android and IOS. It allows the user to interact with the story with drawings (Gamejam, 2020). In the game, the main character needs help to deal with several situations where he/she uses the objects drawn by the user to escape from the situation. The graphics are simple, and the instructions are given through speech balloons (text). The system compares drawings with other users' and gives feedback once something is drawn. The story itself is not branched, so the main character always tells the user to draw a specific object for helping him/her. The user can skip the drawing and the object is still used by the character. In this situation, the user still receives a "great job" feedback message. It is inclined to be considered as a game as it gives

rewards to the user and is always comparing the drawings. Also, there is no participation of the user on affecting the story itself with the drawings.

Paulson et al. (2008) implemented a set of simple systems that use sketch interaction with the intention of promoting kinesthetic and tactile learning for children. Learn Your Shapes! is one of them. As the name already suggests, this application allows children to learn the basic shapes through sketching. This application received positive feedback when presented to an expert in children's education. According to Kim et al. (2013), Learn Your Shapes! "provides children with a sketching interface that prompts children to draw basic geometric shapes but is constrained by few prompted shapes and simplistic static binary feedback on the correctness of those shapes". As stated by Kim et al. (2013), the TAYouki system addresses the limitations of Learn Your Shapes! when presenting a tool that interacts with the children's drawings and presents a cartoonlike face with emotions that reacts to the correctness of the drawings. Both applications were based on recognition algorithms designed from sketches made by adults and were not adjusted for application to children's sketches.

According to Kim et al. (2016), several applications that use drawing to teach children are available for IOS and Android platforms, like PBS Parents Play & Learn that provides math and drawing exercises – drawing the alphabet – for children. These applications help children to develop their motor skills while learning basic concepts. To better evaluate if these types of applications in fact help children to enhance their motor skills and school readiness, EasySketch was developed and tested. The system provides a set of dots so that children can have a path and learn how to draw shapes, letters, and so on. As stated by Kim et al. (2016), "Our interface performed better in assessing children's fine motor skills compared to the conventional approach (i.e. star drawing test), while children improved their drawing skills through feedback from our pedagogical system".

Most of the researched works based on interaction by sketches and storytelling used simplified systems for developing the narrative, such as predefined branches, which reduces the user's sense of authorship. The system presented by Lima et al. (2014) is one of the few that explores a more complex story generation method, which is based on a simulation of characters' emotions and scripted behaviors, but still defined manually by the author. Other forms of interactive narratives involve AI techniques, such as planning (Ghallab et al., 2004), that can improve the sense of authorship for the user, but brings its own challenges, like balancing the

freedom of the user when drawing objects at any time with the development of the plot itself. Even though several systems allow the user to interact using drawings, the use of AI as a more robust form of narrative can provide folk stories with a fresh perspective. Since sketch-based tools provide children with involvement and request their attention, a new tool can help to keep children interested in folk stories.

3. Developing História Viva

As previously explored, storytelling is a powerful tool to convey values and can also enrich creativity, imagination, and critical thinking (Wang et al., 2014). Currently, Gen Z children are digital natives with plenty of online distractions and parents are missing important moments to share classic stories (Barnett, 2017). There exists an opportunity to give a new approach to folk storytelling with digital interactions that would be more appealing to children (Garzotto, 2014). Based on this scenario, a sketch-based interaction system called "História Viva" is proposed. The idea is to provide a product that allows children to interact with folk storytelling using drawings. The application is aimed at 6 to 11 year old children, based on the age that the Portuguese National Reading Plan (Leitura, 2018) recommends the reading books of folk stories, such as *Seis Histórias Tradicionais Portuguesas* (Moutinho, 2017).

3.1 Creating Personas

The creation of a system that accommodates the needs of a diverse variety of users can be problematic since it increases the cognitive load for all of them. The best way to design successful products is to have specific types of individuals (or groups of individuals) and their specific needs in mind (Cooper et al., 2007). According to Cooper et al. (2007), developing personas helps to understand a variety of people and their expectations, providing a tool that allows the designer to determine what a product should do and how it should behave. It also facilitates communication with other stakeholders as they provide a common language that helps the justification of design decisions, build consensus as they create a common language, measure the design effectiveness as they provide quick iterations with tests, and contribute to other product touchpoints, like marketing plans (Cooper et al., 2007). Personas should be based on elements of end users through collected data and/or interviews. They also need to be realistic, evoke empathy by having a name, image, and narrative (Travis et al., 2011). To create a persona, a clear description is needed of who they are – if primary or secondary, according to the usage of the system and goals of the project – and what they are trying to achieve (Kolko, 2011). According to Rubin and Chisnell (2008), personas are evidence-based characters of

archetypical users as they represent behaviors and goals that will facilitate the understanding of the users.

For this project, preliminary qualitative research using a semi-structured interview was conducted for an exploratory study about children, their parents, and folk stories. This exploratory data was gathered through a survey and was used to build fictional personas considering the needs, wants, and limitations of each. Two types of personas were developed: the child (Figure 8) and their facilitator/guardian (Figure 9).

3.2.1 Exploratory Survey

3.2.1.1 Method.

Two surveys were created to help gather more information about potential users. These surveys were conducted online, through Google Forms. One survey was directed at parents, and the other at children in order to distinguish information provided by these separate points of view. The questionnaire was semi-structured and contained both closed and open questions. The link to the questionnaire was sent by email to a group of acquaintances' parents and children. The questions explored whether children liked stories, knew about folk stories, what their favorite stories were and so on. For the parents, the survey mostly contained questions about their profession, reading habits they have with their children and the devices used. The list of questions and the results have been included as Appendix A.

3.2.1.2 Procedure.

The surveys took place during October 2018, and children were invited to answer a 12-question survey. Parents were invited to answer a 21-question survey. They both followed a similar structure, first asking demographic questions (age, gender, profession in the adult survey), followed by reading habits, favorite tales, the importance of storytelling, and the last section covered the use of technology.

3.2.1.3 Results and Considerations.

Thirteen people participated in the survey: 8 adults (parents) aged between 31 and 50, and four children aged between 7 and 12. All the children knew a Portuguese folk tale but there was no common answer to their favorite story. When asked about their favorite story, they all responded with foreigner narratives, like *Beauty and the Beast*, *Red Riding Hood*, and *Felicity Wishes: Friendship and Fairy School* (Thompson, 2001), among others. All of them liked stories and all of them would have liked to play with a story that would change according to their interactions. The most used devices daily were TVs (75%), tablets (25%) and mobile phones (25%). The adults knew of a Portuguese folk tale, quoting *Red Riding Hood* as Portuguese. All of the parents read for their children when possible, usually before bedtime.

Primary Persona

Name: Carla
Age: 8 years old
Nationality: Portuguese
Residency: Lisbon
Occupation: 3rd year, 1st cycle student.

Carla likes to hear and read stories. Her favorite story is *Beauty and the Beast*. Sometimes her mom reads for her, usually before bedtime. Her favorite Portuguese tale is *Cuquedo* by Clara Cunha e Paulo Galindro. She loves to play games. Carla would like to go to the park where she can play with her friends and walk the dog as she plays Pokemon Go. Her main frustrations are to go to bed when her parents tell her to and that her teacher tells her the same stories, in the same way. Also, due to the Covid-19 pandemic situation, Carla cannot go to the park that often anymore. Carla loves to draw. She uses her smartphone, her mom's tablet, and TV as her daily devices. She is very curious, smart and has lots of energy.

Carla's Journey

Carla is frustrated because she cannot go to the park regularly. Due to the lockdown situation, she is often inside the house. At least she is happy to have her parents at home with her. Carla likes stories, especially Disney ones. She gets frustrated with her remote class when her teacher

tells them a folk story and she cannot interact with it. Her mother sees her frustration and decides to download the História Viva app on her tablet and her laptop. Later that day, her mom asks her if she knows any Portuguese folk stories. After thinking a bit, she answers, "The Little Prince" (Antoine de Saint-Exupéry). Then her mom, Fabi, asks her to sit next to her as she is going to show her a Portuguese folk story. Carla is very excited about it. Three magic doors appear on the screen and her mom asks Carla to decide which one to open. Carla opens a door and the story begins. Carla is speechless. It is like magic. As the story progresses, Carla needs to interact with the plot, giving it various possible endings. The main character is in a very dark place (literally) and light is needed to help him find his way out. So, Carla immediately draws a sun on the tablet. The sun shines inside the story and immediately lights up the room, helping the character to go to a different place. It can take a while, but eventually... after the end of the story, Carla is fascinated by the experience. She asks her mom more about the storyline, in which Fabi explains that is from a Portuguese folk tale, found in José Vaiale Moutinho book called *Seis Histórias Tradicionais Portuguesas*. Now Carla wants to try different drawings to see if the story changes and she also asks Fabi to play other stories.

Figure 8. Carla using História Viva.

Secondary Persona

Name: Fabi
Age: 42 years old
Nationality: Portuguese
Residency: Lisbon
Occupation: Front-end developer

31

Fabi is a very dedicated and hard-working mom. She loves programming and experimenting with new recipes in the kitchen. She also loves games and stories. She takes turns with her husband to read for her daughter, Carla, but sometimes it is simply not possible. Because of the pandemic, she is working remotely from home. Her goal is to balance work with helping Carla with school while also coping with Carla's frustrations since they are all at home. Her main frustration is the noise in the house which makes it difficult to concentrate as her daughter and her husband are stuck at home with her. She needs to concentrate to write the codes necessary to do her job. She loves to be outside as well, so in current times when this is restricted, everything is becoming more difficult. Fabi is a very sweet and attentive woman who pays attention to details.

Fabi's Journey

Fabi has just returned from the supermarket. A positive outcome of the pandemic is that she is able to cook every day. She is a developer and very attentive to the detail in everything she does. After cooking lunch, she notices that her daughter, Carla, is a bit frustrated with the restriction measures due to the pandemic. Carla loves to go outside, and she also misses going to school and meeting her friends. After talking to Carla and seeing her frustration with remote schooling, Fabi recalls an app that might help Carla to interact with folk stories. She first downloads the system and installs it on her computer. Then she downloads the app and installs it on her mobile. At the same time, she needs to talk to her husband who is making a lot of noise due to the number of meetings that he has daily. Fabi calls Carla and shows her História Viva. Fabi reads the explanation on how the system works and both of them are very excited to share this experience. The story's animation begins once Fabi connects the laptop system to the mobile app typing the IP address that shows on her laptop screen. Carla can interact by drawing on her mom's tablet and the animation progresses with her interactions. Fabi is very fascinated by the experience as well, especially seeing her daughter very happy while interacting with the system. She notices that Carla was particularly impressed by the act of drawing on one device and the story changing its plot, on another. As a developer, she notices that the system has a bug and thinks about reporting it. After Carla's experience, she shows her daughter the book that inspired História Viva's animation. She also accesses the contact email of História Viva and decides to write to them with her compliments and suggestions for improvement.

Figure 9. Fabi using História Viva.

3.2 Ideating and Designing the System

"Would you tell me, please, which way I ought to go from here?

That depends a good deal on where you want to get to, said the Cat.

I don't much care where – said Alice.

Then it doesn't matter which way you go, said the Cat.

– so long as I get SOMEWHERE, Alice added as an explanation.

Oh, you're sure to do that," said the Cat, "if you only walk long enough."

(Carroll, 2000)

The exploratory stage and the goal to develop a solution that would tackle the stated problem led to the development of História Viva. Sketch-based systems are a powerful tool for children (Paulson et al., 2008) and can contribute to keeping the user interested and increasing the sense of authorship (Lima et al., 2014). Therefore, there is an opportunity to use this interactive tool to stimulate children's interest in folk stories. The inspiration for História Viva came while reading *Alice´s Adventures in Wonderland* (Carroll, 2000), in the opening quote of this section. Alice was lost in the forest and did not know which path to follow. What if Alice had followed a different path? História Viva came up at that moment of questioning what would happen if the observer would have the possibility to choose different paths for Alice. The name itself means that the story would be alive since it would adapt according to the user's interaction.

In order to provide a system that allows children to interact with the narrative by drawings, História Viva was created. The system aims to work with 6 to 11 year old children, based on the age recommendation of folk storybooks by the Portuguese National Reading Plan (Leitura, 2018). Even though there is a considerable range of the children's age (from 6 to 11), the idea was to create a design that accommodates this variety. The evaluation of a part of the system was necessary in order to study its usability. Based on that, the prototype focused on the sketch-based interactive part of the product since that is the focus of the usability studies. História Viva requires a personal computer with the system installed for the animation to take place. It also requires a mobile phone or digital tablet with the app installed for the drawings to be made. The children can draw using their fingers or a digital pen/pencil, depending on what the user has available at the moment that will give the system the necessary inputs. It can also benefit through projections by connecting a projector to the computer to give the user a more immersive experience. When a user draws an object and this object is recognized by the system, a 2D representation of the object is represented in the story and can influence the decisions of the characters and affect how the story progresses (Figure 10). For example, if the main character is lost in the dark in the middle of the forest, the user can draw a sun to help the main character to follow a path. If the user draws another object, like a torch, the character can end up starting a wildfire by mistake, which will lead to a completely different storyline. The development, usability, and technical aspects will be further explained in the chapters that follow.
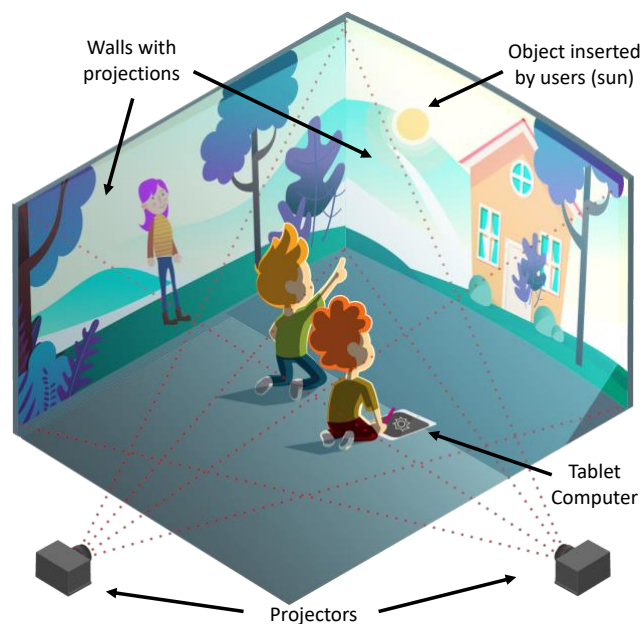
Figure 10. Illustration of the components and environment of our interactive storytelling system.

3.2.1 Working the Story

The decision to work with a folk story as a base for the História Viva project was founded on the importance of preservation, adaptation, and innovation of children's folklore (Kate & Pascoe, 2013), and also, the inclusion of folk stories in the Portuguese National Reading Plan (Leitura, 2018). *A Sopa de Pedra* (Stone Soup) was the story chosen to serve as the basis of História Viva. It is part of *Seis Histórias Portuguesas* by Moutinho (2017), which is in the annual reading plan for 4th cycle children as recommended literature (Leitura, 2018). This specific tale was selected because it contains lots of rich cultural elements that can be explored, including but not limited to religion, compassion, food, the values of sharing and acceptance of newcomers, and the discussion around these issues which are very contemporary.

Stone Soup is a European folk story in which hungry strangers passing through persuades the local residents of a town to share their ingredients in order to make a meal for everyone to enjoy (Wikipedia, 2020). The story falls under the "clever man" category of the Aarne-Thompson-Uther folklore, an international tale-type index created by Antti Aarne in 1910, and later translated and expanded on by Stith Thompson (1977), which uses plot patterns to classify the stories (Ashliman, 2008). The origin of the tale is unknown. No exact date can be found when it was first published in Portugal, but it became very popular and associated with the region of Almeirim, where the tale and the soup itself became a national delicacy and can be found in restaurants and supermarkets all over Portugal (Moutinho, 2003).

There are several variations of this story. There is also an adaptation that uses a hammer instead of the stone (Bear Skin Digital, 2020) or even a nail, in the Swedish folktale (Zemach, 1964). In other variations, the travelers were soldiers returning home (Brown, 1975). *Stone Soup* is also known overseas. Walt Disney presented its version of the tale in which Daisy gets all the ingredients to cook the soup using just one button with the "help" of uncle Scrooge (Disney Wiki, 2020). In Brazil, Daytime Emmy Award winner and TV presenter of children's shows, Xuxa, staged the story as part of her project *Xuxa In The World Of Imagination* (Meirelles & Meneghel, 2002). In Portugal, Teófilo Braga (2013), presented the tale in 1883 and contemporary author José Viale Moutinho (2014) wrote a few different versions of *Stone Soup*.

Moutinho's stories presented different main characters and titles. In two versions the friar is the traveler (2003), where in another, the friar is the one that hosts the traveler (2003). In this last version, the title of the story is *Stone Broth* (Moutinho, 2014). José Viale Moutinho is an award-winning Portuguese writer, who has authored about fifty books for children (Moutinho, 2017). His version of *Stone Soup* was used to construct the new narrative for História Viva since he is also the author of the *Seis Histórias Portuguesas* that is in the annual Portuguese National Reading Plan (Leitura, 2018).

