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# The use of serious digital games to talk about grief and finitude with children: reports on the design and evaluation process of two games

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**Abstract**: The discussion of grief and loss is often avoided, particularly when it comes to conversations involving children. The COVID-19 pandemic has tragically resulted in the loss of relatives and friends for thousands of children, bringing this topic to the forefront. Parents and caregivers have found themselves compelled to broach the subjects of death and grief with children, aiming to provide them with an understanding of the global events unfolding around them. Yet, such discussions remain steeped in taboo. Literature underscores the significance of addressing children's emotions during times of loss, offering guidance on how to navigate such experiences to mitigate the risk of long-term trauma in adulthood. This project introduces the development of two serious games tailored to assist health professionals in (1) guiding children through grief therapies and (2) initiating discussions about finitude with this specific audience. Using the SemTh methodology, which guides the design and evaluation of therapeutic digital games, a multidisciplinary team comprising Health professionals (psychologists and occupational therapists), as well as Computing professionals collaborated on the creation of these games. Implemented on the RUFUS platform, developed by these authors' research group, this platform utilizes predefined templates to guide the game instantiation. Notably, the project contributed two new templates to the platform: narrative and inverse narrative, enabling the construction of games through storytelling. The new templates on the RUFUS platform were assessed through empirical and analytical studies to allow usability and effectiveness of them.

**Keywords:** Therapeutic Digital Games, Design, Evaluation, Death, Grief, Palliative care, Storytelling, RUFUS platform.

## 1 Introduction

Death is seen as something sad and it should not enter the child's world too soon, only if necessary. However, this avoidance can impact the child's psyche, especially if they encounter a situation of mourning [Fleming, 1998].

The act of playing is instinctive for children. Psychologists employ techniques, such as play therapy [Wong, 2013; Gonzalez and Bell, 2016], to engage in dialogue on various issues with this audience. Digital games are also becoming more prevalent in clinics and treatments, as it has become increasingly common for children to have access to digital-format games.

There is a range of serious digital games that aim to assist professionals in different contexts, including in the areas of Education and Health. The games "*Jogar também faz bem*" (Playing is also good for you, in English) [Nishikawa *et al*., 2016], LEPI [Garcia *et al*., 2019], LUME [Rodrigues *et al*., 2020] and "*Pensar e Lavar*" (Think and Wash, in English) [Dutra *et al*., 2023], are examples of games created by researchers from the Brazillian Human-Computer Interaction community. These games focus on the development of skills and learning processes.

Several tools can be used to achieve the goal of a serious game in a given context, including resources such as kinects and tablets, associated with various types of game dynamics.

However, in both, the Brazilian and international communities, there is a scarcity of serious games that can be used to discuss grief, death, and loss with children, whether it be the loss of a family member or a pet. Currently, there are no specific games found to address grief. Additionally, no games were found that support health professionals in dialogues with individuals with chronic illnesses receiving palliative care.

Motivated by this gap and in response to an invitation from researchers in the field of digital legacy and institutions that care for children with cancer, two serious digital games were designed in the context of this project.

A multidisciplinary team participated in the project to create these two serious digital games for children aged 2 to 7 who are going through a grieving process or who need to understand aspects of the finitude.

The game prototypes were created using the SemTh approach, which supports the process of building therapeutic digital games, and is divided into four stages: clarification of the design process, interaction modeling, materialization, and evaluation [de Souza *et al*., 2019].

After prototyping the two games and validating them with health professionals, following a first round of SemTh instantiation, the games were materialized using the RUFUS platform[1], which was developed by the research group of these authors, and which allows the authoring of serious games for non-Computing professionals, using pre-defined templates

[1]Available at: `https://rufus.icmc.usp.br/`

for game mechanics, such as: quizzes, puzzle, collecting items, and creating narratives. This platform contributes to research in the field of End-User Development [Lieberman *et al*., 2006].

The creation of games at RUFUS also followed the stages of the SemTh approach, as the two mechanics adopted had yet to be implemented on the platform.

This paper describes the SemTh stages used in prototyping the two games and also the implementation of the two new mechanics on the RUFUS platform. It is noteworthy that this paper is an extended version of another with the title: "Design of Therapeutic Digital Games that Support Dialogue with Children about Death", presented during the XXII Brazilian Symposium on Human Factors in Computing Systems (IHC'23) [Verhalen and Rodrigues, 2023]. This last paper presents the main results of the master's thesis entitled (in Portuguese): "*Design de Jogos Digitais Terapêuticos que Apoiam o Diálogo com Crianças sobre a Morte*" (Design of Therapeutic Digital Games that Support Dialogue with Children about Death) [Verhalen, 2022].

This study presents as a novelty the idea of digital games that aim to help Health professionals in the therapy of grief and feelings of loss with children. In our searches in the literature to date, this theme was not found in any studies. The theme is also unprecedented among the works already published in the Journal on Interactive Systems (JIS).

This paper is divided into the following sections, in addition to the Introduction: Section 2, which describes the theoretical references, Section 3, which describes the related works, Section 4, which describes the methodological approach used in the work (SemTh), Section 5 the instantiation of the SemTh Approach, and Section 6 that portrays ethical issues, contributions, limitations and reflections on the work.

## 2 Theoretical Reference

Grief processes differ from person to person. Although the five stages of grief defined by Kubler-Ross are commonly the same (namely: Denial, Anger, Bargaining, Depression, Acceptance), they may not occur in that exact order [Kübler-Ross, 1973]. A person may not start their grieving process with denial and then move on to anger [Kübler-Ross, 1973]. These stages can vary, especially for children, as the experience of grief is new to them [Fiorini and Mullen, 2006].

In the Psychology area, during grief therapy [Santos *et al*., 2017; Wong, 2013], games are used in the sessions, with play therapy, being an essential methodology for conducting treatment in these scenarios.

Play therapy with games is used so that the child can better express their feelings during the session. Various activities can be applied during play therapy, such as drawing, storytelling, and music, among other resources. It is important to emphasize that the child needs to have some control over the therapy [Guerney, 2001], for it to achieve the expected objectives. Additionally, the child should be free to interrupt the therapy whenever they wish.

Unlike a traditional game adapted for therapy, serious games are specifically designed with a developmental and skill enhancement objective [Susi *et al*., 2007]. They are created for various purposes, such as education, military training, and, in the case of play therapy, for therapeutic interventions by health professionals.

The games created in the context of this work are intended to be not only serious games, but also therapeutic and empathetic games. This last category encompasses games with the ability to generate reflection or commotion. Allows the player to ponder, for example, about human finitude [de Melo Pinheiro *et al*., 2021].

A therapeutic game has the advantage that patients can learn everyday situations in controlled environments [Madeira *et al*., 2011], usually monitored by health and/or education professionals. It has a specific goal focused on therapy.

An empathetic game aims also to awaken empathy by utilizing gameplay and the player's ability to put themselves in the character's place. de Melo Pinheiro *et al*. [2021] surveys aspects of empathy in games through comments in empathetic games and identifies three main concepts: when the game is an artistic work, when the game allows the player to express feelings, and when it prompts reflections. In the literature, authors also describe guidelines for designing [Rodrigues *et al*., 2021a] and instructions to promote empathetic games [Galvão *et al*., 2024a]. Galvão *et al*. [2024b], in turn, provide a framework to support the development of empathetic games.

The concept of storytelling was also heavily utilized during the development of the games presented here. One of the most commonly used tools in media aimed at children is the use of stories. Stories can connect the listener and the narrative [de Almeida Silva *et al*., 2018]. Additionally, Storytelling is widely used in pedagogy; it was further popularized by Digital Stories (DS) Tumolo [2015], which aims for more dynamic narratives using audio, images, and videos [Robin, 2006]. DSs have been used as a pedagogical resource, which seeks to present something new to students and make the content less abstract.

Telling a story can come in different forms, being an element frequently present in games, either to ambiance the game, or as a central element.

In addition to being an element present in games, films, and music, storytelling is typical in activities with educational and therapeutic purposes, with adults and children. In early childhood education classrooms, for example, it is common for the teacher to introduce stories to conduct targeted activities, making the story a point of motivation.

de Almeida Silva *et al*. [2018] observe that, with storytelling, it is possible to transmit ideas and try to create a connection between the listener and the story.

## 3 Related Works

In an educational context, Yazıcı Arıcı *et al*. [2023] carried out research that aimed to determine the perceptions of preschool children studying in different regions of Turkey regarding digital games with the help of metaphors. Four hundred twenty-one preschool children participated in the research. The children produced 421 metaphors collected in the following seven categories, namely: Nature Images,

Technology Images, Fantasy/Supernatural Images, Education Images, Affective/Motivational Images, Struggle Images, and Value Images. For the authors, the findings of the research using metaphors can guide other scientific research to reveal the content of games played by children and their contribution to education.

In the context of Health, there are in literature and virtual repositories, games that discuss death, such as Gris (Namada Studio®)[2], That Dragon, Cancer [Santos *et al*., 2018] and Limbo (Playdead, Double Eleven®) Playstation Store[3]). However, these games do not depict death playfully or suitably for a child within the age range proposed in this study.

VanEck [2006] explains that not all serious games are useful for all audiences. Therefore, it is necessary to understand the needs of the target audience to apply an appropriate game [VanEck, 2006].

Games in the context of palliative care and finitude, in turn, have been found in the literature, including Acquascouts [Hoffmann *et al*., 2021] and Pets *versus* Onco [Chai *et al*., 2022]. These games mostly involve activities for the child to take care of an animal, carry out daily tasks, and answer questionnaires about their health.

The games identified in the context of care regarding finitude provide information to the child and offer some forms of care. The proposed game here in this context, called Inverted Narrative, aims to have the child create their own story, incorporating elements they want to discuss with the therapist.

