How Design and Technology Can Contribute to Learning: The Mobeybou in Brazil Educational Game Case Study

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Abstract Currently, there is a generation of children that tend to be exposed from a very early age to digital media, especially in the most economically and culturally developed societies. Thus, it is necessary to think about ways in which technology can contribute to learning, namely by seeking to converge the recreational component with the educational while preventing or suppressing potential dangers. This study aimed at extending the Mobeybou pedagogical materials, i.e., a Digital Manipulative for storytelling, and a set of interactive story applications, thus integrating the easy access that children have to technologies and the positive characteristics of games. In this context, here we present a descriptive case study of the design process of the interface for a game to be integrated into the Mobeybou in Brazil story app. The game interface is intended to reinforce the knowledge conveyed through the reading of the story app, therefore contributing to the development of language skills, creativity, and digital literacy. The game interface should be easy and intuitive to use, its development followed a design thinking methodology. A pilot test carried out with a group of five children aged between 8 and 9 years-old revealed very encouraging results, showing that the game interface was easy to use and engaged children with the story content.

Keywords UX design · UI design · Design thinking · Mobile game · Mobeybou

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1 Introduction

Never before have young children been exposed to digital media as today [1, 2]. A study carried out by Common Sense Media in the United States [3], on the use of media by children up to 8 years of age, pointed out that children, between 5 and 8 years-old, spend an average of three hours a day in front of a screen. The two activities where they spend most of their time are watching television or videos (73%) and playing video games (16%).

Depending on how these digital technologies are used, they can be beneficial or detrimental for children [4]. Using age-appropriate and well-developed technologies has the potential to promote learning in a playful way [5]. On the other hand, there are also negative effects when children visualize inappropriate content [4]. Excessive use of smartphones or tablets may also pose a risk to children's health, such as visual problems and physical inactivity.

This work emerged in the scope of Mobeybou[1] (Moving Beyond Boundaries), a research project that consists in the study and development of a set of digital tools for the creation of narratives aiming at contributing to the development of cognitive, social, and linguistic skills in young children within a multicultural context [6]. It aims to take advantage of the easy access that children have to technology and the positive characteristics of games and playful technologies.

1.1 Project Background

The central tool of the Mobeybou materials is a Digital Manipulative (DM). DM are objects with embedded computational properties that serve as interfaces for manipulating digital content [7]. Mobeybou is composed of 60 physical blocks that communicate with a computer device via Bluetooth and with each other via magnets embedded on the sides. Each block represents a story element from different world cultures. Connecting the blocks triggers the embedded digital content such as static and animated images, ambient sounds, and music (see Fig. 1). The children create their stories by connecting the blocks to each other while they verbalize their stories. The stories can also be recorded. A digital version of the DM, the StoryMaker, allows using the digital environment without having the physical blocks.

Additionally, there is a set of interactive story apps (Mobeybou in India, Mobeybou in Brazil, and Mobeybou in Cape Verde) that give children information about the different cultures represented in the DM and the storyMaker. Here we will focus on the interactive story app Mobeybou in Brazil. Like all the Mobeybou story apps, Mobeybou in Brazil uses the cultural elements represented in the DM. The story starts in the south of Brazil and the protagonist travels through the different regions to the north, visiting different landscapes and overcoming several challenges along the way. To read the narrative, the child can choose between a boy and a girl protagonist. To

[1] http://mobeybou.com.

Fig. 1 The Mobeybou DM (left), Home screen of the story app, Mobeybou in Brazil (right)

reinforce the knowledge acquired during the reading of the story app, we decided to develop and integrate into the app a game with its story elements. This paper reports the development of the game interface. In the following section, we will begin by presenting the theoretical framework and then a descriptive case study of the design process of the game interface.

1.2 Theoretical Framework

User Experience Design (UX) and User Interface Design (UI). To develop the game interface, it was necessary to consider the dimensions of the User Experience design (UX Design), User Interface design (UI Design) as well as the product usability. These are essential dimensions that need to be analyzed when creating digital products. UX Design is the process of creating an experience that meets the needs of the user when interacting with an interface [8]. The quality of the user experience is determined by the ease or the difficulties that the user experiences while interacting with the interface [9]. Morville [10] considers that for having a positive experience the product must be useful, usable, desirable, findable, accessible, credible, and valuable. Usability is directly linked to the user experience. Usability is referred as a quality that reveals the ease of use of an interface [11, 12]. Nielsen [13] refers to usability encompassing five components:

1. Learnability: how easy it is for the users to complete the tasks the first time they use the interface;
2. Efficiency: how quickly the users complete the tasks after knowing the interface;
3. Memorability: how easily the users regain usage proficiency after a period without using the interface;
4. Errors: number of errors that the users make and how easily they recover from them;
5. Satisfaction: level of satisfaction that the user has when using the interface.

Usability can be used as a product's quality that can be evaluated or as a set of principles that help achieve that quality. These are known as the ten usability heuristics, developed by Nielsen [14]. These usability heuristics are general rules

and not specific usability guidelines. A way to evaluate the usability of a product is through usability tests. The tests allow identifying design problems and opportunities [15]. According to Nielsen [16], a usability test conducted with five users allows detecting up to 85% of the usability problems of a product.

UI Design plays an important role in creating experiences, it consists of the design of the interface elements, e.g., buttons, menus, and other interactive elements that allow the interaction between a user and a device [17]. Here the designer must have graphic and digital design skills to adjust the visual properties of these elements, such as color, shape, typography, graphic composition, and hierarchy to create an interface that is both appealing and functional.

In short, UX Design and UI Design are complementary concepts that depend on each other to create relevant digital products. If one of both fails or is underestimated, it may jeopardize the quality of the product [9].