História Viva was created using the *Stone Soup* tale as a base narrative and branches were added to create the other possibilities in the story. One of the challenges of making *Stone Soup* interactive was the fact that the story itself needed to be adapted as the user will be able to change the story's paths with their drawings. Branching path stories allows the user to make choices inserted at certain points as they progress along with the story. While some decisions have a minor impact on the story, others can change the path the characters are following completely, so this type of story will always have multiple endings (Lebowitz & Klug, 2011). Stories with branches need more work to be written as the author devises complementary stories within the base narrative. Each time the user makes a decision, the story can develop into two or more directions. Since creating branches means complementing the story with different scenarios, the challenge here was the introduction of other elements. For that matter, other elements from other folk stories written by José Moutinho were introduced. For *Stone Soup*, Moutinho (2017) presents two main characters, the traveler and the owner of the house (host). It was observed while reading *À Lareira* (Moutinho, 2014), a book with a compilation of Portuguese folk stories, that the female characters were hardly ever the lead of the adventure. Other characters were also often portrayed in several stories with religious roles (for example, saints, friars, etc.), fantasy roles (for example, royalty, witches, werewolves, etc.), and roles which portray the experiences of everyday life (for example, marriage, love, betrayal, etc.) among others.

Women as lead characters in children's stories are in the minority in literature. According to IMF (2020), 68% of books feature a male protagonist in comparison to 19% which have a female lead; in which the female protagonists have two main paths: marriage or tragedy. Even though this is not the focus of this study, it is important to note that embracing gender diversity in stories is something that still needs a lot of work (Barron, 2020). Keeping that in mind, Ana is the lead character for História Viva's *Stone Soup*. She is a curious character that loves to

explore and travel to have new adventures. The other characters are based on Moutinho's books referenced below and were selected based on the contribution they offer to the story. The friar is the host as per the *Stone Soup* story (Moutinho, 2014) and characters from other tales were added, such as the werewolf in *The Werewolf from Fareja* (Moutinho, 2003, p. 71), Our Lady of Joy in *Joy, Cliff and Pleasures* (Moutinho, 2003, p. 70), and wolves and gourds in *The Old woman and the Wolves* (Moutinho, 2014, p. 54). In terms of user interaction, a list of 13 objects was used in order to help the main character, Ana, to accomplish her tasks according to the development of the story (Figure 11). They are the "sun", which turns night into day; "campfire", "candle", "lighter", and "matches", which are used as sources of light during the night, but are also dangerous and can cause a wildfire; "rain", which can extinguish a wildfire; "axe", "sword", "knife", and "scissors", which can be used to free tied characters; and "stone", "carrot", and "broccoli", which are ingredients that can be used to cook a soup. The stone can be also be interpreted as a negative response as opposed to the carrot that is a positive response.
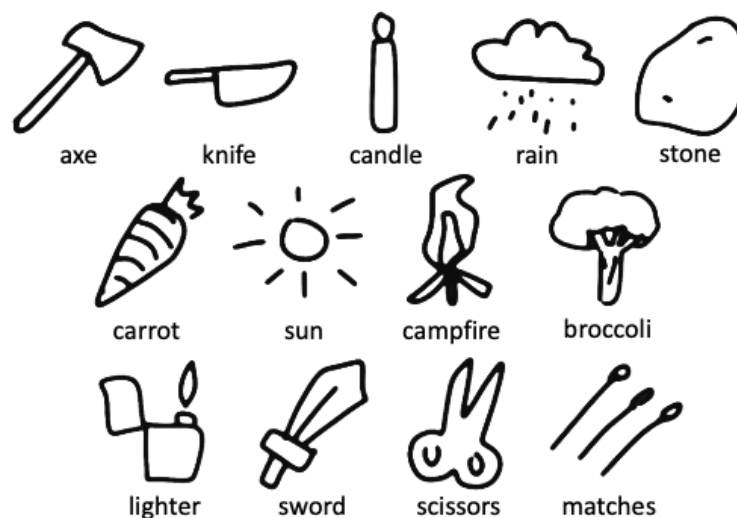
Figure 11. Classes of sketches (objects) that can be identified by the sketch recognition system in História Viva.

There are three main user interactions, divided into the beginning, middle and end of the story. For example, Ana is walking through the forest and as she gets scared, she hides inside a gourd (Interaction 1). Two of these interactions result into branching points (Figure 12). Ana's actions assist in the creation of these points. Other common elements of the different stories previously mentioned help to create the links to the branches. For example, the stories that have forests and food themes were connected to *Stone Soup*. These connections will be described next.

In *Stone Soup* (Moutinho, 2017), a traveler was walking around a forest and as he was tired and hungry, he stopped to rest next to a house. In *The Old Woman and the Wolves* (Moutinho, 2014, p. 54), an old lady wanted to visit her grandchildren and in order to pass through the forest, she needed to hide from wolves, so she got inside a gourd.

In História Viva's version: Ana is walking in the forest; she hears wolves and hides inside a gourd (Interaction 1). The user can draw objects for Ana to cut the gourd, like "axe", "sword", "knife", and "scissors".

In *The Werewolf from Fareja* (Moutinho, 2003), a werewolf walks through the forest on full moon nights to deliver two bags of rye to the village woman.

In História Viva's version: Ana is in the dark forest and cannot see. She asks for help (Interaction 2). The following objects can be sketched by users and inserted into the story world: "sun", which turns night into day; "campfire", "candle", "lighter", and "matches", which are used as sources of light during the night but are also dangerous and can cause a wildfire. During this second interaction, if the user draws a sun, Ana can see the village and go into that direction, if the user draws the other objects with fire, the forest catches on fire.

In *Stone Soup* (Moutinho, 2017), the traveler asks food from the owner of the house. The host denies it, telling the traveler that he had none at that moment. The traveler then decides to cook the stone soup outside the house.

In História Viva's version: For the first branch, Ana goes to the village, asks for food from the host of the house (friar). The host can help her (Interaction 3) if the user draws an ingredient to add to the soup, or not if the user draws a stone. If the user draws the ingredient (carrot or broccoli), the friar invites Ana to come inside the house. They cook and eat together (End 1). If not, Ana is helped by another traveler that was passing by (End 2).

In *Joy, Cliff and Pleasures* (Moutinho, 2003), Our Lady of Joy helps to extinguish the fire in the forest by making it rain. This version also gets elements from *The Werewolf from Fareja*, (Moutinho, 2003), as the werewolf gives food to the village woman.

In História Viva's version: For the second branch, once the user has drawn a fire that causes the whole forest to burn, Our Lady of Joy helps Ana by putting out the fire. She guides her to a place where she can cook the soup. The werewolf appears and offers Ana food (Interaction 3) which she can accept, if the user draws an ingredient, or not if the user draws a stone. If she

accepts the werewolf's help, they cook together and, in the end, the werewolf transforms into a real man (End 3). If not, the Our Lady of Joy returns and helps Ana to make the soup (End 4).

Stone Soup System Flow
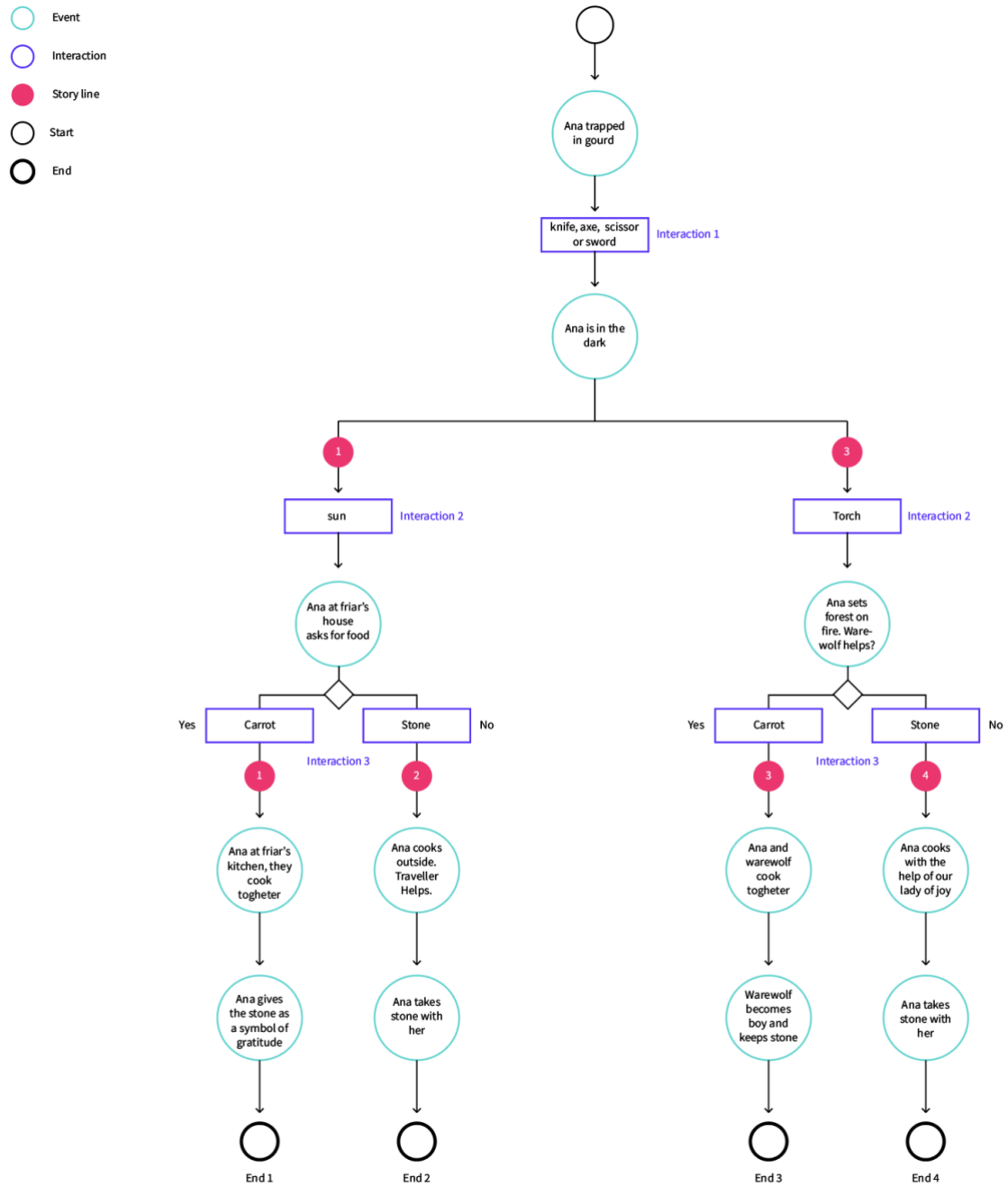
Figure 12. Stone Soup story flow.

3.2.2 The System Behind História Viva

As best UX practice leads to better interaction and a deeper perception of the product/service, a good user experience becomes essential for História Viva, as it is aimed at bringing a "magical" immersive experience to Gen Z children who are already immersed in digital systems. To provide better guidance on good usability, designers use several sets of principles that as a general rule of thumb to create a better experience when interacting with systems (Enginess, 2014). História Viva uses Norman's principles (Norman, 2013) to provide the user with a better experience. The usability of História Viva will be further explained in the prototype chapter of this work (see Chapter 5).

The navigation of the whole system (Figure 13) will not be explored in this dissertation since this study focuses on sketch-based interactions. Due to time constraints, it would not be possible to develop a full feature prototype. It is important to clarify that the development of the prototype for História Viva will focus on the part when the user starts the story (Figure 14) and interacts with the system by sketching.
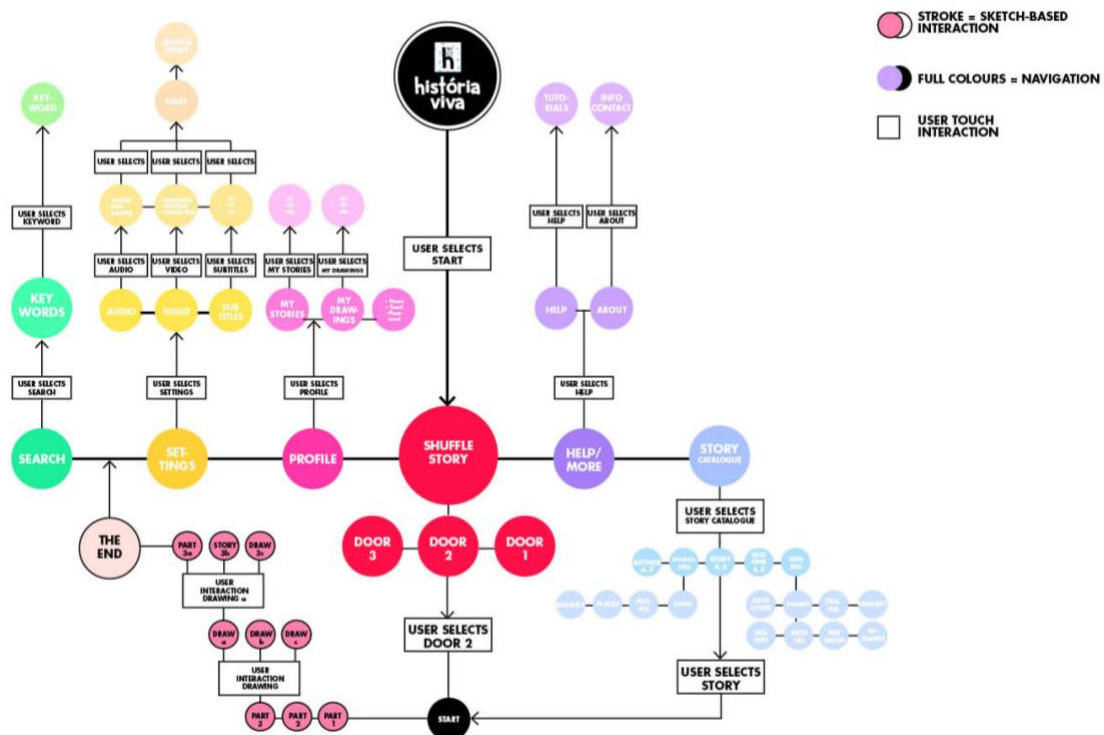
Figure 13. Navigation map of the full system.
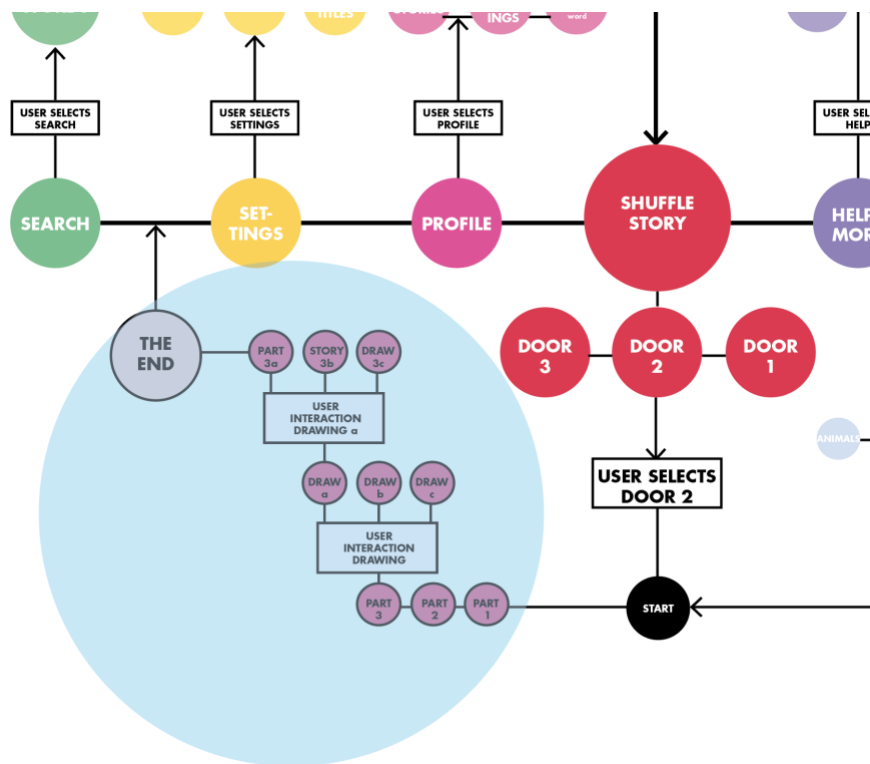
Figure 14. The system's map with the point of focus (in blue) on sketch-based interactions.