The two prototyped games were materialized on the RUFUS platform, as mentioned above. This platform is described in the subsection 3.1.

### 3.1 The RUFUS Platform

The RUFUS platform provides pre-defined game mechanics (or templates) for health and education professionals, for instance, enabling them to create their own games for use with their target populations [da Hora Rodrigues *et al*., 2023, 2022; Rodrigues *et al*., 2022, 2021b].

In RUFUS, professionals can choose the game mechanics they want to use and adjust their parameters, such as scores, dialogues, displayed images, and feedback for correct and incorrect responses, among others. The available mechanics (at the time of writing this paper) include question and answer, item collection, puzzle assembly, narrative, and inverted narrative. After configuring the parameters, a mobile player assembles the game with the settings defined by the specialist, making it available in an application for Android mobile devices[4].

The RUFUS platform is available in Portuguese and English for professional use.

It is noteworthy that the narrative and inverted narrative mechanics were incorporated into RUFUS during the development of the master's project, that originated this work, initially to meet its specific demand for serious games in the scenario described in the sections above.

## 4 SemTh Approach

de Souza *et al*. [2019] present the SemTH approach, created to enable the design process of therapeutic digital games. The name was inspired by the terms "Semio-participatory" and "Therapeutic games".

The approach has four stages and is inspired by the Waterfall Model process in common use in the area of Software Engineering [Sommerville, 2011]. The waterfall model proposes that activities must be fully programmed before starting, but also that activities that have already been carried out can always be returned to to improve them. The stages proposed by SemTh are as follows:

1. **Clarification of the Design Problem:** seeks to understand in what context the game will be applied, the people who will use it, and then decide what best fits its construction;
2. **Interaction Modeling:** models the solution screens in a joint work between developers and health professionals;
3. **Design Materialization:** uses knowledge from the two previous areas to create a prototype (which can be of different fidelities);
4. **Evaluation:** takes the prototype to be evaluated by professionals, the target audience, and any other interest groups.

Figure 1 illustrates the SemTh stages, which are cyclical and iterative.

SemTh also enables the use of methodologies such as Participatory Design (PD). The activities of this project also incorporated, the use of Educational Objects (EOs) [Maciel *et al*., 2014], a method of story creation that seeks to facilitate the process using personas and structured scripts. In this work, EOs were primarily used in the construction of the script of the first game (storytelling).

For Interaction Modeling, the Specific Domain Modeling Language for Therapeutic Applications [Garcia *et al*., 2016] was employed. In the Evaluation stage, the EmoFrame system [Santos dos Santos *et al*., 2022][5] was used, providing digital evaluation instruments. It was employed to assess user satisfaction. Among the instruments available in EmoFrame, the SUS (System Usability Scale) questionnaire [Brooke, 2013] and SAM (Self-Assessment Manikin) [Bradley and Lang, 1994] were used, in digital format. The SUS consists of 10 random questions, calculating the system's usability level based on user responses. SAM aims to analyze user satisfaction, motivation, and the feeling of control through images [Bradley and Lang, 1994].

The following section describes the instantiation of SemTh in the two games designed in the context of this project.

[2]Available at: `https://store.playstation.com/pt-br/product/UP3643-CUSA16694_00-GRISPS4SIEA00000`

[3]Available at: `https://store.playstation.com/pt-br/product/UP2054-CUSA01664_00-PLAYDEADD11LIMBO`

[4]Available at: `https://play.google.com/store/apps/details?id=com.RufusSystem.Rufus`

[5]Available at: `https://emoframe.icmc.usp.br/`

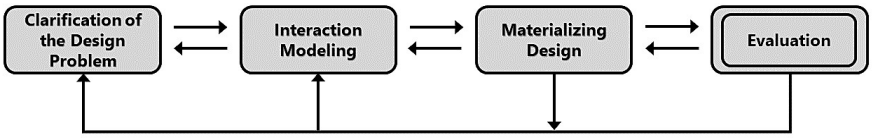


**Figure 1.** Flowchart showing the stages of the SemTh approach [de Souza *et al*., 2019].

# 5 Instantiating SemTh

In this project, the SemTh approach was employed in two distinct phases: the first for designing the game about grief and loss, and the second for designing the game to address finitude with children, and, in two rounds: to design the prototype and to create new mechanics in RUFUS that could materialize the prototypes.

The following section describes the Narrative, the first game prototyped, and a new mechanic projected/incorporated into RUFUS to enable the functional deployment of the game in question.

## 5.1 Narrative Game - Jungle Party

### 5.1.1 Clarification of the Design Problem

For this game, a Literature review was done, to identify games that could be used to treat, alongside health professionals, the theme of grief in children. Furthermore, conventional media resources, such as children's books, movies, and games that addressed themes related to grief and loss were sought.

At the end of this stage, the first one in SemTh - clarification of the design problem - requirements for the game were identified, and detailed by Verhalen *et al*. [2021].

In total, 24 requirements were conceptualized, comprising 16 functional requirements and 8 non-functional requirements. Below (in Table 1) are some of the identified requirements, along with their sources. The complete list can be seen in the work of Verhalen *et al*. [2021].

As seen in the table, the requirements originated from the literature review and other media (e.g., books, games, films), along with discussions with literature experts and health professionals. These stages were essential to understand that children's books and other media accompany experts in conveying a message to the children's audience.

Analyzing games and papers, it was noticed that storytelling was common with the children's audience since, in general, professionals told a story, bringing the child into the context to be conveyed. It was decided that the game to discuss grief with children aged 2 to 7 would be a narrative.

As inspiration for the game, the professor, researcher, and writer Dra. Silvia Amélia Bim[7], a children's book author and a partner in this project, created the story titled Teodora and Gaia's Party, or **Jungle Party**. The story is about an endless party, hosted by Teodora and Gaia friends, where people meet, interact, and become friends but leave at some point. At this party, the people come in and out of it, but sometimes do not say goodbye. It is a metaphor for life [Verhalen *et al*., 2021].

[7]Available at: `http://lattes.cnpq.br/1808731785135915`

**Table 1.** Requirements for an empathetic game intended for the grieving child.

| Nº Requirement | Requirement | Origin |
|---|---|---|
| [FR01] | The game must try to represent the emotions through the scenario (e.g., GRIS). | Literature |
| [FR03] | The game must do those explanations preferably in spoken as written form. With an accessibility view (WCAG3[6]). | Literature |
| [FR05] | The game must allow the child to interact with the scenario represented [Wong, 2013]. | Literature |
| [NFR07] | The game can use metaphors, as long as they are consistent with the loss scenario [Karns, 2002]. | Literature |
| [FR08] | The game must show the passage of time, together with the change of scenario. (e.g., Five Stages of Grief). | Literature |
| [FR09] | The game should only allow the child to follow the narrative if they fulfill all the tasks and objectives made available in previous levels (based on play therapy [Fiorini and Mullen, 2006]). | Literature |
| [NFR17] | The game should not transmit religious messages of any nature [Rodrigues *et al*., 2018]. | Discussion/ Literature |
| [FR22] | The game must avoid using anthropomorphic characters and those that physically reference the lost person Rodrigues *et al*. [2018]. | Discussion/ Literature |

**Source:** Adapted from Verhalen *et al*. [2021].

To compose the characters of Teodora and Gaia's Party in the game, endangered animals from the Brazilian fauna were chosen (e.g., *Lobo Guará*, *Tamanduá Bandeira*, *Onça Pintada*, among others). The player would then choose one of these characters to interact with the created narrative. In addition to a forest setting, an effort was made to prevent the child from associating the characters or scenarios with any familiar environment or person. Based on the aforementioned story, a script for the narrative was then developed. The next step was to model the screens.

### 5.1.2 Interaction Modeling

The SemTh modeling stage proposes using the modeling language for therapeutic applications developed by Garcia *et al*. [2016]. Through symbols and seals, the language allows people from different areas to participate in constructing the game screens. The advantage of modeling is that discussing the solution design among stakeholders becomes more fluid,

as it does not require technical terms. Modeling also does not require specific tools, allowing the design to be discussed and created on paper, for example, as long as everybody has access to symbols and stamps and can be moved freely. This work used the Word® tool to create the interactive modeling of the narrative game scenes [Verhalen, 2022].

Figure 2 illustrates one of the modeling carried out during this stage of the approach [Verhalen, 2022]. The modeled screen refers to a scene in the narrative representing the dialogue between the child and a character at the party. This screen contains the following symbols and signs: background image, character image, plus text to define the character's name, and the chosen sound. In addition to these signs, the flexibility seal (F) is present, as the child will be able to define the name and image of the character and the OT seal! (Therapeutic Objective), this choice of characters and names may be linked to some therapeutic activity idealized by the professional developing the game. The decision seal (D) informs that the player must make another choice, from a set of options, this being another point of flexibility (F), associated with a therapeutic objective (OT!). The player's actions (A) in the narrative are stored and generate a report (R), made available to the health professional, to analyze the child's choices during the game and carry out interventions in favor of therapeutic treatment [Verhalen, 2022].

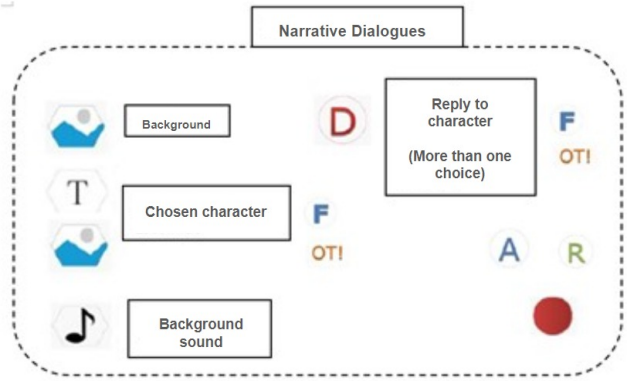


**Figure 2.** Modeling the Narrative Dialogue Screen.
**Source:** Adapted from Verhalen [2022]

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The first screen of the designed prototype (Home) contains a background image, a text field with the name of the game, and a button with label "Enter" (which requires a decision (D) from the player). On the next screen, the player needs to make other decisions such as: which image will be their character, the character who will be their friend in the narrative, names for them, and accessories. Figure 3 illustrates this last screen.