3.2.3 Visual Elements and User Interface Design

The development of the visual elements for História Viva embraces different branches of design, such as branding animation and the UI for the prototype screens (Azoulay & Kapferer, 2003; Gasek, 2012; Kolko, 2011). The development of the logo, the frame-by-frame design of the characters, and scenarios for the animation and the library of the elements for the user interface design must be cohesive so that they all promote História Viva identity. For the prototype, História Viva's design system is basic at this stage. Codes and complex documentations were put aside to be further developed when the prototype is approved. With that in mind, the creation of the identity is composed of the following segments:

3.2.3.1 Logo Development.

Brand development is not the focal point of this work. However, a brief explanation of the development of História Viva's logo can provide more context for this work. The logo development was based on a summarized creative proposal of Kapferer's identity prism (Azoulay & Kapferer, 2003). This shorted version is based on the three main pillars in Figure 15. The first is the impact of the brand with the user which correlates with a physical aspect of the object. For example, in História Viva, the main inspiration behind using capitular letters was the font of old tale books. Second, for História Viva, the vertex of personality which connects the brand to emotions and qualities to which the user can relate is visible in the elements of the logo that represent movement and growth, which, in turn, relate to life. Third, the business strategy, which is associated with História Viva's brand and its relation with the market, can, for example, be seen in the use of vibrant colors and a clear font type that represents a system that relates to stories adapted for a contemporary marketplace.

Figure 15. Logo development of História Viva

3.2.3.2 Color.

História Viva uses red as per the primary color (Figure 16). It is the most vibrant color and connected to a call to action. According to Bamz's Study (1950), the color red represents the age from 1 to 10 years old, being effervescent and spontaneous. Secondary colors are comprised of yellows, purples, and greens which represent strength, magic, and friendship respectively

(Modesto et al., 2006). This color palette presents the distinctive tones that were used to better harmonize the different needs of História Viva when the animation setting was designed.

Figure 16. Colors of the system.

3.2.3.3 Typography.

For headings, the MilkMan font was used with three different sizes to adapt to different situations (Haäfe & Haph, 2012). The size numbering might seem big, but the font itself is small, needing a bigger size to balance it out as can be seen in Figure 17. The three sizes are divided by 8, keeping the consistency with the 8-pixel grid. The rounded font is fun, dynamic, and childlike. For paragraphs, the Source Sans Pro family was used. This font was the first opened type developed by Adobe and it has a legible sans serif typeface capable of performing well in different interfaces (Hunt, 2020). Two different sizes and link options are used, depending on the scenario.

Figure 17. Text styles.

3.2.3.4 Sizing and Spacing.

The scale will be used for the future development of the complete product, once the prototype stages advance. This scale will help in the construction and distribution of the visual elements in a balanced way, using a grid (Vitsky, 2019). The grid will be created based on the 8px scale (Figure 18). For the prototype, the concerns were with the children's interactions, so the buttons were designed large and noticeable according to the recommendations of Nielsen Norman Group when designing for children (Liu, 2018). The click area follows their recommendation and has a 140px size.
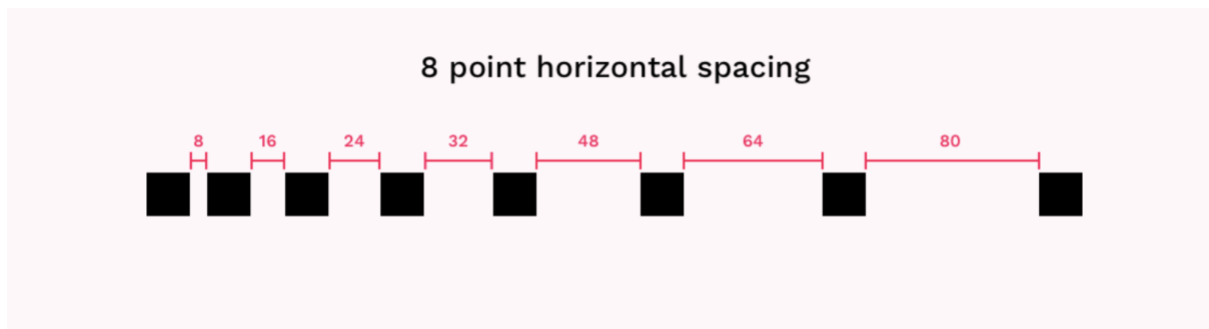
Figure 18. 8pt spacing system.

3.2.3.5 Imagery.

The development of the visual elements for História Viva followed several graphic references (Figure 19). Children will draw as they interact with the system, so brushes and Cryon textures were used to create the background (Figure 20) and other components. These type of visuals were inspired by Normal Norman (Lazar & Stephen, 2016), a children's book about a girl scientist and her orangutan that tries to understand what is normal. Also, Disney's *Alice in Wonderland* (1951) was studied to complement the visual elements and also played an important role in the research of color palettes.

45
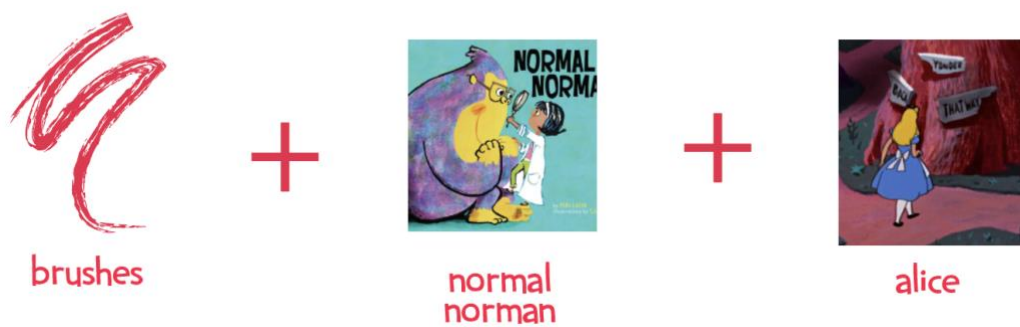
Figure 19. Visual inspirations for História Viva.

Figure 20. Colors and textures of the system's first screen.

3.2.3.6 Components.

Buttons and other visual elements were developed bearing in mind that they will be used/modified for the complete version of the system (Figure 21). Since this is a proposal for a prototype focused on sketch interactions, there is a list of objects recognized by the system and used in the story as previously described (Figure 22). The prototype uses primary buttons and

feedback visual cues. Other components, like the search button, navigation arrows, and so on will be used in the complete system, once designed and implemented.
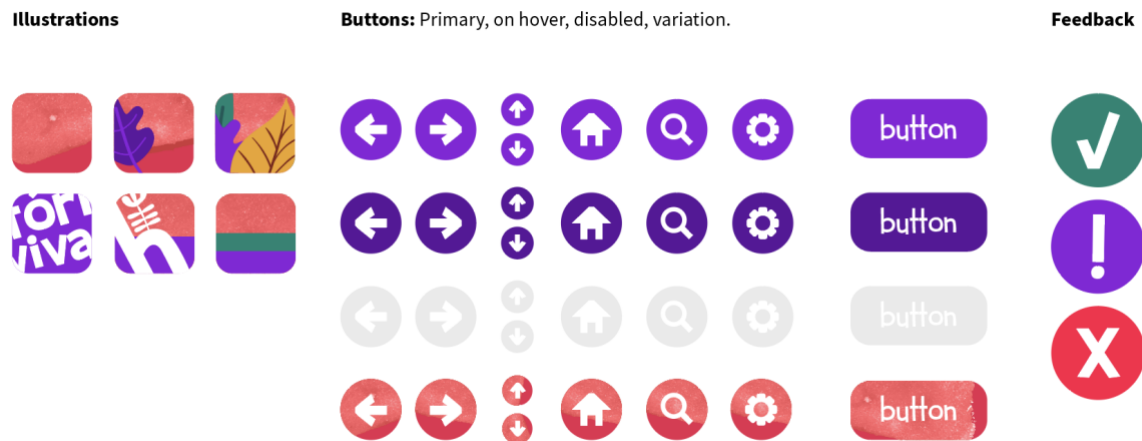
Figure 21. Illustrations for thumbnails, buttons, and feedback hints for the system.

Figure 22. Items list.

3.2.4 Animation

For História Viva, frame-by-frame animation technique was used to give the user the illusion of movement by creating small changes in the key frames. This type of animation is similar to the traditional hand-drawn animation, where each movement is drawn separately on a different

sheet of paper (Russell, 2017). This type of animation usually gives a harder finish to the movements, which can be very well explored for comedy (Gasek, 2012). It also provides the designers with the opportunity to work freely with the desired artistic style for the animation.

For this project, the animation design adapts the steps proposed by George Shuter (Shuter, 2020) as: (1) Scriptwriting, (2) Voiceover, (3) Animation, and (4) Post-production.

3.2.8.1 Scriptwriting

Taking into consideration the structure planned, writing a script is important to embrace the story and polish the details to enrich the narrative (Lebowitz & Klug, 2011). The script (Appendix C) was aligned with the *Stone Soup* story flow (Figure 12), and the addition of other elements from Moutinho's stories (Moutinho, 2014) as previously mentioned. The story of *Stone Sou*p (Moutinho, 2017) worked as the basis for interactive storytelling. When the main character, Ana, is lost in the dark forest and the user draws a sun, the whole system lights up and the character ends up in the village. If the user draws fire, the whole forest burns, and Ana cooks the soup in the forest during nighttime. For the story, two main scenarios were developed, the forest and the village, as per the original tale. Both add the possibility to explore the environment better due to the other possibilities brought forth by the digital interaction. For example, the forest has the night scenario and the day scenario, depending on the interactions of the user. The script was written in Portuguese and English to embrace a broader range of users, and it also serves as a guide to plan the visual development of the prototype and provide the people who will do the voiceovers a better context of the storytelling.

3.2.8.2 Voiceover
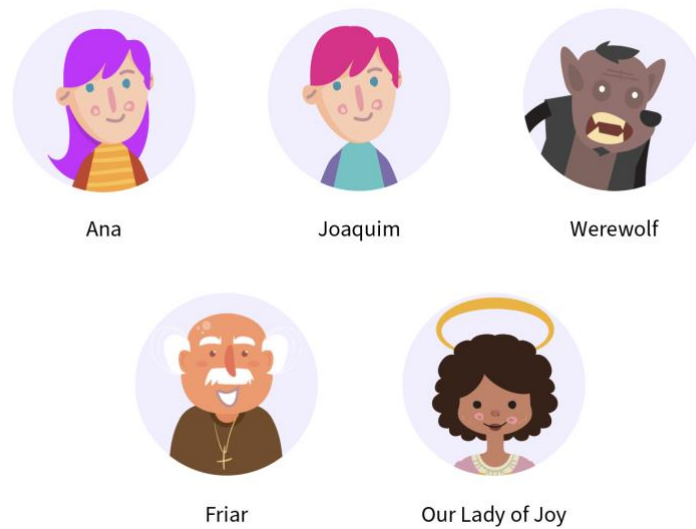
Figure 23. Characters of História Viva.

The script was broken up based on the lines for each character (Figure 23), so the voices would be recorded easier. English was the first choice for the voices since it is the main language of this project and it provides children from different cultural backgrounds the opportunity to use the system. Subtitles in other languages will be displayed. For this prototype, the subtitles will be in Portuguese. The voiceover also serves as a guide to develop the characters' movements once they are in sync with the animation. The voices were recorded by:

Ana Gariso: Ana,

Felipe Gheno: Joaquim,

Hugo Antunes Henriques: Werewolf and Friar,

Joana Lobo: Our Lady of Joy.

To record the voices, an IOS app called Voice Memo was used where each voice was recorded separately, by each character. Each audio sentence was refined using Adobe Audition and saved in a .mp4 file format which will be used when programming the animation.

3.2.8.3 Characters and Scenarios

The characters were illustrated using the Adobe Illustrator tool, a digital tablet, and a pen. The frames were designed with four actions in mind: giving (Figure 24), idle (Figure 25), talking

(Figure 26), and walking (Figure 27), except for the Lady of Joy, which fluctuates and blinks (Figure 28). The illustrations of the characters and scenarios were created using self-drawn illustrations with elements of image banks (Figure 29).
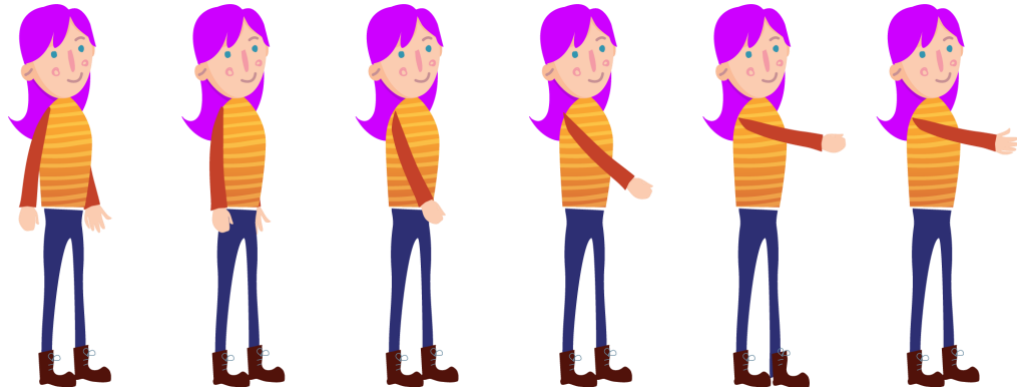
Figure 24. Ana giving.

Figure 25. Ana idle.

Figure 26. Ana speaking.

Figure 27. Walking.

Figure 28. Our Lady of Joy, floating and blinking.
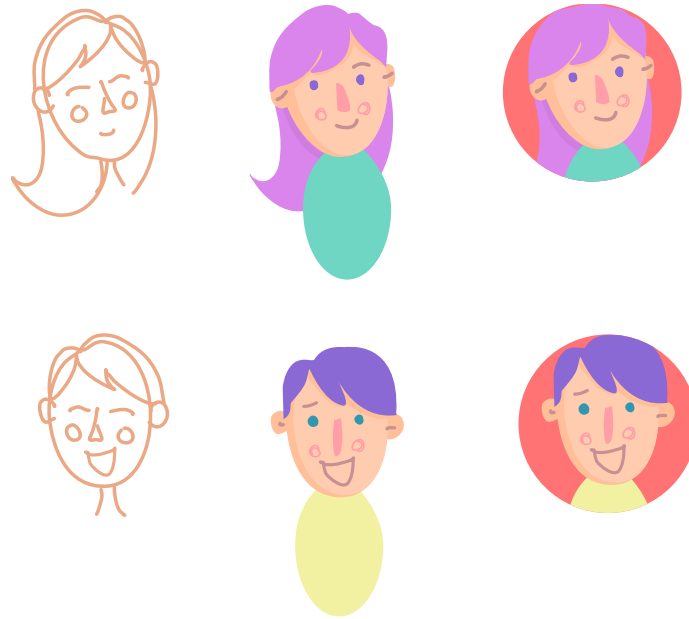
Figure 29. Main characters design.

As previously mentioned, the scenarios were designed based on two main areas namely the forest and the village. Each of the main scenarios has their own variation that had to be designed. The forest has a day, night, and fire variations with its elements placed into them (Figure 30). There is a different shade of dark when the fire is placed on the set. This provides support to the character's interactions and a better context within the development of the story.
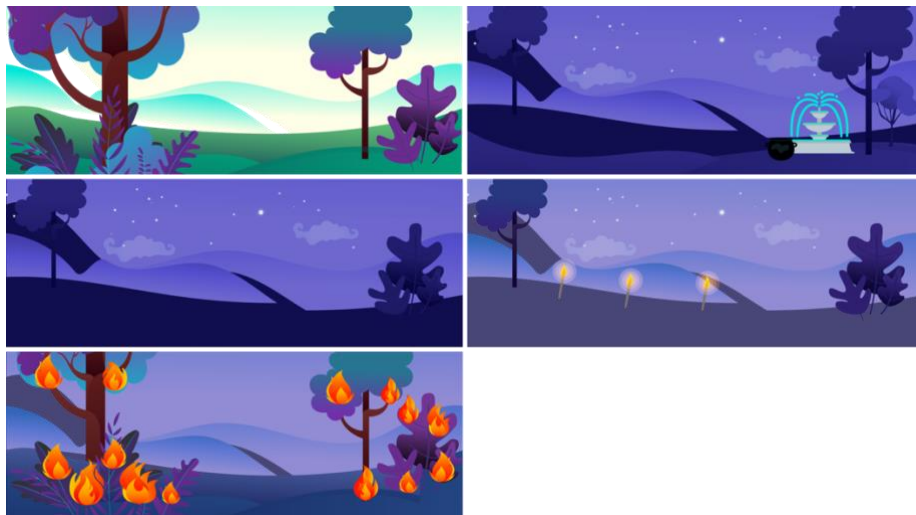
Figure 30. Forest variations.

The village is comprised of the friar's house, its surroundings, and a kitchen (Figure 31). It does not have the night version since Ana only goes there if the user draws a specific object that will

light up the forest and her way to the village. Ana can cook the soup and interact with the friar inside or outside the house, depending on which interactions the user selects.

Figure 31. Village scenario.

3.2.8.4 Post-production

At this stage, all the elements of the animation are put together, in this case, by coding, which will be further detailed in the next chapter. Also, other elements were incorporated into the story to give the user a better immersive experience, such as the owl and wolves sounds and the music in the first screen of the system.

4. The Prototype

Prototyping is important to História Viva since it can give the researchers valuable information on precision and real-time performance of highly interactive storytelling environments. Without the prototype, the study that will take place would not be possible since it aims to evaluate the sketch-based interactions. A prototype is a model of the product used to test an idea. It provides the designer with a very efficient and cost-effective way to get essential feedback to validate the product and its usability (Brown, 2009). While designing for História Viva, three focus points were taken into consideration to build the prototype: the visual components, the technology behind the system, and the usability. For the prototype to work, two systems needed to be developed. First, the História Viva system has to be installed on a desktop computer. This system will display the animation and will change according to the user's interaction in the app. Second, the app História Viva will be installed on a mobile phone or tablet and will allow the user to draw and send the input for the system to adapt the story (Figure 32).
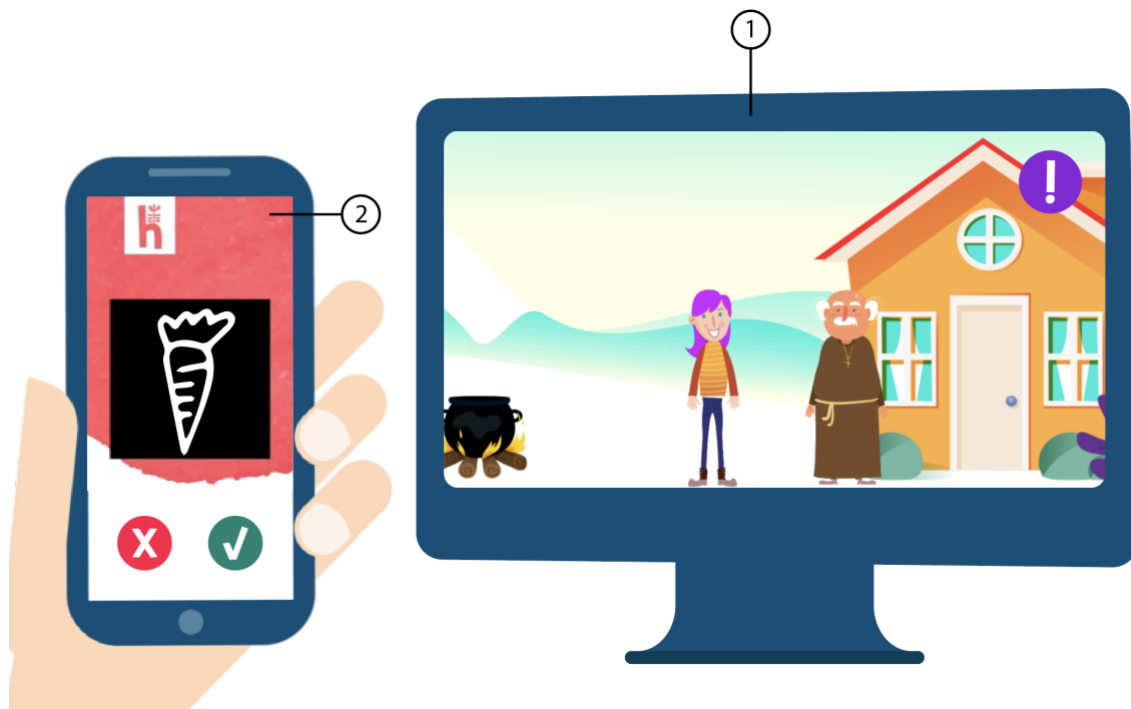
Figure 32. The system in the desktop (1) and the app to be installed in the mobile or tablet (2).

4.1 The Technology Behind the Prototype

História Viva used the Lua code to program the animations. Lua is a powerful scripting language designed by a team in Pontifical Catholic University of Rio de Janeiro in Brazil (Lua, 2020). The architecture of História Viva allows the user to draw on a mobile app while the animation is being displayed on the desktop screen or projector. Once the system recognizes the sketch, a message is sent to the app by the local network that will translate the input. The interface then will be updated to inform the user about the identified object and the story plot will change accordingly.

Since Ivan Sutherland proposed the Sketchpad System in 1963, a variety of other sketch-based interactive systems were developed. In general, they use the process for identifying the sketch as a classification problem, where the system contains a set of drawings' classes (a vocabulary) and must recognize a new sketch-based on its similarity to some other object from a library, which is a typical machine learning problem (Lima et al., 2020). The sketch recognition module for História Viva uses deep learning, a field of machine learning that allows computational models that are composed of multiple processing layers to learn representations of data (Lecun et al., 2015). Since deep learning requires training data, which can be difficult to obtain, a dataset of sketches was used. Quick, Draw! Dataset is the largest available dataset of sketches, with over 50 million sketches of 345 different classes, such as clouds, cats, swords, cars, and so on (Google Creative Lab, 2021). It was created by drawings of 15 million players of a web game called Quick, Draw! (Quick, Draw!, 2021). The dataset contains a huge number of illustrations from different objects and it also contains a big diversity of the drawing styles due to the different cultural backgrounds that the players have. This dataset was used for História Viva so the system could identify its 13 objects. These objects and their use will be explored in the next section.

4.2 The Prototype's Usability

Since children are the main users of this system, designing a prototype bearing in mind their needs are essential, as previously stated. Because children from the ages of 6 to 11 participated in this study, it took into consideration common elements of this age range, such as the use of larger on-screen components, like buttons, to avoid complex tasks and cognitive load, and to

increase time for the interactions (Kientz et al., 2020). It is relevant to add that the basic principles of good usability works for children and adults, meaning that things that make it easier for adults to use an app also works for children (Sherwin & Nielsen, 2019). Some of these particular features will be further explored in the Six Principles of Interaction by Norman (2003) and used to guide the development of the prototype. Others relate to the user while executing the test, which will be added in the next section of this dissertation.

As mentioned before, Norman's Six Principles of Interaction studies the design of different everyday objects (2003), focusing on human-centered design and applying these principles to digital products. The prototype of História Viva follows these principles as its base to assure better usability for the users:

1. Visibility: Figure 33 depicts 3 main areas which provide better visibility through visual aspects and less text to enhance the usability for kids (Smyk, 2014). The first is interaction cue display. This symbol of attention will be displayed at any time the user needs to draw. In addition to the main character guiding the user, this visual element brings more visibility helping the user to act. The second is the drawing area, displayed in black to give the user higher contrast with the background and the sketching place to happen. The third is the send/clear buttons that will send the drawing to the system or delete it.
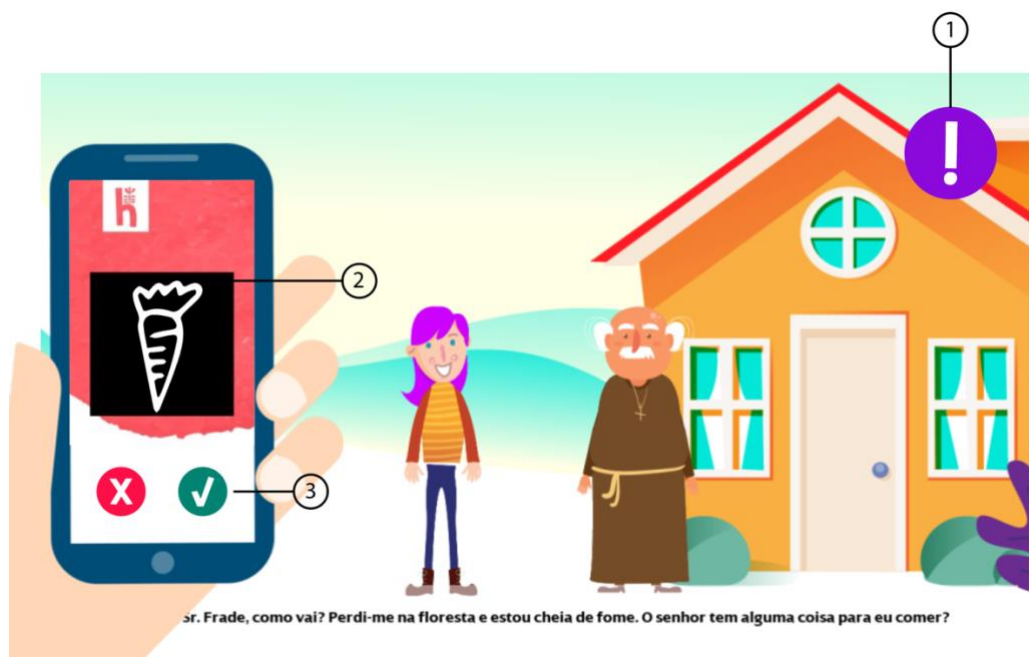
Figure 33. Main interactions: (1) Interaction cue display, (2) Drawing area, (3) Send/clear buttons.

2. Feedback: For História Viva's desktop system, the user will see the animation which guides the user and gives feedback by voice or text. When the user arrives at the interaction points, adding to the guidance of the main character, the screen with the animation will display a visual cue illustrated as an exclamation point (1 of Figure 33). In the mobile app, the black area will display the drawing made by the user in real-time, since they simulate the experience of drawing of the pen or pencil. Once the user clicks on send, a message will inform the user that the sketch was sent to the system (2 and 3 of Figure 33). The tests with the prototype will provide valuable information on how to refine, add, or change the feedback system between the user and História Viva. As mentioned, the system needs to recognize the drawings as inputs to provide outputs to the user affecting the story. If the system does not recognize the object, Ana repeats the request.

3. Constraints: For the main interaction in the prototype, where the children can draw, História Viva provides a focus to the user with a black square in the UI, where they can interact with that limited space to focus on their actions (Figure 33). As this space is centralized, the user can use their right or left hand to draw, making it possible to have a left- and right-handed experience. The list of objects also provides the user with a vast set of elements to draw but are in sync with the size of the story, meaning that Ana always suggests what the user can draw to help her, so the list of elements in each interaction is limited.

4. Mapping: In terms of user interaction, the 13 objects that can be sketched by users and inserted into story world are: "sun", which turns night into day; "campfire", "candle", "lighter", and "matches", which are used as sources of light during the night, but are also dangerous and can cause a wildfire; "axe", "sword", "knife", and "scissors", which can be used to free tied characters; "stone", "carrot", and "broccoli", which are ingredients that can be used to cook a soup; "rain", which can extinguish a wildfire. The stone can be also understood by a negative response as opposed to the carrot which serves as the positive response. For example, the werewolf offers to help Ana. If the user draws a stone, it means no, and a carrot, yes. Both buttons in the mobile device present an accent color. The green color and a check mean that the drawing is accepted, and a red color and X clears the sketch artboard.

5. Consistency: For História Viva, a base for the visual elements was developed (as explored in Section 4.2.3) with the intention of giving the user consistency in the user interface. The user can draw the objects in their own style and that will be translated into a set of elements that were designed with the balance and the visual graphics already presented in the story in mind (Figure 34).
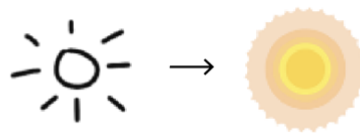
Figure 34. Left: Sun sketched by user; Right: Sun displayed in the story world.

6. Affordance: The black square represents the space in which the children must draw, like a blackboard. Also, as the story moves along and builds with the sketches, Ana guides the user to provide what is needed for her to move on. For example, when the werewolf approaches her, offering help, Ana thinks out loud, giving a hint for the user to draw a carrot to accept the stranger's ingredients, or a stone, to make him go away. The two main buttons on the mobile device present an accent color and its symbol facilitates the function of those components, as it uses a green color and a check, which means that the drawing is accepted, and a red color and X to clear the sketch artboard as previously mentioned.

Since the early stages of studies on usability, prototyping has been considered an important element of developing a good design-based product. It provides the designer with a very efficient way to get essential feedback to validate or check the interface and its usability. According to Gero (1990), prototyping gives the designer important information to develop concepts since relevant evidence manifests itself as the design proceeds and varies with the decisions taken. História Viva's prototype is an essential object of study that will allow the researchers to test the part of the system where requires digital sketch-based interactions. As further research, tests were conducted to evaluate the system from the user's perspective. These will be discussed in the next chapter.

5. Usability Testing

Usability testing is a set of techniques used to measure the interaction of the user and the product in order to better understand its usability. It is about observing the user performing a task so the product can be adjusted to avoid confusion and frustration (Steve, 2000). Because it requires the user to interact with an object, these tests need a coherent design artifact that can be, for example, wireframes or a prototype (Cooper et al., 2007). According to Krug (Steve, 2000), three participants is the ideal number, since it is a qualitative method and should result in insights leading to improvement, and not proving an assumption. Proving things requires quantitative testing, which is a different approach that involves a rigorous process. Also, according to the author, no matter what type of tests are applied, there have always been improvements that needed to be done, since it is it impossible to map all of them while testing. For Nielsen (2012a), 5 users provide as many usability problems as if the test used more participants. However, depending on the project, more participants or fewer participants can be required. For qualitative usability studies after the 5th participant, the repetition on the issues become constant, being a strong indication that the collected data is enough to provide helpful insights (Nielsen, 2012a).

História Viva aims to do a usability test with five children, between the ages of 6 to 11 years old, that will participate in moderated usability testing with the guidance of a parent/guardian. Markopoulos and Bekker (2002) propose a list of parameters to set a fairly accurate description of any usability testing. As they provide a study comparing different usability methods when testing with children, this dissertation uses their proposition to establish user testing. In the next section, the tests will be further explored as they are divided into (1) Purpose of the test; (2) The artifact tested; (3) The interaction tasks; (4) Participants; (5) Facilitators; (6) Environment/Context; (7) Procedure; and (8) Capture of data. The results of the usability test and questionnaire will also be documented in this chapter.

5.1 Purpose of the Test

1. To evaluate the children's interactions by drawing.
2. To evaluate the usability of the prototype by observation and think aloud.
3. To apply the SUS questionnaire to measure the user experience.

5.1 The Artifact Tested

História Viva is a sketch-based interactive storytelling product, composed by a desktop/laptop system that requires a Windows operating system and a mobile application that requires Android. Other materials needed are an internet connection via wi-fi (both systems need to be connected at the same network) and a secondary mobile phone or tablet that will allow the recordings of the interactions.

5.3 The Interaction Tasks

By navigating through the prototype, the users will perform a task. In this case, they will be interacting with the story until the completion of one storyline. By thinking aloud, the designer can hear the participant's misconceptions, doubts and misinterpretations. Regarding children, it is expected of them to be quieter than other users in a think aloud section (Joyce, 2019). After performing the task, users are invited to answer a questionnaire. This post tasking exercise allows observation and verbalization to be enriched with an adaptation of the System Usability Scale (SUS) for user testing with children (Putnam et al., 2020). This adaptation was created based on the SUS method, which is a system that was developed by John Brooke in 1986 to help evaluate effectiveness, efficiency, and satisfaction (Teixeira, 2015). The method uses a 5-point Likert scale (from strongly agree to strongly disagree) to answer 10 questions and a final score indicates the product's usability. This procedure provides a reliable tool for measuring the usability of a system (Usability.Gov, 2020). These methods will be further explored in the segments of this section.

5.4 Participants

The participants (Table 1) of the test were five children: two 11-year-old boys, and three girls: nine, eight and six years old. The tests took around 15 minutes to complete (usability tests plus questionnaire) and were conducted remotely. The participants will be mentioned as users to be preserved.

Usability Test Planning: História Viva Prototype

User	Gender	Age	Time of task execution
1	Female	6	8,5 min
2	Female	8	5 min
3	Male	11	5 min
4	Male	11	5 min
5	Female	9	5 min

Table 1. Participants of the tests

5.5 Facilitators

The participation of the parents was essential since they also helped the children when needed. With that said, some instructions were redirected to them. They act as moderators while installing the program and the app and setting the test with their children. They also recorded the interactions since it is needed to see the drawings in the mobile app and its results, affecting the animation on the desktop system. An email was sent to the parents with the instructions (Appendix F). The tests were conducted and recorded in the user's house. An online chat was arranged using Google Meet to explain the purpose of the test and the user's role.

5.7 Procedure

The test was divided into two stages namely, the setup, where the parents' help was essential for the installation of the system, and the usability test itself. The instruction on the setup was sent by email (Appendix F). Once everything was set, the researcher explained who he is, what the purpose of the test is, and how História Viva works during a call. Once the test started, the parent acted as the moderator, recording the actions and asking the children to say what they were thinking out loud while performing the tasks. The desktop system was executed and displayed História Viva's first screen. On the first screen, an IP address appeared which was used to connect the desktop system to the app. Then, the app was opened in the mobile phone and the user was invited to type the IP address that was presented in the desktop. Once they were connected, the animation started. The main character in the story guided the children, asking for help at the times they needed to draw on the mobile or tablet. The drawings were created through a single digital device where children were expected to interact by drawing

objects as the story evolves. There were three interactions (drawings) per story. After the interaction with História Viva, the moderator stopped recording and the child was invited to answer 14 questions using an online questionnaire.