### 5.1.3 Design Materialization

In this stage of SemTh, the modeling created in stage 2 is used to materialize a high-fidelity artifact. This materialization can be a prototype in mock-up format or a first functional version of the computational solution under design. It is essential, however, that it is an interactive representation, that is, in which stakeholders can interact with the solution [Verhalen, 2022].

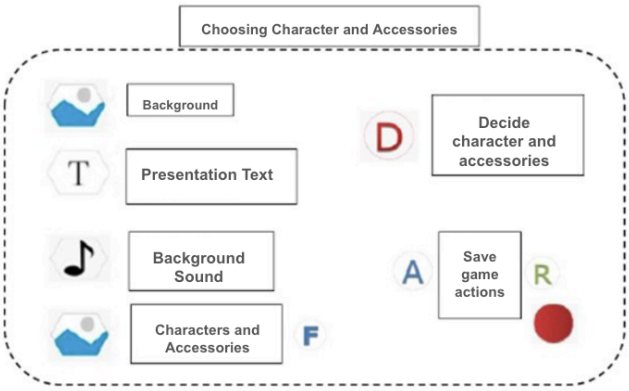



**Figure 3.** Modeling and materialization of game screens for player choices.
**Source:** Adapted from Verhalen [2022].

A first prototype of the narrative game was made in Adobe XD® tool[8], and this prototype had a total of 144 scenes, including screens used to simulate visual effects so that, when evaluated by experts, it would be as close as possible to a gaming experience.

Figure 4 illustrates the materialization of the screen modeling in Figure 3, in which the player needs to make decisions about which image will be his/her character in the narrative.

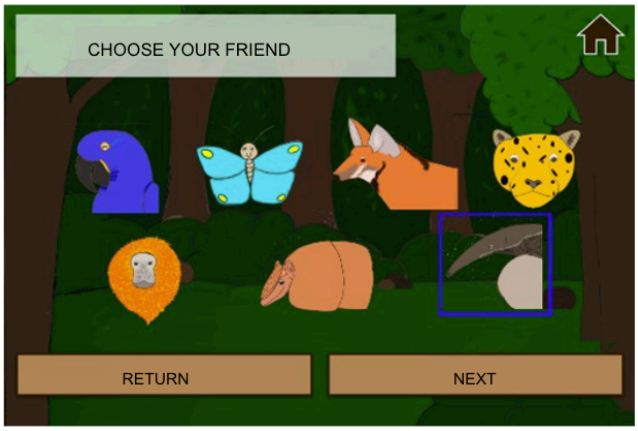



**Figure 4.** Materialization of game screens for player choices.
**Source:** Adapted from Verhalen [2022].

We highlighted a change on this screen concerning the modeling done, as it was noted that the space on the screen for choosing the characters and accessories together would be small. In the prototype, these player decisions were divided into three screens.

The decision screens for characters and accessories corroborate the implementation of requirement FR09 - **The game should only allow the child to continue the narrative if they fulfill the tasks and objectives made available in previous levels**. The choice of animal characters, in turn, corroborates the implementation of FR22 - **The game must avoid using anthropomorphic characters and those that make a physical reference to the loved one** [Verhalen, 2022].

During the prototype creation process, it was noted that it would be interesting to provide a screen on which the child could enter their name, or that of their character, and also their friend's name. This screen, however, was not projected into the modeling. The importance of this screen is mainly

[8]Available at: `https://www.adobe.com/br/products/xd.html`

due to FR05 - **The game must allow the child to interact with the scenario presented**, so that they have more creative freedom [Verhalen, 2022].

Once the game's materialization stage was completed, experts evaluated it. The following section describes this stage of SemTh in this instantiation.

#### 5.1.4 Evaluation

In stage 4 of SemTh, the prototype is evaluated by experts. In this project, this stage was conducted with three experts (E), who are part of the research group, a specialist in Literature Science (E1), a psychologist (E2), and a specialist in Computer Science and also the writer of children's books (E3) [Verhalen, 2022].

Each evaluation was carried out individually and on different days, using the Google Meet® tool. The prototype in Adobe XD was made available to evaluators, who could interact with it freely. The researcher did not interfere, only in cases in which the evaluators could not follow the narrative [Verhalen, 2022].

The interactions were recorded with the consent of each of the evaluators, for later analysis by the team. There were no changes to the prototype between each of the evaluations, to maintain consistency, ensure that feedbacks were not affected, and find similarities and divergences between opinions.

Below will be listed some of the experts' recommendations [Verhalen, 2022].

- Offer a speech bubble instead of a speech frame, including in feedbacks (E1 and E3);
- Change the word "accessory" to something like "something your friend wore" (E1 and E2);
- Provide greater prominence for the character who is currently speaking, when there is more than one character in the scene (E1 and E2).
- Make all statements available in capital letters, for better understanding by the child (E3);
- Separate long sentences better (E2);
- Provide the option to say "Bye" when the character says goodbye (E1);
- Enable the accessibility option, to the children don't depend on anyone to read (E2).

After considering the suggested modifications by the experts for design aspects and implementing the suggestion of creating the "No" route (when the child does not want to play), the development activities for the functional version of the game were initiated.

After unsuccessful attempts to use narrative creation tools available in the literature, the research group chose to implement this mechanic on the RUFUS platform, which at the time, only offered three game mechanics: the quiz game – a game that consists of questions and answers; the collection game – in which a character walks around the screen collecting elements, gaining and losing points according to the therapeutic objective, and the fit – in which shapes of different objects should be fit into their shadows.

#### 5.1.5 RUFUS implementation

The prototype elaborated to Jungle Party game was used to identify flexible components of a new game mechanic to RUFUS, named **Narrative**. The identification of these components, and the flow of a narrative, allowed the research group to implement this new mechanic on the platform [Verhalen *et al*., 2022].

Initially, with the prototype in hand, a flowchart (see Figure 5) was created so the RUFUS development team could have it as a reference. This flowchart displays the structuring of scenes, the composition of spaces, and the game's lines, to demonstrate more clearly to developers how objects interact in the narrative. For example, the "Dialogue" path: is made up of speech, character, and audio, and leads to a "Choice": made up of options, which lead to interaction and (text) messages and, at the end of these choices, lead to "As is": which will make options available in different feedbacks formats, as well as the result of the interaction for health professionals.

One of the priorities for the development team to implement was that the end user (the player) could freely choose in the mobile application the characters that would represent him/her during the game. This way, the player would be able to identify with the choice. It was also an implementation priority that the health professional, in the RUFUS Web interface, at the end of creating the game, could create and connect the scenes easily, allowing interaction between them [Verhalen, 2022].

In Figure 6, it is possible to visualize the current screen of the Narrative in RUFUS. It should be noted that this screen went through 3 stages design, implementation, and evaluation. Details of these three stages using SemTh approach are described in Verhalen *et al*. [2022] and in da Hora Rodrigues *et al*. [2023]. The image displays the screen in which the health professional creates scenes for the story, allowing the selection of characters for each scene, specifying their dialogues, identifying the speakers, and providing possible responses.

In the first version of the interface, the responses from the SUS (System Usability Scale) [Brooke, 2013] (see Table 2) indicated a score considered "Unacceptable" (regarding usability) as more recurrent, in witch 3 out of the 7 participants pointed out this score. In the second evaluation, a considerable improvement is already noticeable, with results such as "Excellent" (3 participants) and "Best Possible" (4 participants), scores that did not appear in the previous evaluation. At the end of the third evaluation, achieving entirely positive results regarding the usability of the Narrative tool on the RUFUS platform was possible. In the SUS, scores above 68 points are considered good usability.

The SAM (Self-Assessment Manikin) instrument [Bradley and Lang, 1994] was used to evaluate the emotional response of users (valence, arousal, and dominance) interacting with the narrative in the RUFUS. Table 3 illustrates that results were also negative initially and tended towards the positive throughout the evaluations.

To incorporate the Teodora and Gaia Narrative into RUFUS, some modifications to the routes were necessary to ensure that the story could be effectively presented to the player (see Figure 5). For example, in the figure, it is possible to

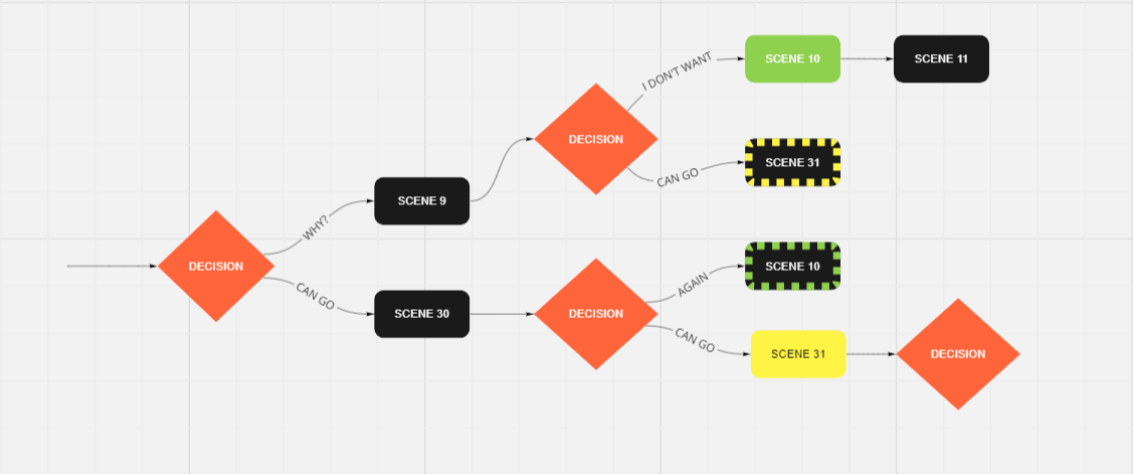



**Figure 5.** Flowchart for mobile.
**Source:** Adapted from Verhalen [2022].

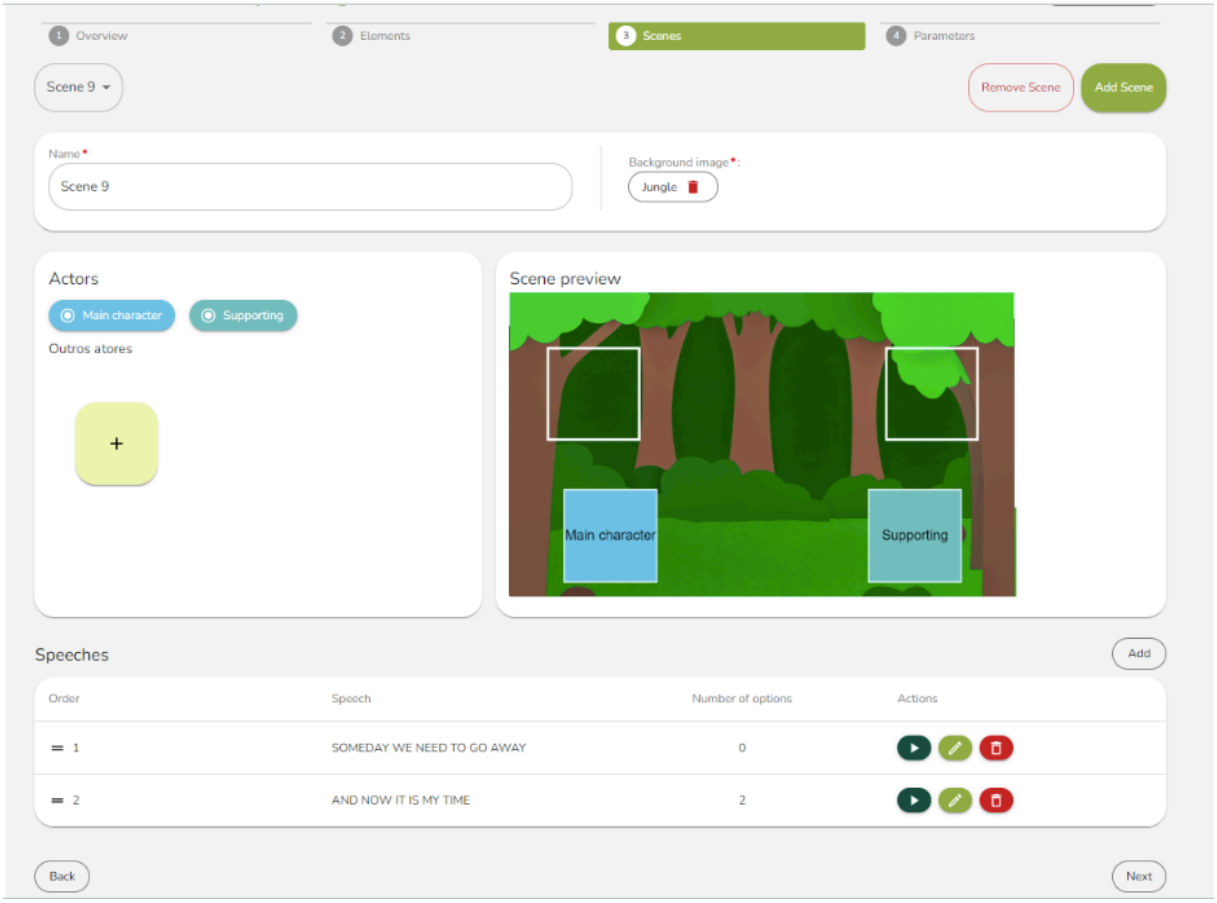



**Figure 6.** Narrative creation screen on the RUFUS platform.
**Source:** Research group archives.

see that, depending on the player's decision, it is possible to go from scene 31 to scene 10. This way, the routes became more simplified, offering various options to the player without adding more scenes.

This interaction can be visualized in Figure 7 and Figure 8. Figure 7 illustrates the configuration of scene number 9 in RUFUS, in which the player must decide to let his/her "friend" leave the party or ask him/her to stay. In Figure 8, it is possible to see how this scene is presented in the mobile version, in which it is played out effectively. If in the action of Figure 8[b], the player chooses the first answer, he/she will go to the scene illustrated in Figure 8[c]. If the player chooses the second answer "OK, YOU CAN GO", he/she will go to the scene illustrated in Figure 8[d].

Evaluations with target users interacting with the RUFUS mobile application, and the Teodora and Gaia game, were approved by the research ethics committee and conducted by the research group. Preliminary results from a study of three bereaved children are positive and encouraging. However, these evaluations are not the focus of this paper.

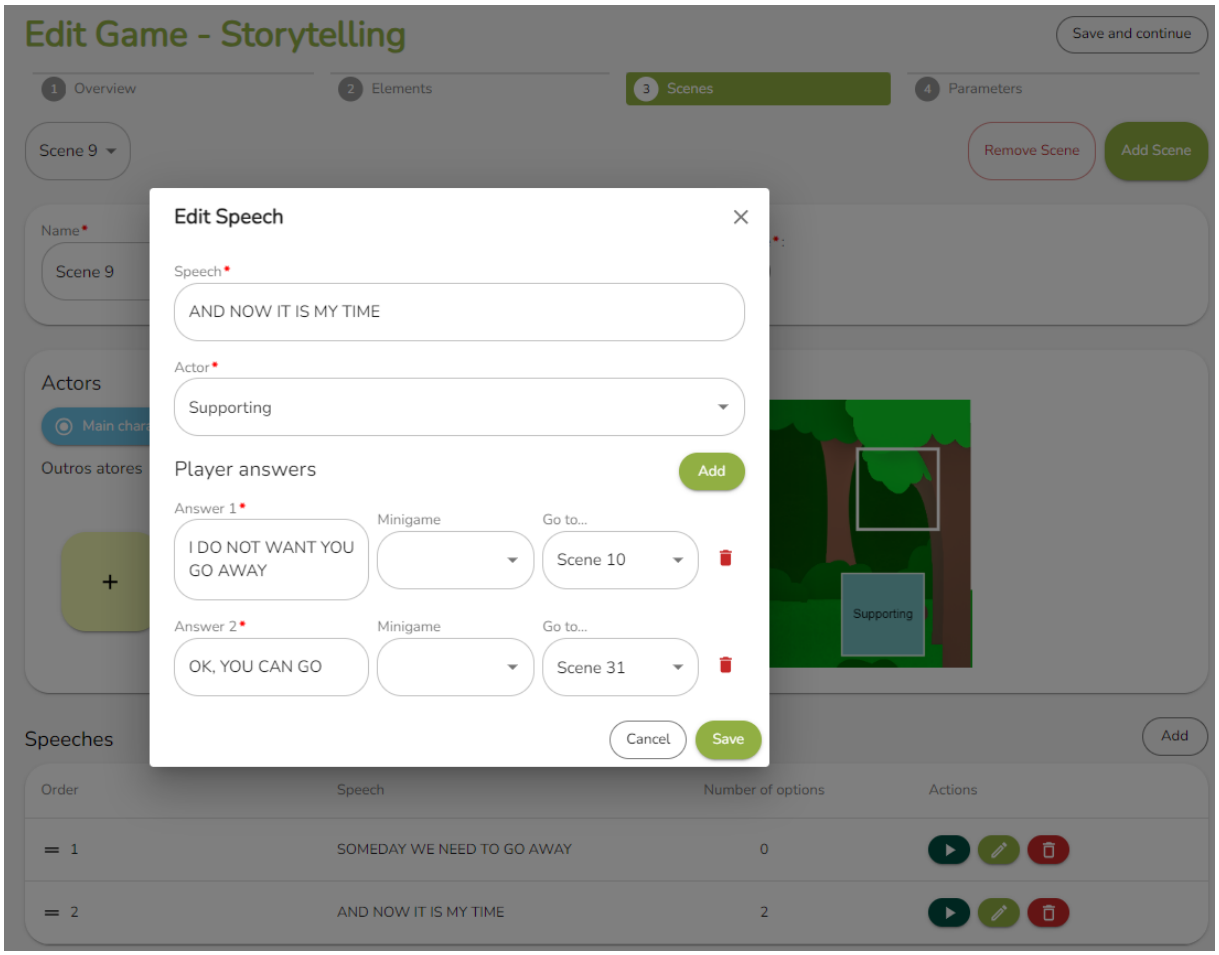



**Figure 7.** Narrative creation screen on the RUFUS platform.
**Source:** Research group archives.

**Table 2.** SUS results for the evaluations 1, 2 e 3.

| Participants - P | Score | Result |
|---|---|---|
| **First Round** | | |
| P1 | 39.29 | Unacceptable |
| P2 | 30.36 | Unacceptable |
| P3 | 75.89 | Good |
| P4 | 51.79 | Unacceptable |
| P5 | 71.43 | Good |
| P6 | 63.39 | Ok |
| P7 | 62.50 | Ok |
| **Second Round** | | |
| P1 | 77.68 | Good |
| P2 | 88.39 | Excellent |
| P3 | 91.07 | Best as Possible |
| P4 | 77.68 | Good |
| P5 | 91.07 | Best as Possible |
| P6 | 95.54 | Best as Possible |
| P7 | 86.61 | Excellent |
| P8 | 89.29 | Excellent |
| P9 | 97.32 | Best as Possible |
| P10 | 89.29 | Excellent |
| **Third Round** | | |
| P1 | 92.86 | Best as Possible |
| P2 | 91.87 | Best as Possible |
| P3 | 87.50 | Excellent |