5.8 Capture of Data

The recordings of the usability provided qualitative data to be analyzed in order to frame the insights, map the user's pain points, and the usability issues. The results were summarized into a table and linked to Don Norman's Six Principles of Interaction (2013). As previously mentioned, the questionnaire was based on the SUS for user testing with children to complement the prototype test and also to provide quantitative data (Putnam et al., 2020). In order to calculate a SUS score, the researcher had to subtract one from the user responses to odd statements, for example, if the user answered 3 (3-1=2), and subtract corresponding values from five in the even-numbered statements, for example, if the user answered 2 (5-2=3). At this point, the converted response scale ranged from 0 to 4 with four being the most positive. By adding responses from all participants and multiplying the total by 2.5, it converted the range from 0-40 to 0-100 (Brooke, 2013).

5.9 Results

There are observations to take in consideration after running the prototype test, like the fact that it was not practical to be in a call while executing the program (once they need to use the computer and two mobiles to execute the tasks). This approach was tried in a pre-test section where the connection through Zoom was interrupted several times. Another observation to add is that children have the capacity to concentrate on only one thing at a time and are usually quieter when performing a think aloud section (Markopoulos & Bekker, 2002). Even though children were invited to speak while performing the task, due to the high cognitive load of the performance – as children paid a lot of attention to the animation and Ana's requests while drawing – most comments were before or after tasking. The results are presented below, separated into qualitative data (usability testing) and quantitative data (SUS questionnaire).

5.9.1 Qualitative Results

The notes that follow is regarding the usability testing sessions performed between December 2020 and January 2021 and are divided into observations made while watching the user performance, comments made by the user and/or the parent and mapped possible pain points. Mapping the pain points are necessary to improve the user journey through the discovered opportunities (Salazar, 2020).

User 1 (6 years old):
Managed to finish a story in 8,5 minutes.
Observations: Space for drawings are too small. She used all the space to draw a carrot, which was read by the system successfully every time (Figure 35). She liked it and even played it twice. The hardest part was getting the instruction with the carrot right, but it was also what she liked best. During the story, she wanted to draw more things like the stone, the salt… (the last part was not clear where the character adds all the ingredients, according to the drawings). The user double-clicked on the submit button and that made the system go into unplanned directions. She played it three more times. She really liked the interaction with drawings and how that related to the animation. The submit and erase buttons are not fully displayed in the screen but in other recordings of this section the screen was in full screen mode and this issue was resolved.
Comments: Her dad liked the fact that the story has different outcomes, for example, that she designed a fireplace that was interpreted as fire, and the second one that drew the sun. Her dad did not like it being in English, but the daughter forced him to keep the audio on. Her dad works in technology and his technical point of view is that he loved the concept of drawing on the phone and viewing on the PC, but he realized a few limitations, such as an X and an * used together were a knife, a date, and points which were supposed to be salt, for example, was read as rock, and so on.
Pain points: The story being narrated in English. Also, the drawing space was limited, and it was challenging to draw the objects and for the system to recognize the carrot.
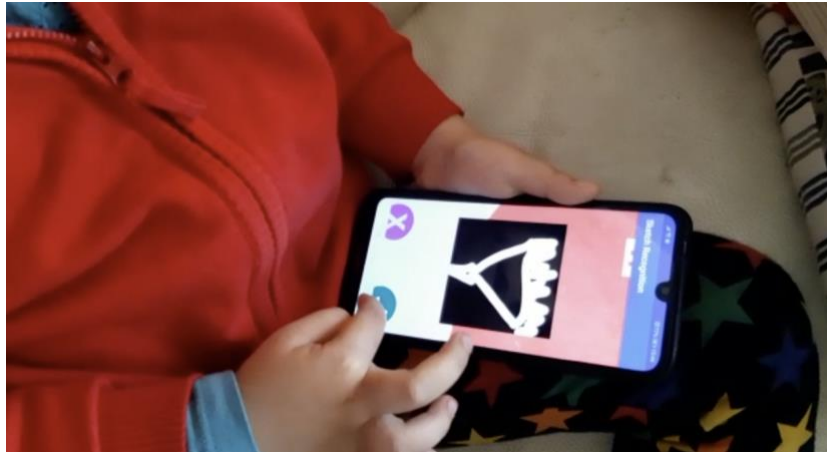
Figure 35. Drawing a carrot

User 2 (8 years old):

Managed to finish a story in 5 minutes.

Observations: Her dad helped her to press the submit button. During the first drawing, she sketched and waited for the system to recognize it. When the friar asked her if he should help her, she drew a check mark. She did manage to end the story with no jumps, which means that the system responded accordingly with her interactions and progressed in a linear story line.

Comments: She really liked the story and the development of it but her one frustration was that the story should contain more levels. She would like to play it again but wishes that the story would have more stages and characters.

Pain points: Object recognition: drawing a carrot was read as an axe/candle (Figure 36). The story is too short; it needs more levels and different scenarios.
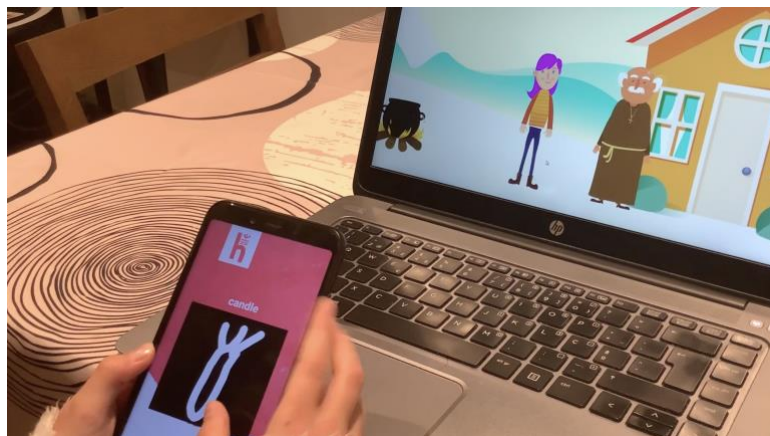
Figure 36. System misidentifies an object.

User 3 (11 years old):

Managed to finish a story in 5 minutes.

Observations: It takes a while to understand the drawings in the story. When this happens, the user's impulse is to click the send button several times which can cause the system to over process. This results in taking the story into different directions. João double-clicked a few times on the drawings to submit them which took the story from the village to the werewolf, and then back to the village (Figure 37). He drew very careful and was attentive to details. When the story finished, nothing happened. If the user wants to play again, they need to exit the system and reenter the IP.

Comments: His answers were positive. He thought the story was well constructed and creative or "very cool" and that the animation and the overall design is very well done. He liked to use the system and would like to use it again. It got a little bit frustrating when the system did not recognize the carrot the first time he drew it. The black drawing area was adequate and there was nothing that he would have changed.

Pain points: The participant drew while the character was speaking for the second time. He did not wait for the character to finish talking which can make the system to take a while when recognizing the drawings. He clicked on the submit button several times, which created frustration and ended up with a new storyline.
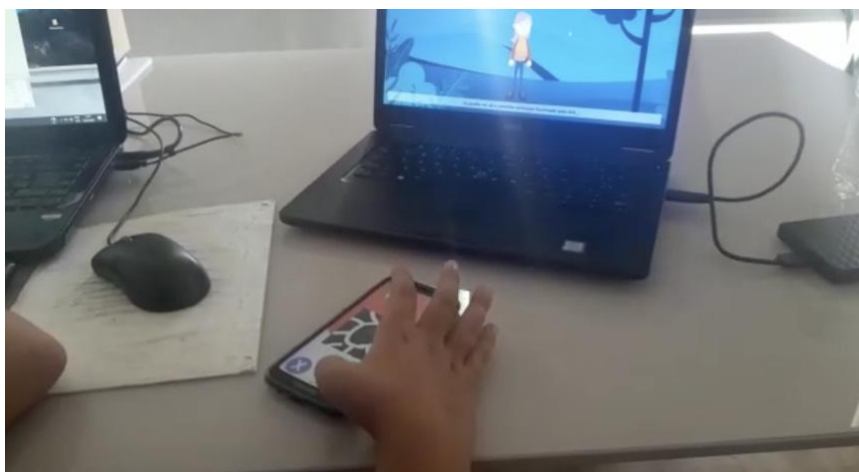
Figure 37. Drawing a sun and double-clicking to send.

User 4 (11 years old):

Managed to finish a story in 5 minutes.

Observations: The user also waited after Ana would repeat the request to start drawing. He drew very carefully and clicked the submit button more than once (Figure 38), causing the same situation as previously. The story would jump from one scene to the other, creating a new order of the facts, for example, Ana should go to the village if the user draws a sun, but ends up talking to the wolf instead. Because of the repetitive click on the submit button, there were a few bugs presented, like the disappearance of the main character even though the user could hear her voice. When the user tried to draw a sun, everything caught on fire, and that what was only supposed to happen if the user drew matches or a fire. In this case, he also clicked a couple of times on the submit button.

Comments: The story was interesting and what he liked the most was the plot and helping the girl to make a soup. His least favorite thing was that, sometimes, the system did not recognize his drawings. He would play again once there are other possible drawings available and as a suggestion, he would like to create different types of soups for himself.

Pain points: System was too slow to recognize the drawings and sometimes it did not recognize the objects. Clicked several times on the submit button, which created frustration and ended up with a new storyline.

Figure 38. Double-clicking to submit.

User 5 (9 years old):

Managed to finish a story in 5 minutes.

Observations: She did not have any problems with double-clicking the submit button. The experience was smooth as the system recognized all her drawings (Figure 39), and she did manage to end the storyline as designed. She drew clearly and used most of the space in the drawing area.

Comments: Her first observation was that the colors were nice. She would like to play more and would purchase this interactive storytelling system. She really liked to help Ana in the various situations, for example, when she was trapped in the gourd. She would love to play again and she would also add new characters.

Pain points: She wanted to play more, so there is a need to have a better start again button. Also, the drawing area of the mobile could be larger.
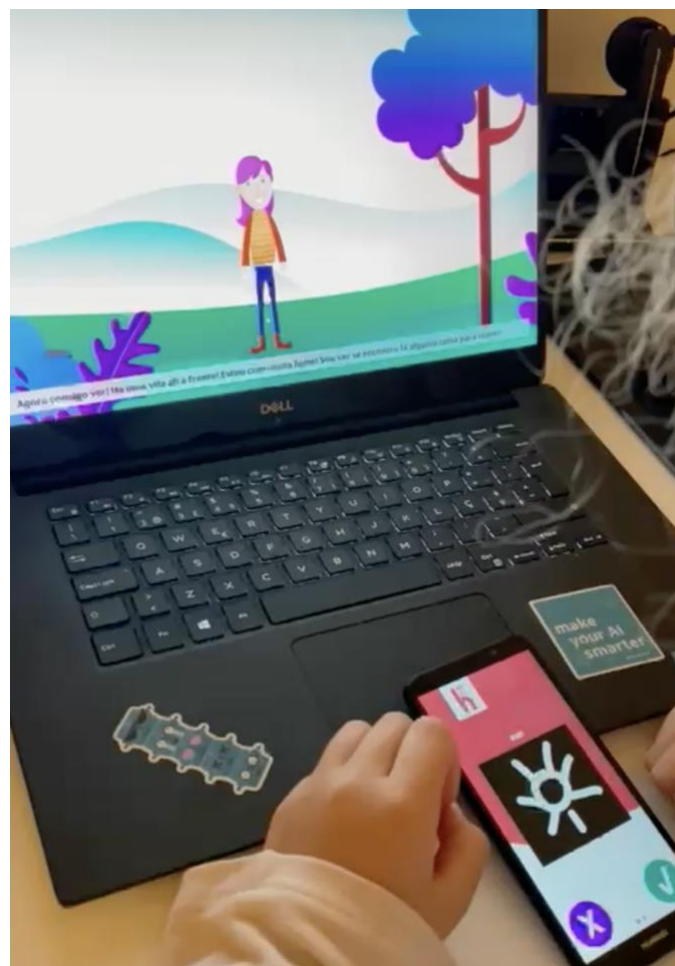
Figure 39. The system recognizes the drawing of the sun.

A summary is provided in Table 2, where issues that generated pain points and related opportunities for the improvement of the system were documented. The first five documented observations relate to the interactions by drawing and from five to eight related to the overall usability of the prototype. In this summary, it is possible to identify that the main issues to improve in the system, according to Don Norman's Six Principles of Interaction (2013), are regarding (2) feedback and (3) constraints. The system needs to improve while providing feedback to the user and also restrict actions like sending the drawing more than once, among other adjustments. The tests were successful, and the feedback was mostly positive. The sketch-based interactions were well received, surprising the user when the drawings affected the story. But it could also generate frustration when the system did not recognize the drawings. The children were entertained and focused while performing the test. It is also worth mentioning the positive reception of the visual design, which the users described as "well done animation" and "I love the colors!" They wanted the story to be longer as they wanted to play more.

Qualitative Results			
Results	Pain Points	Opportunities	Norman's Principles
1	Click more than once on the submit button. The system takes some time recognizing the sketches that make the user send various inputs to the system.	Allow the user to click only once on the button. If the user clicks more than once, the other clicks are not recognized by the system.	3
2	No feedback is given to the user in that matter, informing that the drawing was sent.	User needs feedback provided with better visibility informing that the drawing was sent.	2
3	Drawing space is narrow.	Enlarging the drawing space will allow a better area of interaction and might respond better in the drawing recognition.	3
4	Users need to repeat a few times for the drawings to be recognized.	Have more space to draw, sending just one input at a time (correcting the click) and giving more visibility in the feedback given on the sketched objects.	2
5	Narrative in English.	Develop further audio languages and prioritize Portuguese.	2

			3
6	It is not possible to start over other than restarting the prototype.	Allow user to restart the story, or further, when the complete system is developed, go to the home screen.	3
7	Binary decision making not clear: the carrot was always chosen.	Alternate the order of suggested objects. When Ana or the friar needs to make a decision, they always start suggesting yes = carrot, no = stone. The user always ended up drawing the carrot. Maybe to rethink this interaction. Why not draw a check or x for yes/no?	3
8	The story is great but too short. Lacking more levels and characters.	Develop more complex stories, adding new characters and other scenarios. Giving the user the opportunity to draw their own avatar would be more inclusive and diverse.	3

Table 2. Test pain points and opportunities.

5.9.2 Quantitative Results

A total of five participants of children, between 6 to 11 years old answered the questionnaire after they went to the prototype test section. Table 3 indicates the participants and the answers regarding the questionnaire based on an adaptation of the SUS (Dexheimer et al., 2017).

SUS: Quantitative Results

User	1. I would like to use this app a lot.	2. The app was very difficult to use.	3. The app was easy to use.	4. The app is too hard for me alone, and I need extra help.	5. All História Vivia's scenarios worked well together.	6. Some things did not make sense.	7. Most kids could easily learn to use the program.	8. The app was difficult for me to use.	9. I felt very comfortable/ confident using História Viva.	10. I needed to learn a lot before I could use the app.	SUS Final Score
1	5	1	4	4	4	1	3	3	5	2	75
2	4	1	5	3	4	1	4	1	4	1	85
3	4	1	5	1	5	1	4	1	5	1	95
4	4	2	4	1	5	2	5	1	5	1	90
5	5	1	5	2	5	1	5	1	5	1	97.5

												442.5
TOTAL													88.5

Scale: 1:   5:
             Completely Competely
             Disagree   Agree

Table 3. Quantitative Results.

Statement 1: I would like to use this app a lot. 2 users (40%) answered 5 (completely agree), 3 users (60%) answered 4 (agree).

Statement 2: The app was very difficult to use. 4 users (80%) answered 1 (completely disagree), 1 user (20%) answered 2 (disagree).

Statement 3: The app was easy to use. 3 users (60%) answered 5 (completely agree), 2 users (40%) answered 4 (agree).

Statement 4: The app is too hard for me alone, and I need extra help. 2 users (40%) answered 1 (completely disagree), 1 user (20%) answered 2 (disagree), 1 user (20%) answered 3 (neither agree nor disagree), 1 user (20%) answered 4 (agree). In this answer, the 4 refers to the fact that one of the users did not know how to interact with a desktop computer /laptop, for example, interacting with a mouse.

Statement 5: All História Viva's scenarios worked well together. 3 users (60%) answered 5 (completely agree), 2 users (40%) answered 4 (agree).

Statement 6: Some things did not make sense. 4 users (80%) answered 1 (completely disagree), 1 user (20%) answered 2 (disagree).