**Source:** Adapted from Verhalen [2022].

**Table 3.** SAM results for the evaluations 1, 2 e 3.

| Participants - P | Valence Domain | Arousal Domain | Dominance Domain |
|---|---|---|---|
| **First Round** | | | |
| P1 | 5 | 6 | 3 |
| P2 | 6 | 7 | 1 |
| P3 | 3 | 1 | 4 |
| P4 | 4 | 6 | 3 |
| P5 | 3 | 3 | 6 |
| P6 | 3 | 3 | 5 |
| P7 | 2 | 1 | 7 |
| **Second Round** | | | |
| P1 | 7 | 6 | 7 |
| P2 | 9 | 7 | 6 |
| P3 | 9 | 8 | 9 |
| P4 | 9 | 7 | 7 |
| P5 | 8 | 9 | 8 |
| P6 | 9 | 9 | 9 |
| P7 | 9 | 9 | 8 |
| P8 | 9 | 9 | 9 |
| P9 | 9 | 9 | 9 |
| P10 | 9 | 9 | 8 |
| **Third Round** | | | |
| P1 | 9 | 7 | 9 |
| P2 | 9 | 9 | 8 |
| P3 | 9 | 9 | 6 |

**Source:** Adapted from Verhalen [2022].


**Figure 8.** Narrative game in *mobile* version.
**Source:** Research group archives.

The following subsection describes the second envisioned game, the Inverted Narrative. This specific game sought to find strategies to dialogue with children in palliative care, due to a chronic and life-threatening illness, such as cancer.

## 5.2 Inverted or Reverse Narrative - Idea Box

### 5.2.1 Clarification of the Design Problem

For the game aimed at discussing finitude with children, the same SemTh stages were followed. Initially, a literature review was conducted to explore how palliative care is provided to children primarily, and the methodologies used by hospitals, health professionals, and other individuals involved during treatment.

During the review, the work that referred to the "*Caixa de Ideias*" (Idea Box, in English) [Garcia-Schinzari *et al*., 2014] stood out, a methodology involving a box with various objects and materials, in which the child should take out these objects and create stories based on them.

The literature study allowed us to observe that the game needed to give the children the freedom to express themselves about the situation they were experiencing. The idea of the Idea Box game was conceived to provide game elements so the child can create their own story with charac-

ters and objects. This mechanic differs from the mechanics described in the previous section, in which the child (as a player) consumes a story with a script defined by the health professional.

To develop the **Idea Box** game prototype, the SemTh approach was also used, following the same stages. Thus, the game requirements were elicited, reusing some of the requirements from the grief game, that also fit the context of this game. Four specific requirements for the finitude game were identified [Verhalen *et al*., 2023]. Table 4 describes these requirements.

**Table 4.** Functional Requirements (FR) for Idea Box game.

| Nº Requirement | Requirement | Origin |
|---|---|---|
| [FR01] | The game must allow the player to freely assemble the scenes, however they prefer: This requirement was based on the idea of the Ideas Box [Garcia-Schinzari *et al*., 2014], which contains several elements, and can be used by players freely. | Literature |
| [FR02] | The game does not need to follow a predefined story: According to research identified in the literature [Netto *et al*., 2022; Del Pino and Pereira, 2017], it is important that the child freely participates in playful activities, trying to bring a little of their own world for your therapy. Therefore, she needs to express herself. | Literature |
| [FR03] | The game can contain images, music, and texts according to the creator's wishes and needs: Netto *et al*. [2022] highlight the importance of different activities and stimuli during ludotherapy, thus, the game must provide stimuli so that the child can feel more "owner" of it. | Literature |
| [FR04] | The game must provide an easy way to visualize the story, final or in progress: This requirement was created based on observations of suggestions from professionals, as the vision of the story at the end, even if it has been left half, it is still a therapeutic result. | Literature |

**Source:** Adapted from Verhalen *et al*. [2023].

The Idea Box game was produced with the support of an undergraduate Computer Science student, as part of his Final Course Project [Silva, 2022], which focused on developing the mobile version of this game.

After brainstorming sessions with group participants, a game flow for the Idea Box was created. In this flow, it was possible to project what the interactions carried out by the user in the game would be like and which screens should be made available. They are: an initial screen – the creation of a character, and the creation page – containing the structure of the game and, which gives access to options for selecting background, music, objects, speech bubbles, songs, characters, removing elements, selecting pages and viewing the story [Verhalen, 2022].

Interactions with the Idea Box game are established through buttons, that display elements to compose the story. With the requirements and the flow on how to create a story in the Inverted Narrative mechanic, screens interactive modeling of the game was created, following the second stage of SemTh.

### 5.2.2 Interaction Modeling

The Word® tool was also used for the interactive modeling of the game to support palliative care, as in creating the game for grief.

Figure 9[a] illustrates the modeling of the Idea Box home screen proposed. This screen contains a white background (an image), the characters to choose from (images), followed by a decision (D) about which character the player chooses to use. Unlike the narrative game screen, the character will not be given a name in this case.

In Figure 9[b], it illustrates the modeling of the screen for creating the narrative scenes. The screen has a white background image, and icons with images for the player to select. The player then taps the icons to decide (D) the elements he will choose, such as: the background image, the character image, the speech bubbles, and the soundtrack. The lines have associated texts, and the music icon has related sounds. These choices are part of the therapeutic objective of the game (OT!), designed with Mental Health professionals. All these elements make up a scene, defined by the dashed line in the figure.

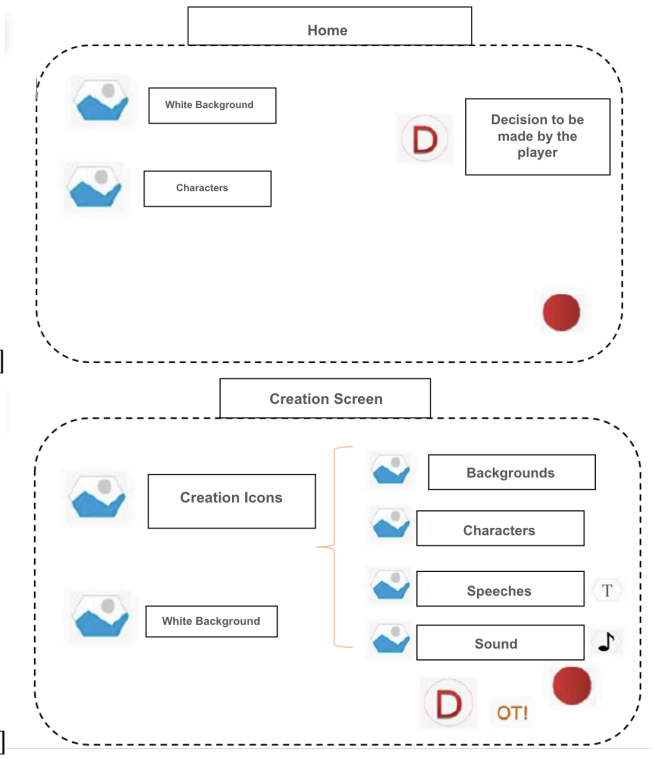



**Figure 9.** Modeling of the game Home screen to support palliative care and screen modeling to create narrative scenes.

**Source:** Adapted from Verhalen [2022] and Verhalen *et al*. [2023].

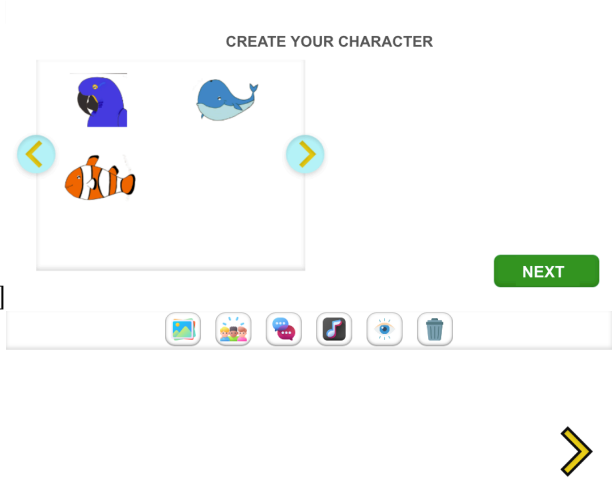
After the modeling stage, the materialization of the game

was conducted. The following section discusses the same.

### 5.2.3 Design Materialization

The Idea Box game was also prototyped using the Adobe XD® tool. Characters and scenarios created for the grief game were reused. For the icons, images available on the Flaticon website[9] were used.

On the initial screen, the player must choose a character from a set of images, pre-defined by the health professional. Figure 10 illustrates the materialization made in Adobe XD®, related to the modeling in Figure 9.




[a]

[b]

**Figure 10.** Materialization of the beginning screen. Adapted from Verhalen [2022].

**Source:** Figure [a] Adapted from Verhalen [2022] and Figure[b] from Verhalen *et al*. [2023].

Once in possession of the prototype, already considering the adjustments resulting from the discussion, it was evaluated by Mental Health professionals, who work in therapies for death/grief. These professionals are partners in the research group and work collaboratively on grief and children [Verhalen, 2022].

### 5.2.4 Evaluation

To evaluate the prototype, two partners were invited: an Occupational Therapy teacher – specialized in grief therapies - including bereaved children (evaluator 1 - E1), and an Occupational Therapy student – who also works with grief therapies for death and children (evaluator 2 - E2) [Verhalen *et al*., 2023].

The evaluation was carried out independently, on different days. The prototype was illustrated in a PowerPoint® presentation for each evaluator, as it was not interactive, just illustrative. The evaluation took place using the Zoom® tool, in which the impressions and suggestions of each of the evaluators about the prototype were recorded. Both evaluations lasted an average of 40 minutes, and there were similar observations, described below [Verhalen *et al*., 2023]:

- An explanation must be provided on how to interact with the game;
- A triggering element must be made available, such as: a phrase or image that leads to the subject that the health professional wants to discuss;
- The screens were considered “clean”.

Both evaluators reported that in the context of palliative care, the game is coherent and offers dynamics used in treatments for this purpose. For E2, in general, these treatments seek to bring “the playful world” into the treatment.

E1 and E2 point out the use of trigger elements, a common resource before starting psychological treatments, and which generally involves making drawings, followed by the other activities that constitute the treatment. For both, the Idea Box can be used for this purpose, to trigger the theme of the treatment, before starting it.

The game mechanics described above were also implemented on the RUFUS platform.

### 5.2.5 RUFUS implementation

After identifying the elements common to the Idea Box game prototype, a new mechanic, named the **Inverted Narrative**, was implemented in RUFUS platform to materialize functionally the Idea Box and other games in different contexts.

Figure 11 illustrates the screens of the Web interface authored by RUFUS for the creation of the game by the professional. Initially, the professional defines the name and description of the game (a step common to all RUFUS games), and then he/she defines the elements (assets) that will be offered to the player, so that he/she can create his/her narrative (e.g., background image, characters, accessories, objects and speech bubbles) and, finally, defines parameters such as success and/or error feedback (a step also common to all games available at RUFUS).

Figure 11 illustrates screens of this game in the RUFUS configuration Web interface (a) and on mobile (b) [Verhalen and Rodrigues, 2023].

In Figure 11[b], in the top menu (bar), the player can choose one of the two characters made available by the health professional (Figure 11[a]), the octopus or the whale. The player must touch and drag the object to insert the character into the scene.

By touching the object in the scene, as illustrated in the octopus on Figure 11[b], the player can carry out actions such as removing the object from the scene (page), rotating it, duplicating it, or reducing it. To add new scenes (pages), the player must touch the “+” icon in the bottom right corner. In the top right corner is the menu icon, in which the player can return to the background image options, characters, objects, and speech balloons provided by the health professional (Figure 11[a]). The arrows centered on the right and left edges, in an opaque way, allow the transition between scenes.

After implementing part of the Inverted Narrative functionalities in the RUFUS mobile application, it also passed through preliminary evaluation. Graduation students, in the majority of the bachelor’s degree in Computer Science courses, were invited to interact with the application. The sample was made for convenience. Seven people participated in the evaluation. The participants were seven men,

[9] Availabe at: `https://www.flaticon.com/`

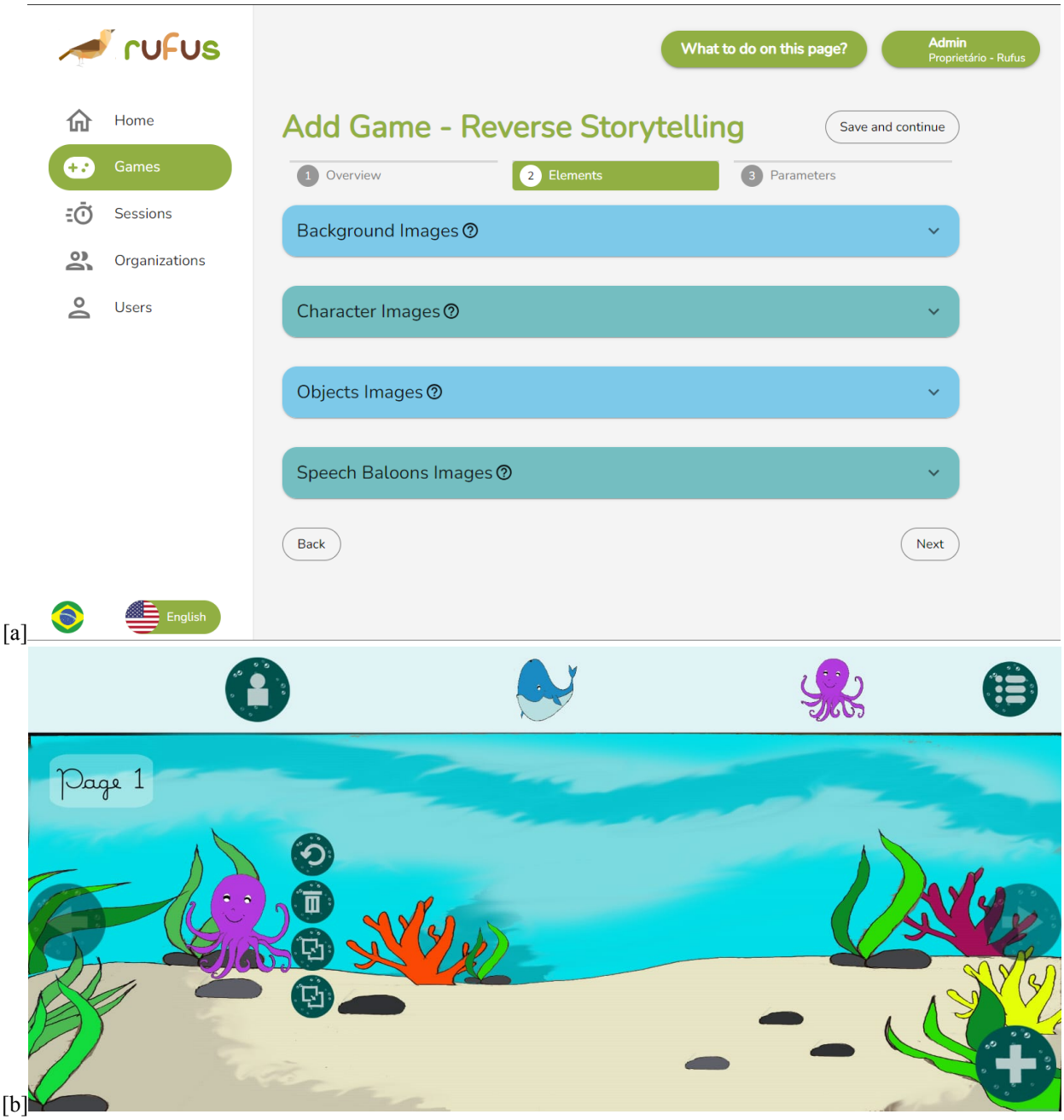



**Figure 11.** Screens of Inverted Narrative in the Web and Application Interface of RUFUS.
**Source:** Adapted from Verhalen *et al*. [2023].

aged between 22 and 31. Everyone had some experience with games, with the majority being computer games, console games, and cell phone games [Silva, 2022; Verhalen, 2022; Verhalen *et al*., 2023].

The evaluators interacted with the application following a script with 16 tasks. There was no initial interference from the applicator, but, in cases in which the evaluator took more than 2 minutes, the applicator interfered to carry out the other tasks and not frustrate the evaluator [Silva, 2022; Verhalen *et al*., 2023].

After interacting with the application, the evaluators responded to the SUS and SAM questionnaires. The results can be viewed in Table 5 and Table 6, respectively.

The SUS results point to a positive result for the usability of the application, but the semi-structured interviews subsequently conducted with the evaluators revealed problems that demanded attention from the RUFUS development team. One aspect highlighted as negative, for example, was the lack of error messages and help tutorials. Regarding the

**Table 5.** SUS results for evaluating the mobile interface of the Inverted Narrative game.

| Participants - P | Score | Result |
|---|---|---|
| P1 | 93.75 | Best Possible |
| P2 | 86.61 | Excellent |
| P3 | 66.07 | Ok |
| P4 | 75.00 | Good |
| P5 | 95.54 | Best Possible |
| P6 | 80.36 | Excellent |
| P7 | 58.04 | Unacceptable |

**Source:** Adapted from Silva [2022].

**Table 6.** SAM results for evaluating the mobile interface of the Inverted Narrative game.

| | P1 | P2 | P3 | P4 | P5 | P6 | P7 |
|---|---|---|---|---|---|---|---|
| Domain Satisfaction | 8 | 8 | 7 | 8 | 9 | 8 | 6 |
| Motivation Mastery | 9 | 6 | 6 | 7 | 9 | 8 | 4 |
| Feeling of Control | 8 | 1 | 4 | 7 | 9 | 8 | 7 |

**Source:** Adapted from Silva [2022].

SAM results, it was observed that the three domains (Valence, Arousal, and Dominance) had positive results. The interviews, however, reinforce suggestions for improvement in the area of feeling of control.

# 6 Final Remarks

The main contribution of this work was the conception of two therapeutic digital games, evaluated by health professionals, that can contribute to treatments for the contexts for which they were developed.

The game addressing finitude, Inverted Narrative, demonstrates potential for other psychotherapeutic approaches, as drawing a story can be the initial step for various treatments, as pointed out by one of the prototype evaluators.

The game for grieving treatment is also a promising proposal, and considering the post-COVID-19 scenario, in which many children lost relatives and loved ones unexpectedly, the game can be an ally for the child to understand the feeling of loss, alongside a qualified professional to discuss the subject. Case studies with grieving children were conducted using the Jungle Party game. According to the researcher in the field of Occupational Therapy who conducted these studies, the game proved to be a valuable and effective trigger to initiate a dialogue on the topic of death with the observed children. The Ideia Box game will be used in the first or second semester of 2024 with an institution of São Carlos/SP/Brazil. These studies, however, are waiting for approval from the ethics committee to be carried out.

The work also contributed to the conception, development, and evaluation of two new mechanics for the RUFUS platform. Thus, professionals can create their own narratives and inverted narratives for purposes other than just grieving and discussions about finitude.