Statement 7: Most kids could easily learn to use the program. 2 users (40%) answered 5 (completely agree), 2 users (40%) answered 4 (agree), 1 user (20%) answered 3 (neither agree nor disagree),

Statement 8: The app was difficult for me to use. 4 users (80%) answered 1 (completely disagree), 1 user (20%) answered3 (neither agree nor disagree).

Statement 9: I felt very comfortable/confident using História Viva. 4 users (80%) answered 5 (completely agree), 1 user (20%) answered 4 (agree).

Statement 10: I needed to learn a lot before I could use the app. 4 users (80%) answered 1 (completely disagree), 1 user (20%) answered 2 (disagree).

The average of the SUS is 68 points. If the test yielded results under 68 points, it is an indication that there are usability issues that need to be resolved. Results lower than 60 are not acceptable,

60-70 is ok, 70-80 is good, 80-90 is excellent, and above 90 is the best usability possible (Usabilitytest, 2021). Figure 40 shows a summary of the SUS score and its correlation with an adjective rating.

SUS Score	Letter Grade	Adjective Rating
Above 80.3	A	Exellent
Between 68 and 80.3	B	Good
68	C	OK
Between 51 and 67	D	Poor
Below 51	F	Awful

Figure 40. SUS Score and rating (Usabilitytest, 2021).

In this test, the lowest number 75 from user 1 and the highest is 97,5 from user 5. User 2 scored 85, user 3, 95, and user 4, 90. The total SUS score is 88.5, which according to SUS is excellent. Figure 41 displays a chart that indicates the number of participants (y) and each SUS score numbers (x).
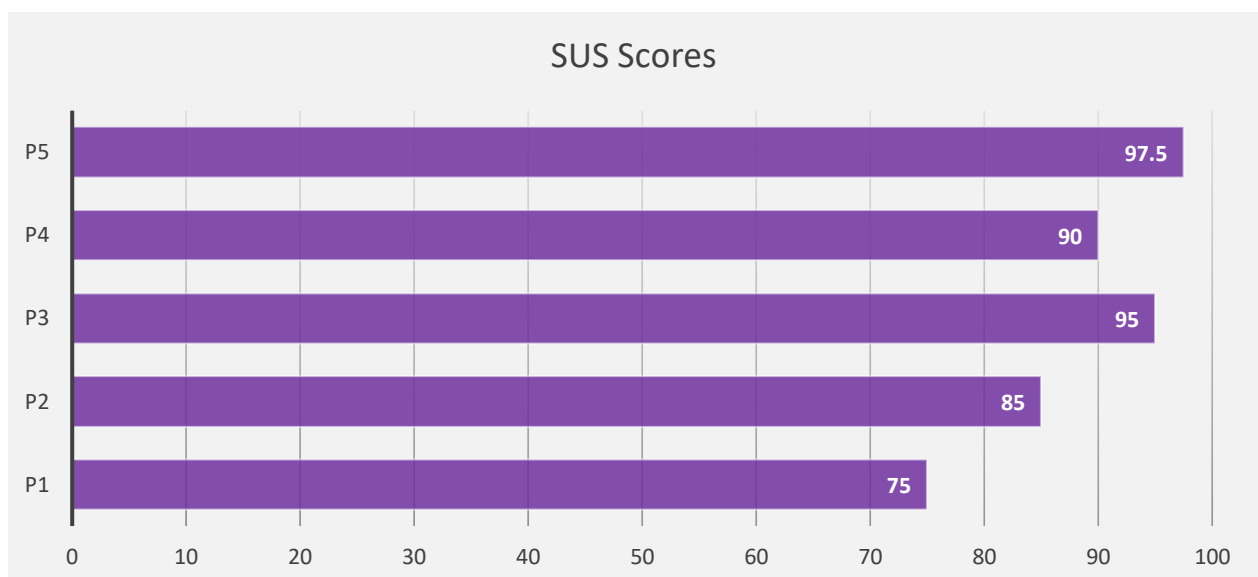

Figure 41. Chart SUS results.

In order to complement the SUS questionnaire and explore the answers of the users, four open questions were asked, and the answers are shown in Table 4.

Open-Ended Questions				
User	What did you like the most when playing with História Viva?	What did you like the least?	Would you repeat the experience?	Is there anything else that you would like the app to have/do?
1	Set the forest on fire. Father: Interactions by drawing	Repeat the drawings [when they were not understood by the program]	Yes!	More scenarios
2	What I liked the most was helping the girl get out of the gourd.	What I liked less was that it was always the same or that there were no levels.	Yes, many times.	Yes, that there were levels.
3	At the time of making the soup because it had animation with chorizo, salt, carrot, stone soup.	There's nothing I didn't like.	Yes, because it was cool, creative and would have more options.	No, because it was all new to me.
4	That she wanted to make stone soup.	Sometimes the drawing is not recognized.	Yes, because you have a lot of possibilities to create history.	Maybe you can choose which soup you would make.
5	The story	Nothing	Yes	One more character

Table 4. Open-ended questions.

The open-end questions provided insights about the design in this experience and it complements the quantitative questionnaire, whereas collecting quantitative data from a low number of participants alone can be misleading (Laubheimer, 2018). Overall, the comments were very positive, and the children were very receptive and entertained by the experience and the story. Frustrations were mostly related to the lack of feedback, delay/misinterpretation of the drawings and the duration of the story itself (they wanted the story to have more levels, characters, possibilities, and so on), which can be also a positive indication that the children wanted to keep interacting with the system. All the children said that they would play again, more times and even purchase it if that was the case. Most users felt that play História Viva is straightforward. The youngest participant thinks that it is difficult to play all by herself since it involves interacting with a desktop computer too. It is interesting to note that all the children in this test were not aware of the *Stone Soup* tale before the interaction.

6. Final Considerations

Folk stories are a part of culture that is passed down from generation to generation. With development of technology, it is important that folk storytelling adapts according to current times, especially when children from today's generation are digitally fluent and attracted by the use of technology in their everyday lives. In this study, the contextual research framed subjects that seemed relevant for this work. Investigating interaction design provided a rich field that explored design, human behavior, and experiences. The research on storytelling allowed the understanding of the different variations of narratives and their representations. In addition, it highlighted the importance of folk storytelling as a traditional form of maintaining social knowledge. Studying similar systems that use sketch-based interactions provided a bibliographical and technical background to the creation of this work's prototype. The in-depth study of these topics provided a holistic view of the current situation regarding the topic, which assisted with the development of a proposition for a system that provides a different take on the interaction in folk storytelling.

This work described the development of an interactive narrative that adapts to the drawings and, also, the process to create an animation based on a Portuguese folk story that served as a creative base for the system, História Viva. This was a challenging project since it required the creation of multiple components, like the branched narrative, the studies for user experience (that involved branding, visual design, interactions by sketching, testing, and so on), and also the design of a frame-by-frame animation to make the sketch-based digital interaction prototype testable. The technical implementation was possible with the participation of Prof. Edirlei Lima.

The design process allowed História Viva to be proposed and the prototype developed. It used methods to better understand people, their behavior, and habits in order to provide to the users with a good experience while interacting with the prototype. The usability tests and interviews provided interesting findings with topics for discussion such as:

1. All the participants of the usability tests did not know the *Stone Soup* tale beforehand. Children are interested in stories and digital era brought access to different forms of entertainment and interaction. In a globalized world, where stories are presented in digital format, children may know more about stories shared by large corporations, such

as Disney, than folk stories passed down from generation to generation that corresponds to a particular local culture.

2. The experience with História Viva was well received. Children wanted to play more to have a longer experience with different stories and characters. The visual design was also highlighted, being complimented by the users while testing as "well done animation" and "I love the colors!" The children were entertained and focused while performing the test.

3. The sketch-based interactions were comfortable to perform and the children would use the system more times. The drawing experience surprised the users when the drawings affected the story, but it could also generate frustration when the system did not recognize the drawings. Children loved to draw the carrot.

4. The system needs to be adjusted, especially where it concerns feedback and constraints.

Folk storytelling can benefit from new forms of interaction, like the use of digital sketches, to present folk stories in a way that might be appealing for children from today's generation. This dissertation can contribute also as a starting point to understand matters that involve folk storytelling and technology. This study allowed the development of a functional sketch-based prototype called História Viva, where children can co-create the story using creativity. Lastly, the article *Sketch-Based Interaction for Planning-Based Interactive Storytelling* (Lima et al., 2020)*,* presented at the 2020 SBGames, is a publication resulting from this work.

6.1 Challenges and Limitations

The few past months presented several challenges that influenced the development of this work. The scope for História Viva changed, from libraries and immigrant children to the final proposition as the COVID-19 pandemic required this project to adapt. The user testing needed to be done remotely which demanded extra effort and help from the parents. The technical requirements (installation of both system and app) and the connection between them resulted in two invalid tests due to the fact that the moderator could not install them correctly, and four others that did not have the operational systems that História Viva requires. One of the

participants was not able to test as they could not sync the app and the system accordingly (technical issues). This frustrated the child as she was very excited to test the system.

6.3 Future Work

There is a great opportunity to continue and develop the complete system for História Viva which shows potential to be entertaining to children and give folk stories a fresher approach. A wide range of participants, from families and their kids to professors and designers, see the potential in this project as a begging to bring folk stories new ways of interaction. While developing this work, other opportunities were presented and are worth mentioning, as they indicate academic potential to be further studied and developed, such as:

1. Immersive experience: To provide a deeper experience, the animation can be projected using different walls of the same environment, in a living room, classroom or even a public library. This form of interaction might have the potential of providing children a richer involvement on the experience for folk storytelling as they are surrounded by the effect that their own drawings created.

2. Participative interaction: In a scenario where children can collaborate with each other in person, the system can be used simultaneously. For example, as the system is projecting the same animation in the classroom walls, children can use different devices to draw and submit their creation. The story will assume and project the object that was sketched by the majority of the children.

3. Diversity studies: In a contemporary scenario, diversity needs to be tackled in order to embrace the different cultures that the participants have. This can correspond to the development of features that allows the user to choose their own language, soundtrack or even building their own main character, letting children to choose their colors, clothes, unique characteristics, and so on. This could provide more engagement and immersive experience to the users.

4. New culture for migrant children: Migrant children face several challenges to integrate in a new culture. The barriers go beyond language and can be difficult for them to adapt.

Folklore storytelling provides a first contact with culture, allowing people, particularly children to engage with cultural imaginative elements. Interactive storytelling allows rich experiences, and It could be a powerful tool in the integration process of migrant children.

7. References

Aarne, A. (1910). *Verzeichnis der Märchentypen*. Suomalaisen Tiedeakatemian Toimituksia.

Alexander, B. (2011). The New Digital Storytelling. Creating Narratives with New Media. *Revista Estudos do Século XX*, *15*, 275–277. https://doi.org/10.14195/1647-8622_15_13

Alsina, P. (2010). From the digitization of culture to digital culture. *Digithum*, *0*(12). https://doi.org/10.7238/d.v0i12.911

Arqueiro, A., Cunha, J., Garbe, C., Lafontaine, D., De, M., Dionísio, L., Shiel, G., Valtin, R., Balbinot, V., Baye, A., Lourdes, M., Dionísio, T., Fischer, C., Géron, S., Kennedy, E., Koikkalainen, M., Kovacs, M., Kristmundsson, G., Lemos, G., … Wiesner, E. (2016). *Literacy in Portugal*. http://www.eli-net.eu/fileadmin/ELINET/Redaktion/user_upload/Portugal_Long_Report.pdf

Ashliman, D. L. (2008). *Aarne-Thompson classification system*. Gutenberg. http://self.gutenberg.org/articles/aarne-thompson_classification_system

Azoulay, A., & Kapferer, J. N. (2003). Do brand personality scales really measure brand personality? *Journal of Brand Management*, *11*(2), 143–155. https://doi.org/10.1057/palgrave.bm.2540162

Babich, N. (2020, March 13). *Usability Testing: Moderated vs Unmoderated*. Medium. https://medium.com/thinking-design/usability-testing-moderated-vs-unmoderated-adbccc37404b

Bamz, J. (1950). *Arte y ciencia del color*. In Las Ediciones De Arte. Ed. Ieda.

Barnett, D. (2017, July 12). British folklore: How the traditional tales are benefiting from modern culture. *The Independent*. https://www.independent.co.uk/news/long_reads/folklore-traditional-tales-benefiting-modern-culture-a7837456.html

Barnum, C. (2011). Usability Testing Essentials. In *Usability Testing Essentials*. Elsevier. https://doi.org/10.1016/b978-0-12-375092-1.00023-4

Barron, C. (2020, November 19). 2020's best children's books. *The Washington Post*. https://www.washingtonpost.com/lifestyle/kidspost/best-childrens-books-of-2020-reveal-a-growing-diversity/2020/11/16/bef29fce-0d63-11eb-8074-0e943a91bf08_story.html

Batterbee, I. (2020, Jan 20). *Norman's seven important questions of user interaction*. UX Collective. https://uxdesign.cc/ux-psychology-principles-seven-important-questions-960579272880

Baxter, K., Courage, C., & Caine, K. (2015). *Understanding your users: a practical guide to user research methods*. Elsevier. https://doi.org/10.1016/B978-0-12-800232-2.00013-4

Bear Skin Digital. (2020, July 13). *Axe Soup.* https://bearskindigital.com/tag/axe-soup/

Ben-Amos, D. (1971). Toward a Definition of Folklore in Context. *The Journal of American Folklore. 84*(331), 3–15.

Blank, T. J., & Bronner, S. J. (2009). *Folklore and the Internet*. Utah State University.

Bona, C., Koslow, L., Frantz, R., Nadres, B., & Ratajczak, D. (2020). *How Marketers Can Win with Gen Z and Millennials Post-Covid-19*. BCG. https://www.bcg.com/publications/2020/how-marketers-can-win-with-gen-z-millennials-post-covid

Braga, T. (2013). *Contos Tradicionais do Povo Português - Volume 1*. Agrupamento de Escolas de Rio de Mouro.

Brooke, J. (2013). The Physiologist. *The Journal of Usability Studies, 8*(2), 29–40.

Brown, M. (1975). *Stone Soup: An Old Tale Retold*. ProsperityPages. http://www.michaelppowers.com/prosperity/stonesoup.html

Brown, T. (2009). *Change by design*. Harper Collins Publishers.

Button Soup. (2020). In *Disney Wiki.*. https://disney.fandom.com/wiki/Button_Soup

Cai, Y., Miao, C., Tan, A. H., & Shen, Z. (2007). A hybrid of plot-based and character-based interactive storytelling. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *4469 LNCS*, 260–273. https://doi.org/10.1007/978-3-540-73011-8_27

Carroll, L. (2000). *Alice's adventures in wonderland* (V.1.2). Penguin Publishers.

Cavazza, M., Charles, F., & Mead, S. J. (2002a). Character-Based Interactive Storytelling. I*EEE Intelligent Systems, 17*(4), 17–24.

Cavazza, M., Charles, F., & Mead, S. J. (2002b). Emergent situations in interactive storytelling. *Proceedings of the ACM Symposium on Applied Computing*, 1080–1085. https://doi.org/10.1145/508998.509003

Cavazza, M., Charles, F., & Mead, S. J. (2002c). Interacting with Virtual Characters in Interactive Storytelling. *IEEE Intelligent Systems*, *17*(4), 17–24. http://dx.doi.org/10.1109/MIS.2002.1024747

Celik, M., Dimova, V., & Ivanovska, B. (2012). Motives for Socialization, Sociability and other Positive Characteristics in Children's Stories. *Procedia - Social and Behavioral Sciences*, *46*, 22–25. https://doi.org/10.1016/j.sbspro.2012.05.060

Cooper, A., Reimann, R., & Cronin, D. (2007). About Face 3: The essentials of interaction design. *Information Visualization, 3*(3).

Cox, S. (2005). Intention and meaning in young children's drawing. *International Journal of

Art and Design Education, *24*(2), 115–125. https://doi.org/10.1111/j.1476-8070.2005.00432.x

Dexheimer, J. W., Kurowski, B. G., Anders, S. H., McClanahan, N., Wade, S. L., & Babcock, L. (2017). Usability evaluation of the SMART application for youth with mTBI. *International Journal of Medical Informatics*, *97*, 163–170. https://doi.org/10.1016/j.ijmedinf.2016.10.00

Druin, A., Stewart, J., Proft, D., Bederson, B., & Hollan, J. (1997, March). *KidPad: a design collaboration between children, technologists, and educators.* Paper presented at the ACM SIGCHI Conference on Human factors in computing systems, Atlanta, Georgia, USA. https://doi.org/10.1145/258549.25886

Dundes, A. (1969). *Folklore as a Mirror of Culture. The National Council of Teachers of English (NCTE)*, 46(4), 471-482.