For the Human-Computer Interaction field, the work contributes to new experiences in building interfaces by end-users, following the End-User Development paradigm [Lieberman *et al*., 2006]. This area has gained prominence for empowering non-expert users to construct their own computational solutions. Throughout the design, development, and evaluation of the games described here and implemented on the RUFUS platform, it was possible to study nuances of this type of system, especially issues related to the game's aesthetics, interface element contrast (accessibility), and gameplay.

Furthermore, it was possible to contribute to the improvement of the SemTh Approach, illustrating the possibility of adding new artifacts like design and evaluation instruments to the steps, such as using EOs for script planning and systematizing the application of self-report questionnaires, like SAM e SUS, using the EmoFrame system [Santos dos Santos *et al*., 2022] in evaluations.

It is noteworthy that both games were designed together with specialists in the field, such as psychologists and occupational therapists, who work directly with the target audience of children. The research described here did not involve activities with children and/or their guardians. This is the next stage of this project, as pointed out in the next section.

## 6.1 Limitations

The main limitation encountered throughout the work was the chosen theme. Involving mainly psychological issues, it required a deep dive into references and studies unfamiliar to the researchers' field of expertise.

Another challenge was finding an environment in which it was possible to create the games in a functional version. When the decision was made to adopt the RUFUS platform, another limitation was making them intuitively available to the user so the platform could be guided in building their game instance [Muri *et al*., 2022].

Finally, another limitation was the lack of evaluations with the target children's audience at the time, as due to COVID-19, it was not possible to conduct evaluations with this audience. However, such studies, as described in the previous section, took place in April and August 2023 and will be described in detail in future publications by these authors.

## 6.2 Ethical considerations

The Brazilian Research Ethics Committee approved the use of games with the children's audience with registration number: 52278121.1.0000.5154.

During the evaluations of this project, participants provided consent to participate. The consent form texts were read together, and volunteers were informed about the risks, and benefits of the research, and that they were volunteers, able to withdraw from the study at any time. They were also informed that their identities would be anonymized, making it impossible to identify them. Volunteers also signed a release form for image and sound in the studies conducted via Web conference, in which screens needed to be recorded.

The collected data is only in the possession of the researchers involved in this study and will be stored for five years, with the deadline being 2026. It is emphasized that in the published articles, participants have been anonymized.

The RUFUS platform is an open-source system and is in the process of software registration with the responsible bodies at the University of São Paulo, São Carlos campus. The platform complies with the principles of the General Data Protection Law[10].

## 6.3 Future Works and Final reflections

Due to the use of the SemTh Approach and direct contact with an interdisciplinary team, it was possible to create two serious digital games to serve the target population of specialists, especially in the context of Mental Health. As the next step, further empirical studies on using these games with children aged 2 to 7 years are expected to be conducted, and the

[10]Avaliable at: `https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/lei/l13709.htm`

effectiveness of the created script and the developed computational solutions will be evaluated.

Partial results, derived from empirical studies conducted with two grieving children and the game Jungle Party, encouraged the authors to continue the project. The identified potential and real effectiveness of the game as a trigger for dialogue on grief, finitude, and death are promising. The report from the occupational therapist who accompanied the session reveals that the game is a powerful, playful resource to facilitate dialogue, especially with children who do not want or cannot talk about the topic.

The mechanics of RUFUS are flexible and can allow for the customization of specific stories for various contexts, providing more freedom to professionals and consequently expanding the repertoire of games for other therapies and treatments.

It is hoped that the two games can also assist health professionals in the real treatment of children and, mainly, help them during the process of discovering and accepting the feelings arising from death, loss, and mourning.

# Declarations

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## Authors' Contributions

Aline Verhalen carried out the first version of this document and carried out the research (related to your master dissertation), applied the methodology, data collecting, and analysis, and translated part of this document to English, supervised by Kamila Rodrigues. Kamila Rodrigues managed this research project and, supervised Aline, and contributed to the planning, conducting of case studies, data analysis, and insights into the results; she also edited the final version of this document, corrected it, and offered suggestions to improve the same. All authors have read and approved the final manuscript.

## Competing interests

The authors declare that they have no competing interests.

## Availability of data and materials

The games created in this project, as well as the RUFUS platform, are available at the links: Web - `https://rufus.icmc.usp.br/login`, and App - `https://play.google.com/store/apps/details?id=com.RufusSystem.Rufus`.

# References

Bradley, M. M. and Lang, P. J. (1994). Measuring emotion: the self-assessment manikin and the semantic differential. *Journal of behavior therapy and experimental psychiatry*, 25(1):49–59. DOI: https://doi.org/10.1016/0005-7916(94)90063-9.

Brooke, J. (2013). Sus: a retrospective. *Journal of usability studies*, 8(2):29–40. Available at: `https://uxpajournal.org/wp-content/uploads/sites/7/pdf/JUS_Brooke_February_2013.pdf`.

Chai, C. W. E., Lau, B. T., Tee, M. K. T., and Al Mahmud, A. (2022). Evaluating a serious game to improve childhood cancer patients' treatment adherence. *Digital Health*, 8:20552076221134457. DOI: https://doi.org/10.1177/20552076221134457.

da Hora Rodrigues, K. R., Darin, T. d. G. R., and de Almeida Neris, V. P. (2022). Building your own games: A platform for authoring digital games. In *2022 21st Brazilian Symposium on Computer Games and Digital Entertainment (SBGames)*, pages 1–6. IEEE. DOI: https://doi.org/10.1109/SBGAMES56371.2022.9961073.

da Hora Rodrigues, K. R., Elias Cardoso Verhalen, A., Willian da Silva, J., Marino Silva, T., Geurgas Zavarizz, R., de Almeida Neris, V. P., and Maia de Souza, P. (2023). Design and evaluation of an authoring platform for therapeutic digital games. *Interacting with Computers*, page iwac045. DOI: https://doi.org/10.1093/iwc/iwac045.

de Almeida Silva, L. C., Gracindo, R. F., Calheiros, M. I. F., de Oliveira, V. F., and de Souza, J. P. G. (2018). O efeito terapêutico do ato de ouvir e contar histórias em um setor de tratamento oncológico: relato de experiência. *Gep News*, 1(1):38–43. Available at:`https://www.seer.ufal.br/index.php/gepnews/article/view/4680`.

de Melo Pinheiro, T. S., Valério, C. C., Maciel, C., da Hora Rodrigues, K. R., and dos Santos Nunes, E. P. (2021). Revisiting empathy games concept from user comments perspective. In *Proceedings of the XX Brazilian Symposium on Human Factors in Computing Systems*, pages 1–11. DOI: https://doi.org/10.1145/3472301.3484359.

de Souza, P. M., Rodrigues, K. R. d. H., and de Almeida Neris, V. P. (2019). Semth: An approach to the design of therapeutic digital games. In *Proceedings of the 18th Brazilian Symposium on Human Factors in Computing Systems*, pages 1–11. DOI: https://doi.org/10.1145/3357155.3358440.

Del Pino, C. and Pereira, V. T. (2017). Ludoterapia durante o tratamento contra o câncer infantil: revisão integrativa de literatura. *Revista Psicologia em Foco*, 9(14):26–44.

Dutra, T., Maschio, E., and Gasparini, I. (2023). Pensar e lavar: Processo de desenvolvimento e avaliação de um jogo digital educacional para promover o pensamento computacional para crianças neurotípicas e com deficiência intelectual. *Revista Brasileira de Informática na Educação*, 31:659–690. DOI: https://doi.org/10.5753/rbie.2023.3330.

Fiorini, J. J. and Mullen, J. A. (2006). Understanding grief and loss in children. *Vistas Online*, pages 31–33. Available at:`https://pt.scribd.com/document/516295787/understanding-grief-and-loss-in-children`.

Fleming, G. G. S. (1998). A comparison of spousal anticipatory grief and conventional grief. *Death Studies*, 22(6):541–569. DOI: https://doi.org/10.1080/074811898201399.

Galvão, V. F., Maciel, C., and Da Hora Rodrigues, K. R. (2024a). How to promote empathy in games? an analysis of the structural elements to be considered in the interaction design. In *Proceedings of the XXII Brazilian Symposium on Human Factors in Computing Systems*, IHC '23, New York, NY, USA. Association for Computing Machinery. DOI: https://doi.org/10.1145/3638067.3638073.

Galvão, V. F., Maciel, C., Dos Santos Nunes, E. P., and Da Hora Rodrigues, K. R. (2024b). A framework to support the development of empathic games. In *Proceedings of the XXII Brazilian Symposium on Human Factors in Computing Systems*, IHC '23, New York, NY, USA. Association for Computing Machinery. DOI: https://doi.org/10.1145/3638067.3638104.

Garcia, F. E., Brandão, R., Cheban, G., and Neris, V. A. (2019). Co-criação inclusiva de jogos digitais baseados em storytelling apoiada por um framework em um centro de atenção psicossocial álcool e drogas. In *Anais Estendidos do XVIII Simpósio Brasileiro sobre Fatores Humanos em Sistemas Computacionais*, pages 180–181. SBC. DOI: https://doi.org/10.5753/ihc.2019.8429.

Garcia, F. E., da Hora Rodrigues, K. R., and de Almeida Neris, V. P. (2016). An interaction modeling language for therapeutic applications. In *Proceedings of the 15th Brazilian Symposium on Human Factors in Computing Systems*, pages 1–10. DOI: https://doi.org/10.1145/3033701.3033733.

Garcia-Schinzari, N. R., Pfeifer, L. I., Sposito, A. M. P., Santos, J. L. F., Nascimento, L. C., and Panúncio-Pinto, M. P. (2014). Caixas de histórias como estratégia auxiliar do enfrentamento da hospitalização de crianças e adolescentes com câncer/the use of story boxes as an adjuvant strategy to cope with hospitalization of children and adolescents with cancer. *Cadernos Brasileiros de Terapia Ocupacional*, 22(3). DOI: https://doi.org/10.4322/cto.2014.079.