Elnahla, N. (2019). Black Mirror: Bandersnatch and how Netflix manipulates us, the new gods. *Consumption Markets and Culture*, *0*(0), 1–6. https://doi.org/10.1080/10253866.2019.1653288

Enginess. (2014, Nov 3). *The 6 Principles Of Design, a la Donald Norman*. https://www.enginess.io/insights/6-principles-design-la-donald-norman

Evangelista, C., Neri, V., Bergamasco, M., & Carrozzino, M. (2009, March). *Interactive storytelling for children education.* Proceedings of the 2009 Conference in Games and Virtual Worlds for Serious Applications (VS-GAMES 2009), Coventry, UK (pp. 198–201). https://doi.org/10.1109/VS-GAMES.2009.22

Ferguson, D. (2020, Feb 29). Children are reading less than ever before, research reveals. *The Guardian*. https://www.theguardian.com/education/2020/feb/29/children-reading-less-says-new-research

Fountain, C. (2020, July 17). *Heroines and Heroes: Why Children's Literature Needs More Female Protagonists*. Redbrick. https://www.redbrick.me/heroines-and-heroes-why-childrens-literature-needs-more-female-protagonists/

Franco, T. C., & Lima, E. S. (2017). Paper and Pencil Interactive Storytelling Based on Generic Hand-drawn Sketches. *Computacao,* 594–597. http://www.sbgames.org/sbgames2017/papers/COMPUTACAO/SHORT_PAPERS/174585_2_versao_preliminar.pdf

Franzese, A. (2020, October 17). *Gen Z and Millennials now more likely to communicate with each other digitally than in person*. PR Newswire. https://www.prnewswire.com/news-releases/gen-z-and-millennials-now-more-likely-to-communicate-with-each-other-digitally-than-in-person-300537770.html

Gamejam. (2020). *Draw Story!* [Mobile Application Software]. https://apps.apple.com/us/app/draw-story/id1448231207

Garzotto, F. (2014). Interactive storytelling for children: A survey. *International Journal of*

Arts and Technology, *7*(1), 5–16. https://doi.org/10.1504/IJART.2014.058940

Gasek, T. (2012). *Frame-by-Frame: A guide to non-traditional animation techniques*. https://doi.org/10.1016/b978-0-240-81728-6.00016-6

Gero, J. S. (1990). Design prototypes. A knowledge representation schema for design. *AI Magazine*, *11*(4), 26–36.

Geronimo, C., Jackson, W., & Luske, H. (Directors). (1951). *Alice in Wonderland*. [Motion Picture]. United States: Disney.

Ghallab, M., Nau, D., & Traverso, P. (2004). *Automated Planning: Theory and Practice*. Morgan Kaufmann Publishers.

Google creative lab. (2021). *Quick Draw Dataset.* Google. [Online Game Data Set]. https://github.com/googlecreativelab/quickdraw-dataset

Haäfe, D. E., & Haph, J. V. (2012). *Digital Goods for the Design Community*. Haäfe & Haph. http://haafe.com/

Hagbi, N., Grasset, R., Bergig, O., Billinghurst, M., & El-Sana, J. (2014). In-place sketching for augmented reality games. *Computers in Entertainment*, *12*(3). https://doi.org/10.1145/2702109.2633419

Handler Miller, C. (2004). *Digital Storytelling: A Creator's Guide to Interactive Entertainment*. (6th ed.). CRC Press.

Hartson, R., & Pyla, P. (2012). *The UX BOOK*. Elsevier.

Hunt, P. D. (2020). *Source Sans Pro.* Google Fonts. https://fonts.google.com/specimen/Source+Sans+Pro#about

IMT, Interactive Media Foundation. (2020). *Opera Maker*. https://interactivemedia-foundation.com/en/projects/opera-maker/

IxDF, I. D. F. (2020a). *What is Interaction Design?* Interactive Design Foundation. https://www.interaction-design.org/literature/topics/interaction-design

IxDF, I. D. F. (2020b). *What is User Centered Design?* Interactive Design Foundation. https://www.interaction-design.org/literature/topics/user-centered-design

Jhala, A., Rawls, C., Munilla, S., & Young, R. M. (2008). *Longboard: A sketch based intelligent storyboarding tool for creating machinima*. Proceedings of The 21 International Florida Artificial Intelligence Research Society Conference, Cococnut Grove, Florida, USA (pp. 386–391). https://www.researchgate.net/publication/221438955_Longboard_A_Sketch_Based_Intelligent_Storyboarding_Tool_for_Creating_Machinima

Joyce, A. (2019). *Usability Testing with Minors: 16 Tips*. NN Group. https://www.nngroup.com/articles/usability-testing-minors/

Kate, D.-S., & Pascoe, C. (2013). *Children, childhood and cultural heritage Mapping the field*. E Book Central. http://ebookcentral.proquest.com/lib/cuhk-ebooks/detail.action?docID=1101423

Kientz, J.A., Anthony, L., & Hiniker, A. (2020). *Playful Interfaces: Designing Interactive Experiences for Children User Experience Magazine*. UXPA Magazine. https://uxpamagazine.org/playful-interfaces/

Kim, H.-H., Jinsil Hwaryoung, S., Taele, P., & Jeffrey Liew. (2016, May). EasySketch 2 : A novel sketch-based interface for improving children's fine motor skills and school readiness. *Eurographics*, 69–78. https://www.researchgate.net/publication/303268432

Kim, H. H., Taeley, P., Valentinez, S., Mctiguex, E., & Hammond, T. (2013). KimCHI: A sketch-based developmental skill classifier to enhance pen-driven educational interfaces for children. *Proceedings - Sketch-Based Interfaces and Modeling, SBIM 2013 - Part of Expressive*, 33–42. https://doi.org/10.1145/2487381.2487389

Kolko, J. (2011). Thoughts on Interaction Design: Second Edition. In *Thoughts on Interaction Design.* (2nd ed.). https://doi.org/10.1016/C2009-0-61348-9

Kulturkemi (2020). *Nail Soup - traditional swedish folk-tale*. http://hem.fyristorg.com/kulturkemi/net/soup.htm

Laubheimer, P. (2018). *Beyond the NPS: Measuring Perceived Usability with the SUS, NASA-TLX, and the Single Ease Question After Tasks and Usability Tests*. https://www.nngroup.com/articles/measuring-perceived-usability/

Lazar, T., & Stephen, B. (2016). *Normal Norman*. Sterling Publishing.

Lebowitz, J., & Klug, C. (2011). *Interactive Storytelling for Video Games*. Routledge.

Lecun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature*, *521*(7553), 436–444. https://doi.org/10.1038/nature14539

Leitura, P. N. de. (2018). *Rede de Bibliotecas de Lisboa*. http://catalogolx.cm-lisboa.pt/ipac20/ipac.jsp?session=&profile=pnl2027&source=~!rbml&view=subscription summary&uri=full=3100024~!458630~!1&ri=3&aspect=subtab11&res=298&menu=search&ipp=1&spp=1&staffonly=&term=moutinho&index=.GW&uindex=&menu=search&ri=3

Lima, E. E. S. de. (2014). *Video-Based Interactive Storytelling*. *August*: Proceedings of the 2012 I.E. International Conference on Multimedia and Expo (ICME), Melbourne, Australia (pp. 806-811). https://link.springer.com/article/10.1007/s11042-017-4423-5

Lima, E. S., Feijó, B., Barbosa, S. D. J., Furtado, A. L., Ciarlini, A. E. M., & Pozzer, C. T. (2014). Draw your own story: Paper and pencil interactive storytelling. *Entertainment Computing*, *5*(1), 33–41. https://doi.org/10.1016/j.entcom.2013.06.004

Lima, E. (2021). *Introduction to Narratives and Interactive Storytelling*.
https://edirlei.com/aulas/is/IS_Lecture_01_Interactive_Storytelling_2018.html

Lima, E., Gheno, F. J., & Viseu, A. (2020). *Sketch-Based Interaction for Planning-Based Interactive Storytelling: Proceedings of SBGames 2020* (pp. 348–356).
https://edirlei.com/papers/Edirlei_Sketch_SBGames_2020.pdf

Liu, F. (2018). *Design for Kids Based on Their Stage of Physical Development*.
https://www.nngroup.com/articles/children-ux-physical-development/

Lua. (2020). About. https://www.lua.org/about.html

Magerko, B. (2005). *Story representation and interactive drama.* Proceedings of the 1st Artificial Intelligence and Interactive Digital Entertainment Conference (AIIDE), Marina del Rey, Califormia, USA (pp. 87–92).
https://www.researchgate.net/publication/220978440_Story_Representation_and_Interactive_Drama

Markopoulos, P., & Bekker, M. (2002). How to compare usability testing methods with children participants. *Technology*, 153–159.
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.112.7442&rep=rep1&type=pdf

Marks, R.B. (2018). *Essential Facts.* ESA. 17. The Entertainment Software Association.

Matos, J. M. da C. (2015). *Modelo de Aplicação Digital Para Crianças Entre Os 2 e Os 4 Anos com Implicação na Educação*. (Master's Thesis).
https://comum.rcaap.pt/bitstream/10400.26/18315/1/jose_matos.pdf

Meirelles, M., & Meneghel, B. (2002). *Era Uma Vez - Sopa de Pedra - Xuxa No Mundo da Imaginação.* [Video]. Youtube. https://www.youtube.com/watch?v=u8VLbgDqbEs

Menegazzi, D., Sylla, C., & Padovani, S. (2018, Jul). *A Preliminary Study of Interactivity on Visual Narrative in Children's Story Apps Digital Picturebooks Research View project Visual Identity Design View project A Preliminary Study of Interactivity on Visual Narrative in Children's Story Apps*. Paper presented at the International Conference on Ilustration & Animation, Barcelos, Portugal.
https://www.researchgate.net/publication/328163941_A_Preliminary_Study_of_Interactivity_on_Visual_Narrative_in_Children%27s_Story_Apps

Modesto, F., Perez, C., & Bastos, D. (2006). *Psicodinamica das cores em comunicação*.
Edgard Blücher.

Moutinho, J.V. (2003). *Lendas de Portugal*. Diário de Notícias.

Moutinho, J.V. (2014). *À Lareira I*. Círculo de Leitores.

Moutinho, J.V. (2017). *Seis Histórias Tradicionais Portuguesas*. Fábula.

Muñoz, J., Marchesoni, M., & Costa, C. (2012). i-Theatre: Tangible interactive storytelling.
Lecture Notes of the Institute for Computer Sciences, Social-Informatics and

Telecommunications Engineering, *78 LNICST*, 223–228. https://doi.org/10.1007/978-3-642-30214-5_26

Nielsen, J. (2012a, June 3). *How Many Test Users in a Usability Study?* NN Group. https://www.nngroup.com/articles/how-many-test-users/

Nielsen, J. (2012b, January 15). *Thinking Aloud: The #1 Usability Tool*. NN Group. https://www.nngroup.com/articles/thinking-aloud-the-1-usability-tool/

Norman, D. (2003). The Design of Everyday Things. *The Design of Everyday Things*. Beck-e Library. https://doi.org/10.15358/9783800648108

Norman, D. (2013). *The Design of Everyday Things*. Basic Books.

Opera Maker. (2020). [Mobile Application Software]. http://opera-maker.de/en/

Owen, T. (2014, June 30). *Understanding Folk Culture in the Digital Age: An interview with Folklorist Trevor J. Blank, Pt. 1*. Library of Congress. https://blogs.loc.gov/thesignal/2014/06/understanding-folk-culture-in-the-digital-age-an-interview-with-folklorist-trevor-j-blank-pt-1

Paulson, B., Eoff, B., Wolin, A., Johnston, J., & Hammond, T. (2008). *Sketch-based educational games*. Proceedings of the 7th International Conference on Interaction Design and Children, IDC 2008, Chicago, Illinois (p. 133). https://doi.org/10.1145/1463689.1463739

Putnam, C., Puthenmadom, M., Cuerdo, M. A., Wang, W., & Paul, N. (2020, June). *Adaptation of the system usability scale for user testing with children*. Proceedings of the Conference on Human Factors in Computing Systems, Honolulu, Hawaai, USA (pp. 1–7). https://doi.org/10.1145/3334480.3382840

Quick, Draw! (2021). Google. [Online Game]. https://quickdraw.withgoogle.com/

Rekhi, S. (2017, January 23). *Don Norman's Principles of Interaction Design*. https://medium.com/@sachinrekhi/don-normans-principles-of-interaction-design-51025a2c0f33

Roettgers, J. (2018, December 18). *Black Mirror Bandersnatch: Netflix's First Interactive Movie for Adults*. Variety. https://variety.com/2018/digital/news/netflix-black-mirror-bandersnatch-interactive-1203096171/

Rubel, W. (2015). *History of the Stone Soup Folktale from 1720 to Now*. Stone Soup. https://stonesoup.com/about-the-childrens-art-foundation-and-stone-soup-magazine/history-of-the-stone-soup-story-from-1720-to-now/

Rubin, J., & Chisnell, D. (2008). *Handbook of Usability Testing* (2nd ed.). Elsevier.

Russell, C. (2017, March 25). *Frame-by-Frame Animation*. Adobe Press. https://www.adobepress.com/articles/article.asp?p=2755709&seqNum=14

Salazar, K. (2020, March 22). *7 Ways to Analyze a Customer-Journey Map*. NN Group. https://www.nngroup.com/articles/analyze-customer-journey-map/

Schoonenboom, J., & Johnson, R. B. (2017). Wie man ein Mixed Methods-Forschungs-Design konstruiert. *Kolner Zeitschrift Fur Soziologie Und Sozialpsychologie*, *69*, 107–131. https://doi.org/10.1007/s11577-017-0454-1

Sherwin, K., & Nielsen, J. (2019, January 13). *Children's UX: Usability Issues in Designing for Young People*. NN Group. https://www.nngroup.com/articles/childrens-websites-usability-issues/

Shuter, G. (2020, October 12). *Frame-By-Frame Animation: A Complete Guide*. Twine Blog. https://www.twine.fm/blog/frame-by-frame-animation-complete-guide/

Sideris, A. (2003). *Cultural Heritage and Digitalization*. Imeros. http://www.ime.gr/publications/print/imeros/en/03/index.html

Silver, K. (2007). *What Puts the Design in Interaction Design*. UX Matters. https://www.uxmatters.com/mt/archives/2007/07/what-puts-the-design-in-interaction-design.php

Smed, J., Suovuo, T., Trygg, N. B., & Skult, P. (2019, March). *Lecture Notes on Interactive Storytelling*. Turku Centre for Computer Science.

Smith, G. (2006) in Moggridge, B. *Designing Interactions*. The MIT Press.

Smyk, A. (2014, January 25). *Design Considerations for Little Fingers*. UX Collective. https://uxdesign.cc/design-considerations-for-little-fingers-ad2a19ed3816

Soloaga, C., & Marotta, Y. (2020). *Folclore Digital*. VJ Suave. https://vjsuave.com/projects/folclore-digital/?lang=pt-br

Spencer, D. (2009). *Card sorting - Designing usable categories*. Rosenfield Media.

Stal, S. ter. (2017). *Designing an Interactive Storytelling System for Children Using a Smart Toy. Design of a prototype to investigate the effect of emotional behaviour of a toy on children's storytelling*. Human Media Interaction | University of Twente.

Steve, K. (2000). *Don't Make Me Think! A Common Sense Approach to Web Usability*. Verlags GmbH & Co. KG.

Sukhraj, R. (2019, January 2). *Bandersnatch Is a Must-See Case Study in the Future of Content Creation*. Impact. https://www.impactbnd.com/blog/bandersnatch-future-of-content-creation

Sutherland, I. E. (2003). *Sketchpad: A man-machine graphical communication system*. Masachusettes Institute of Technology.

Sylla, C., Coquet, M. E., Branco, P., & Coutinho, C. (2009, April). *Storytelling through drawings: Evaluating tangible interfaces for children*. Proceedings of the Conference on

Human Factors in Computing Systems, Boston, USA (pp. 3461–3466). https://doi.org/10.1145/1520340.1520503

System Usability Scale (SUS). (2020). https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html

Teixeira, F. (2015). *O que é o SUS (System Usability Scale) e como usá-lo em seu site*. UX Collective. https://brasil.uxdesign.cc/o-que-é-o-sus-system-usability-scale-e-como-usá-lo-em-seu-site-6d63224481c8

Thompson, E. (2001). *Felicity Wishes: Friendship and Fairy School*. Hodder's Children's Books.

Thompson, S. (1977). *The Folktale*. University of California Press.

Törőcsik, M., Szűcs, K., & Kehl, D. (2014). How generations think : Research on generation Z. *Acta Universitatis Sapientiae, Communicatio*, *1*, 23–45.

Travis, D., Hodgson, P., & Higgins, A.-G. (2011). *Bright ideas for User Experience Researchers*. Userfocus.

Tullis, T., & Albert, B. (2013). *Measuring The User Experience*. Morgan Kuffman. https://doi.org/https://doi.org/10.1016/C2011-0-00016-9

Tykwer, T. (Director). (1999). *Run Lola Run*. [Motion Picture]. Germany: Prokino Filmverleih.

Usabilitytest. (2021). *System Usability Scale online with analytics*. usabili TEST. https://www.usabilitest.com/system-usability-scale

Vitsky. (2019, December 27). *The Comprehensive 8pt Grid Guide*. Medium. https://medium.com/swlh/the-comprehensive-8pt-grid-guide-aa16ff402179

Vogelsang, A., & Signer, B. (2005). The Lost Cosmonaut: An interactive narrative environment on the basis of digitally enhanced paper. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *3805 LNCS*, 270–279. https://doi.org/10.1007/11590361_31

Wang, D., He, L., & Dou, K. (2014). StoryCube: Supporting children's storytelling with a tangible tool. *Journal of Supercomputing*, *70*(1), 269-283. https://doi.org/10.1007/s11227-012-0855-x

Wikipedia (2020). *Stone Soup*. https://en.wikipedia.org/wiki/Stone_Soup

Williford, B., Runyon, M., Cherian, J., Li, W., Linsey, J., & Hammond, T. (2019). A Framework for Motivating Sketching Practice with Sketch-based Gameplay. *CHI PLAY 2019 - Proceedings of the Annual Symposium on Computer-Human Interaction in Play*, 533–544. https://doi.org/10.1145/3311350.3347175

Appendix A: Exploratory Survey: Children

Survey: Children											
Participant	1.Gender	2. How old are you?	3. Do you like stories?	4. What do you prefer?	5.Which one is your favorite story?	8.If yes, which one?	9. Do you enjoy going to the public library?	10. Why	11. Which technological devices you use daily?	12. How would you like to interact with a folk story where your interactions would affect the tale itself?
1	male	7	Yes	Listen and Read the stories	Felicity Wishes: Friendship and Fairy School (Thompson, 2001),	Cuquedo	Yes	Because I like reading and listening to the stories	TV, tablet and mobile phone	I would like very much.
2	female	10	Yes	Listen to stories	Red Riding Hood	A biblioteca é uma casa onde cabe toda a gente	Yes	My mom works there	TV, mobile phone	I would like very much.
3	female	10	Yes	Listen and Read the stories	This is me! (Waechter, 2004)	O pé molhado	Yes	Lots of different stories and it is cool to read	TV	I would like very much.
4	female	12	Yes	Listen and Read the stories	Beauty and the beast	O Principezinho	No	I heve TLM	Tablet	I would like very much.

Table 5. Exploratory Survey: Children's questions and answers.

Survey: Parents													
Participant	1.Gender	2. How old are you?	3. Where do you live?	4. What is your profession?	5.What is your formal education level?	6.How important is storytelling for kids?	7. Do you read stories for you kids?	8. In what situation?	9. How often?	10. What is the story you like the most?	11. What is the story your kids like the most to hear?	12. Which one is the most wellknown portuguese folk story?	13. What technology device you use daily?	14. How would your kids to interact with a folk story where your interactions would affect the tale itself?
1	male	41-50	Lisbon - Portugal	Teacher	Masters	Very important	Yes	Bedtime	Daily	Gretel and Hansel	Red Riding Hood	Pedro e o lobo	Mobile Phone, laptop, desktop	I would like very much.
2	Male	31-40	Lisbon - Portugal	Architect	Bachelour	Very important	Yes	Bedtime	1-3 times a week	Fernão Caipelo Gaiota,	Beauty and the beast	O principezinho	Mobile Phone, tablet, laptop	I would like very much.
3	female	31-40	Xanxerê - Brazil	Teacher	Post-Graduation	Very important	Yes	Everyday	Daily	Funny tales	Commic stories	I don´t know that many	Mobile Phone, laptop,	I would like very much.
4	female	41-50		Interior Designer	Masters	Important	Yes	Bedtime	1-3 times a week		Three little piglets	Three little piglets	Mobile Phone, tablet, laptop	I would like very much.
5	male	41-50	Camarate - Portugal	Technical Assistant	Basic	Important	Yes		Rarely	My grandparent's		There are lots	Mobile Phone, desktop	I would not like or dislike
6	Female	31-40	Lisbon - Portugal	Librarian	PHD	Very important	Yes	Freetime / Bedtime	Daily	Cuquedo	Cuquedo	Corre corre cabacinha	Mobile Phone, desktop	I would not like or dislike
7	female	41-50		Businesswoman	Pos-Doc	Important	Yes	Bedtime	Rarelly	Amendoeiras em flor	Uma casa na Lua	Pedro e Inês	Mobile Phone, tablet, laptop	I would like very much.
8	female	41-50	Almada - Portugal	TAS (Health technitian)	Bachelour	Very important	Yes	Anytime	Daily	Children´s tales	Polegarzinha	História da Carochinha	Mobile Phone, laptop,	I would like very much.

Table 6. Exploratory Survey: Parents' questions and answers.

Appendix B: The Stone Soup (Original Story)

Once upon a time, a friar was walking around the world, getting to know lands and people, and preaching sermons. But, between the convents he visited, there were roads that went up and down hills and hills, which made him very tired. It was time to ride a horse or walk.

And he walked on foot, wearing good sandals.

As you know, walking a lot ends up getting tired and gives one of those hungers! Yes, but exercise is also great!

One day, the friar still walked more than usual, ending up sitting by a well, at the foot of an isolated house, right in the middle of a forest clearing. He could hardly speak, poor thing!

The owner of the house was at the window and, when he saw the friar, asked him:

- Good afternoon, sir friar, what are you doing here?

He saw the poor traveler tired, but it is true that he felt no pity for him. In order not to have to put up with anyone, he had built the house on that site.

- I'm on my way to a convent that is a little beyond those hills. Yesterday I got lost and my lunch was over. I'm not even able to walk anymore. I am tired and very hungry!

That said, the friar began to drink the water from a cauldron. The owner of the house spoke with total indifference:

- I'm sorry. I'm really sorry for you.

But he did not decide to give her a piece of bread.

Then the friar, sated with water, added:

- Well, if you'll excuse me, I'll make a stone soup right here ...

While the owner of the house opened his eyes wide in amazement, the friar immediately started looking for a stone on the floor.

That stone was not too big, the other not because it was too small, until he finally chose an egg-shaped pebble and washed it very well.

And the owner of the house, interested in the soup, left the window and came to the door, willing to learn how to cook that bizarre dish.

As the friar asked to borrow a pot, the landlord went to fetch it from the kitchen as the friar started to make a small fire.

The pot came and the friar filled it with water, putting it on the fire.

- Just let it boil ... - said the friar, putting the stone in the pot.

The owner of the house was very surprised:

- And this is really for eating, sir friar?

"It will be soon," he replied. He looked at the pot where the water started to boil. - Isn't there a little bacon around to help taste?

Curious about the recipe, the man took another leap into the kitchen and brought back the bacon. And then the friar spoke:

- Do you know what could make this even better? - And the friar rubbed his hands.

- What?

- Some cabbage leaves ...

- Here you go ... - said the landlord´s wife, who had just arrived from the vegetable garden and was carrying a basket of cabbages on her arm.

The friar kept an eye on the pot.

- Now a pinch of salt would give it a touch!

They brought him salt.

The friar tasted the soup. Then, looking sideways at the lady of the house, he commented:

- There is one thing lacking, my lady!

And the owners of the house, at the same time, asked:

- What you mean?

- Well, a few slices of sausage ... or chorizo!

And the owner of the house, who had not wanted to help the friar when he asked, went to the smokehouse to get a nice chorizo. He was filled with curiosity!

The friar barely laid his hand on the sausage, tossed it into the pot, exclaiming:

- This stone soup is getting great! It just needs a drizzle of olive oil. Can you lend me some, please?

After pouring the oil, the soup was done. Without having to ask, the lady of the house went to get a spoon so that the friar could eat.

When the soup was over, the friar wiped his mouth on his habit sleeve. Then he got up and went to wash the pot and spoon. He was also careful to rinse the stone with water and put it in his bag.

- Oh, lord friar - called the owner of the house, when he was handing the utensils to his lady.

- Yes?

- And the stone?

- Yes?

- Don't you eat it? Guard it?

- Look, do you know anyone who eats stones?

- Not really ... But what is it for?

- Now, I save it for the next time I find a fool like you, who has no pity for a poor friar ...

And the friar left, laughing at the face the owner of the house had made.

(J. V. Moutinho, 2017) translated by the author.

Appendix C: The Stone Soup (Script)

INTRO

Ana is a very curious, smart and courageous girl. One day, during one of her adventures, she was walking in the middle of the forest when she got lost.

[Ana] - I hear wolves! I need to hide! I'm going to get into that gourd ...

- Damn it! I got stuck! I cannot get out of here...

- Need help! Can you draw something for me to cut the gourd?

- I could cut the gourd with a KNIFE or SCISSOR.

- Something sharper like a SWORD or an AX would also help.

- Now I'm free and safe, but it's too dark! I cannot see anything!

- Can you design something to light my path?

- I could see if the path was lit by the SUN ...

- I would also be able to see with the help of a FIREPLACE, a CANDLE or PHOSPHORES.

VILLAGE

[Ana] - Now I can see! There's a village ahead! I am very hungry! I'll see if I can find something to eat there.

- Hello Mr. Friar, how are you? I got lost in the forest and I'm hungry. Don't you have something for me to eat?

[Friar] - Should I help this unknown traveling girl?

- I could offer you something like a CARROT ... (YES, Indoor Scene):

[Scene inside the house]

[Friar] - Sure, let's go in. I must have one or two ingredients ...

[Ana] - That's enough for a good stone soup!

[Friar] - Stone soup?

[Ana] - Don't you know what a stone soup is?

[Friar] - No ... I'm curious to know how it is!

[Ana] - First I put the stone

[Ana] - If I had a little piece of it, the broth would pop ...

[Friar] - Here it is! I have a piece

[Ana] - Great! I'll add it to the broth

[Ana] - There is still a little salt ...

[Friar] - Here it is! I have a little

[Ana] - Great! I'll add it to the broth

[Ana] - With a carrot it would be a treat

[Friar] - Here it is! I have one...

[Ana] - Good! I'll add it to the broth

[Ana] - It would be perfect if we added a bit of chorizo ...

[Friar] - Here it is!

[Ana] - Great!

[Ana] - It's ready! Let's eat?

[Friar] - Of course! It smells really good.

[Friar] - It was delicious! But now what we do with the Stone

[Ana] - The stone can be with you, as a symbol of gratitude for helping an unknown traveller.

[Ana] - With it you can make many broths from the stone.

Or give her a STONE so she can leave soon ...

[Scene away from home]

[Friar] - May God help you, my daughter ...

[Ana] - This friar is very handsome! Well, I have no alternative but to make a stone broth in the pot outside.

[Frade] - Um ... Caldo de Pedra? This one I want to see!

Repeat making the soup from the previous scenario until "It's ready ..."

[Friar] - It smells really good! But now what are you going to do with the Stone?

[Ana] - The stone I take with me to the next broth

FOREST

[Ana] - Oh my god! It's on fire! Our Lady help me!

[Lady] - Watch out my daughter, don't play with fire!

[Lady] - I'm going to put out the fire and put some torches along the forest to guide your way.

[Ana] - Thank you!

[Ana] - Now I can see! There's a pan ahead! I will make a stone soup.

TRAVELER

[Traveller] - Hello, I was passing by. I couldn't help hearing that you are preparing a stone broth.

[Traveller] - Do you need any ingredients?

REPEAT PREPARATION MODE SOUP PREVIOUS SCENARIO SINCE If I had a little piece of it, the broth would be ...

[Traveller] - But now what do we do with the Stone?

[Ana] - The stone can be with you, as a symbol of gratitude for helping an unknown traveller.

[Ana] - With it you can make many broths from the stone.

WEREWOLF

[Werewolf] - Don't be afraid, girl. I'm a good werewolf.

[Werewolf] - Many people have already helped me, so I always bring some food with me to help travellers on nights with a full moon.

[Werewolf] - Do you need any ingredients for the stone broth?

[Ana] - Should I trust this wolf?

[Ana] - I could ask you for something like a CARROT to add to my soup ...

REPEAT PREPARATION MODE SOUP PREVIOUS SCENARIO SINCE If I had a little piece of it, the broth would be ...

[Werewolf] - This stone soup is miraculous! I became a man again!

OR

[Ana] - Or make the soup using only STONE ...

[Ana] - I'm sorry, but I don't trust wolves!

[Werewolf] - Okay. May God help you my daughter ...

[Ana] - Our Lady help me again! I'm hungry and I need ingredients ...

REPEAT PREPARATION MODE SOUP PREVIOUS SCENARIO SINCE If I had a little piece of it, the broth would be ...

[Lady] - And now that you've eaten, what are you going to do with the Stone?

[Ana] - I would give the stone to you, as a symbol of gratitude, but as you are a saint, I imagine that you will not need it ...

[Ana] - Then I take the stone with me to the next broth!

Appendix D: Terms of Consent

Consent & Recording Release Form (Minor)

I agree to allow my child to participate in the usability study conducted and recorded by Felipe Gheno, for a Master's dissertation at IADE, Creative University.

I understand and consent to the use and release of the recording by Felipe Gheno. I understand that the information and recording are for research purposes only and that my child's name and image will not be used for any other purpose. I relinquish any rights to the recording and understand the recording may be copied and used by Felipe Gheno without further permission.

I understand that participation in this usability study is voluntary and I agree to immediately raise any concerns or areas of discomfort my child or I might have with the study administrator.

Please sign below to indicate that you have read, and you understand the information on this form and that any questions you might have about the session have been answered.

Date: _____

Child's name: _____ _

Please print your name: _____

Please sign your name: _____

Thank you!

Appendix E: Questionnaire

For each of the following statements, please mark one box that best describes your reactions to História Viva, from 1 (strongly disagree) to 5 (strongly agree):

Statement 1: I think that I would like to use this system frequently

Statement 2: I found the system unnecessarily complex

Statement 3: I thought the system was easy to use

Statement 4: I think that I would need the support of a technical person to be able to use this system

Statement 5: I found the various functions in this system were well integrated

Statement 6: I thought there was too much inconsistency in the system

Statement 7: I would imagine that most people would learn to use this system very quickly

Statement 8: I felt the system was cumbersome to use

Statement 9: I felt very confident using the system

Statement 10: I needed to learn a lot of things before I could get going with this system

Open-ended questions:

1. What did you like the most when playing with História Viiva?
2. What did you like the least?
3. Would you repeat the experience?
4. Is there anything else that you would like the app to have/do?

Appendix F: Email Instructions

Hi!

My name is Felipe and I'm completing a Master's degree in Interaction Design at IADE. I would really appreciate your participation in this test. As you probably already know, this test aims to verify the usability for an interactive system that uses an animation based on a folk story called *Stone Soup*. História Viva is an interactive storytelling system that allows children to interact with the story by drawing. You will need a desktop computer with a Windows operational system and a mobile or tabled device that runs Android. Please download the files from the links bellow to access História Viva. The setup process will involve 6 quick steps. You will install the system on your computer and an app on your mobile/tablet device. Don't worry, both are safe, and you can download and install with no issues, even if your operational systems indicate that is from unsecured sources. This is with regards to the fact that both systems were developed by us and safely put into our own servers. These systems will not copy any data or have other access to your devices. Ideally, we would have a call with a shared screen of the story. Ready?

Important: Before you start, ensure that the computer and the mobile phone are connected to the same wi-fi network. Let's go!

1. Please download the system that you will install on the computer (windows): https://edirlei.com/HistoriaViva.zip

2. When opening the program for the first time in Windows, it is mandatory to confirm and grant access to the firewall (a window will appear asking for confirmation when opening the program for the first time);

3. Please download the app that you will install on your mobile device (Android): https://edirlei.com/HistoriaVivaSketchApp.apk

4. To install the app on Android, go into the settings and release the installation of apps from unsecured sources.

5. To connect the interaction app to the system, open the system on the computer first and wait for the IP address to appear below the start button. Then, open the app and enter the IP address to connect.

6. Once app connects, the narrative will start. If it doesn't start, it means that the IP address was typed wrong, or the app and the system are not on the same wi-fi network, or the firewall was not opened, or there is some restriction on the wi-fi network.

Attached, please find the terms of consent (attach form and reply to me). Don't worry, this is for academic purposes and will only be used in this study. With your consent, I would like to record the session (the desktop screen only) and I would ask your help to get another phone, if possible, and record only the hand (no face is necessary) and the desktop at the same time.

The test can be scheduled for dd/mm/yy.

Also, for this test, I need your help being the moderator. This means that you need to record the section with a second phone or tablet, while your kid draws on the mobile and their actions takes place on the desktop's animation. This usability test involves the user speaks aloud as they perform the tasks. It is important to understand if they experience any difficulties and their thought processes while playing História Viva.

Great! So, now we are almost done. Please provide your help one last time to evaluate this system. Please access the link so that your child can rate the experience.

https://forms.gle/nNKrcQJtc2DbCjaHA

They need to click 1 to 5. 1 means that they strongly disagree and 5 means that they strongly agree. It will be explained better once the form is opened.

Thanks for your help!