Gonzalez, C. L. and Bell, H. (2016). Child-centered play therapy for hispanic children with traumatic grief: Cultural implications for treatment outcomes. *International Journal of Play Therapy*, 25(3):146. DOI: https://doi.org/10.1037/pla0000023.

Guerney, L. (2001). Child-centered play therapy. *International Journal of Play Therapy*, 10(2):13. DOI: https://doi.org/10.1037/h0089477.

Hoffmann, S., Schraut, R., Kröll, T., Scholz, W., Belova, T., Erhardt, J., Gollmer, D., Mauck, C., Zacharioudakis, G., Meyerheim, M., *et al*. (2021). Aquascouts: epros implemented as a serious game for children with cancer to support palliative care. *Frontiers in Digital Health*, 3. DOI: https://doi.org/10.3389/fdgth.2021.730948.

Karns, J. T. (2002). Children's understanding of death. *Journal of Clinical Activities, Assignments Handouts in Psychotherapy Practice*, 2(1):43–50. DOI: https://doi.org/10.1300/J182v02n01_05.

Kübler-Ross, E. (1973). *On death and dying*. Routledge.

Lieberman, H., Paternò, F., Klann, M., and Wulf, V. (2006). End-User Development: An Emerging Paradigm. *End User Development*, pages 1–8. DOI: https://doi.org/10.1007/1-4020-5386-X_1.

Maciel, C., de Souza, P. C., Lima, L., and dos Anjos, A. M. (2014). *Objetos educacionais, parceria FNDE-UFMT*. UFMT. Cuiabá: UFMT, Secretaria de Tecnologias da Informação Aplicadas à Educação, Book.

Madeira, R. N., Correia, N., Dias, A. C., Guerra, M., Postolache, O., and Postolache, G. (2011). Designing personalized therapeutic serious games for a pervasive assistive environment. In *2011 IEEE 1st International Conference on Serious Games and Applications for Health (SeGAH)*, pages 1–10. IEEE. DOI: https://doi.org/10.1109/SeGAH.2011.6165465.

Muri, M., Carvalho, R., Silva, T., Rodrigues, K., and Darin, T. (2022). Boas práticas para o design de jogos sérios em ferramentas de autoria eud. In *Anais Estendidos do XXI Simpósio Brasileiro de Fatores Humanos em Sistemas Computacionais*, pages 92–95. SBC. DOI: https://doi.org/10.5753/ihc_estendido.2022.224866.

Netto, I. S. B., Leite, C. Q., Gonzales, T. S., da Silva, C. S., dos Santos, A. D. S. P., Ferreira, Y. Q., de Negreiros, M. E. R., Lérias, B. Y. B., and dos Santos, B. F. (2022). A ludoterapia no tratamento oncológico infantil. *Revista Eletrônica Acervo Saúde*, 15(7):e10605–e10605.

Nishikawa, D., Novak, L., Azevedo, M., Branco, P., Olivi, R., Brandão, R., Garcia, F., and Neris, V. (2016). Se cuidar, cuidar de algo, se divertir e aprender fazem bem. *Demonstração de um jogo para apoiar o tratamento da depressão*.

Robin, B. (2006). The educational uses of digital storytelling. In *Society for Information Technology & Teacher Education International Conference*, pages 709–716. Association for the Advancement of Computing in Education (AACE). Available at:`https://www.learntechlib.org/p/22129/`.

Rodrigues, K. R., Conrado, D. B., and Neris, V. P. (2018). Lessons learned in designing a digital therapeutic game to support the treatment and well-being of children with cancer. In *International Conference of Design, User Experience, and Usability*, pages 231–243. Springer. DOI: https://doi.org/10.1007/978-3-319-91806-8_18.

Rodrigues, K. R., Valério, C. C., Pinheiro, T. S., Maciel, C., and Nunes, E. P. (2021a). Diretrizes para o design de jogos empáticos. In *Anais Es-*

*tendidos do XX Simpósio Brasileiro de Jogos e Entretenimento Digital*, pages 86–95. SBC. DOI: https://doi.org/10.5753/sbgames_estendido.2021.19628.

Rodrigues, K. R. d. H., Neris, V. P. d. A., Zavarizz, R. G., Silva, J. W. d., Silva, T. M., Verhalen, A. E. C., and Souza, P. M. d. (2022). Criando jogos digitais terapêuticos a partir da plataforma de autoria rufus. *Anais Estendidos*. DOI: https://doi.org/10.5753/ihc_estendido.2022.225290.

Rodrigues, K. R. d. H., Silva Junior, J. M., Nespule, L., Maia, M. S., Garcia, L. E., and Galati, H. B. (2020). Lume: Um jogo digital para incentivar a leitura de lendas do folclóre brasileiro. *Anais*. Available at: `https://www.sbgames.org/proceedings2020/EducacaoFull/209786.pdf`.

Rodrigues, K. R. d. H., Souza, P., Zavarizz, R., da Silva, J., Silva, T., Verhalen, A., and Neris, V. (2021b). Rufus - uma plataforma para autoria de jogos digitais terapêuticos. In *CLIHC-X Latin American Conference on Human Computer Interaction*. DOI: https://doi.org/10.1145/3488392.3488407.

Santos, D. B. d., Maciel, C., Pereira, V. C., and Nunes, E. P. d. S. (2018). Analysis of the perception of users of empathic games in discussion forums and their relation to death. In *Proceedings of the 17th Brazilian Symposium on Human Factors in Computing Systems*, pages 1–10. DOI: https://doi.org/10.1145/3274192.3274198.

Santos, R. C. S., Yamamoto, Y. M., and Custódio, L. M. G. (2017). Aspectos teóricos sobre o processo de luto e a vivência do luto antecipatório. *Psicologia*, pages 1–18. Available at`https://www.psicologia.pt/artigos/textos/A1161.pdf`.

Santos dos Santos, S., Modesto Campos, E., and da Hora Rodrigues, K. R. (2022). Emoframe: Prototype of a framework to assess users' emotional responses. In *HCI International 2022 - Late Breaking Papers. Design, User Experience and Interaction: 24th International Conference on Human-Computer Interaction, HCII 2022, Virtual Event, June 26 – July 1, 2022, Proceedings*, page 282–301, Berlin, Heidelberg. Springer-Verlag. DOI: https://doi.org/10.1007/978-3-031-17615-9_20.

Silva, T. M. (2022). Design, desenvolvimento e avaliação do jogo de narrativa invertida para a plataforma rufus. Available at:`https://tcc.icmc.usp.br/monografias/monografias_original/2022/2104/26492104-Tiago.pdf`.

Sommerville, I. (2011). *Engenharia de Software. ed*. São Paulo, SP: Pearson Prentice Hall. Book.

Susi, T., Johannesson, M., and Backlund, P. (2007). Serious games: An overview. Available at: `https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A2416&dswid=-2771`.

Tumolo, C. H. S. (2015). Histórias digitais como recurso para ensino/aprendizagem de inglês como língua estrangeira. *Revista Estudos Anglo-Americanos*, (43):101–117. Available at:`https://ppgi.paginas.ufsc.br/files/2015/11/REAA-43-5.pdf`.

VanEck, R. (2006). Digital game-based learning: It's not just the digital natives who are restless. *EDUCAUSE review*, 41(2):16. Available at: `https://commons.und.edu/tlpp-fac/25/`.

Verhalen, A. E. C. (2022). *Design de Jogos Digitais Terapêuticos que Apoiam o Diálogo com Crianças sobre a Morte*. PhD thesis, Universidade de São Paulo. Dissertação. Available at:`https://www.teses.usp.br/teses/disponiveis/55/55134/tde-02062023-085520/en.php`.

Verhalen, A. E. C., Pereira, V. C., Bim, S. A., de Picoli, R. M. d. M., Maciel, C., and Rodrigues, K. R. d. H. (2021). Jungle party - a game about loss and grief. In *IHC '21: Brazilian Symposium on Human Factors in Computing Systems*. DOI: https://doi.org/10.1145/3472301.3484364.

Verhalen, A. E. C. and Rodrigues, K. R. D. H. (2023). Design of therapeutic digital games that support dialogue with children about death. In *Proceedings of the XXII Brazilian Symposium on Human Factors in Computing Systems*, pages 1–8. DOI: https://doi.org/10.1145/3638067.3638112.

Verhalen, A. E. C., Silva, T. M., and Rodrigues, K. R. D. H. (2023). Once upon a time... you! a game to support health professionals in the treatment of children with chronic diseases, helping them to express their feelings. In *Proceedings of the XXII Brazilian Symposium on Human Factors in Computing Systems*, pages 1–10. DOI: https://doi.org/10.1145/3638067.3638129.

Verhalen, A. E. C., Zavarizz, R. G., Silva, J. W. d., Silva, T. M., Nunes, C. E. P., de Gois Ribeiro Darin, T., and Rodrigues, K. R. d. H. (2022). Telling your own story: design and evaluation of a storytelling mechanic in a platform for serious games authoring. In *Proceedings of the 21st Brazilian Symposium on Human Factors in Computing Systems*, pages 1–7. DOI: https://doi.org/10.1145/3554364.3561610.

Wong, F. K. C. (2013). Helping a child cope with loss by using grief therapy. Available at: `http://dspace.cityu.edu.hk/handle/2031/7126`.

Yazıcı Arıcı, E., Kalogiannakis, M., and Papadakis, S. (2023). Preschool children's metaphoric perceptions of digital games: A comparison between regions. *Computers*, 12(7):138. DOI: https://doi.org/10.3390/computers12070138.