Integration of Gamification Elements. The idea of integrating a game into the Mobeybou in Brazil app resulted from the knowledge that gamification activities provide a good opportunity to reinforce learning [18]. Gamification is the process of designing activities and experiences that are similar to games [19, 20]. Gamification can be used in various situations and for various purposes. Here, we sought to investigate its applicability in educational contexts. According to Lee & Hammer [18], there are three main areas in the educational context where gamification can intervene, namely:

1. Cognition: The trial-and-error process that takes place when the players experiment and discover complex game rules encourages critical thinking, problem-solving and creativity. After an initial phase, the games should be adapted to the player's skills, progressively increasing the level of difficulty;
2. Emotions: Games can provoke emotions in the player e.g., enthusiasm, joy, or surprise, among others. At an early stage, games require experimentation, and often players fail repeatedly before learning to play. Gamification can provide emotional support in this phase of negative emotions and even make them positive, reframing failure as a necessary part of learning;
3. Social: Players can try out new identities. This possibility allows players to explore new facets, for example, a shy player can try to be a leader.

Gamification can be applied using several game mechanics e.g.: points and badges—to quantify the player's actions; levels, quests and challenges—to give insight into the player's progress in the game; and leaderboards and achievements—to compare players, generating competition between them [21, 22].

These elements can be used in educational contexts to motivate children and promote learning by transforming uninteresting tasks into interactive and captivating tasks, maintaining the child's involvement with educational subjects [18].

Regarding story apps, gamified activities can generate more involvement with the story, enhancing learning and providing support for vocabulary acquisition [23]. When developing an educational game, it is essential to bear in mind that children do not yet have the same skills as adults, also it is necessary to consider limitations imposed by mobile devices, e.g., the size of the buttons. According to Miller &

Kocurek [24], it is essential to pay attention to the motor skill required by the game, and to use language that is familiar to children.

2 Methodology

This study followed a Design Thinking methodology [25, 26], comprising five phases: *empathize*, define, ideate, prototype, and test [27].

In the *empathize* phase we sought to clarify the problem and gather a comprehensive knowledge of the theme under investigation. This included a literature review on gamification, User Experience Design (UX Design), User Interface Design (UI Design), as well as an analysis of the Mobeybou DM.

In the *define* phase, we synthesized the information collected in the previous stage, identified opportunities, and established requirements. We then defined the types and profiles of possible users. We developed a navigation diagram with user flows, mapping all the screens and the route that the users would take in the game.

The *ideate* phase was dedicated to the design and exploration of various interface solutions to find the most viable one and advance to the next phase. Outgoing from the navigation structure defined in the user flows, we designed wireframes to obtain a low-fidelity representation of a possible solution. Visual design decisions were made regarding typography, chromatic, and UI elements, which resulted in a visual interface design.

In the *prototype* phase, we developed an interactive version of the interface that was used during the design process to communicate ideas and get feedback on the interface's progress.

In the *test* phase, we carried out a series of usability tests to evaluate the usability and effectiveness of the proposed solution with the target audience. Based on the results obtained, problems were identified and subsequently corrected.

We collected demographic information on the use of educational games on mobile devices via online surveys involving children, parents, and educators. In total, we collected responses from 37 children, 42 parents and 12 educators.

In the following section, we will detail the various phases of the development.

3 Design and Development of the Game Interface

3.1 Phase 1—Empathizing with the Product

Following the Design Thinking methodology, we started by defining the problem and its limitations, therefore, several meetings were held with the Mobeybou research team to understand the project and the concepts behind the development of the materials.

We then collected information about the potential users. This helped to make decisions based on their needs and interests, as well as to create the profile of the potential users of the game. We have collected data via online questionnaires with our target users. We collected a total of answers from 37 children, 42 parents, and 12 educators. The results of the questionnaires showed that 24% of the children use mobile devices for less than 30 min a day; 30% use digital devices between one and two hours a day and 46% use mobile devices between 30 min and one hour per day. Children's preferred activities are playing games and watching videos, followed by browsing the internet and reading stories. In the games category, children prefer puzzle games, followed by action and adventure games, Legos, and memory games. Around 57% of the children stated that they occasionally play educational games, whereas 20% do not usually play games.

Regarding games, parents consider that the most important thing in a game is to foster reasoning, strategic thinking and learning to accept defeat. Twenty-eight parents (66.7%) reported playing games with their children and having preference for educational, puzzle, and/or adventure games. Around 52%, stated that their children have the habit of playing games, while 38% inform that their children play only occasionally. Some parents stated that their children ask them for help when they do not know how to interact with technology, and that most of these problems are related to information architecture and navigation.

From the twelve inquired educators eight (66.7%) said that they use games for teaching; three (25%) use games occasionally and one does not use games at all. The used games range from analog games such as naval battle or multiplication tables, to interactive platforms. All the educators in the study believe that games contribute to increasing children's learning motivation.

3.2 Phase 2—Defining the Problem

Creating Personas. Following the information obtained in the previous phase, we synthesized the collected data and created three potential user personas [28]. Personas are fictitious representations of possible types of users who may use a product or service [29]. These fictitious representations are created based on the characteristics of real people and provide a way to empathize with the potential users and understand their behaviors, goals, and needs [28]. Keeping potential users in mind helps to make decisions according to their needs, which in turn contribute to creating meaningful user experiences. Based on the information collected in the previous phase, we have created a persona for each type of user, namely, children, parents, and educators (see Table 1).

Creation of the User Flows. Based on the information collected in the previous phases, we created a user flow focusing on the child's persona to design the navigation within the game (see Fig. 2). The user flow describes the connections between screens and the sequence of steps that the user takes from the beginning to the conclusion

Table 1 The user personas

João Silva Child 5 years-old	Ana Silva Mother 40 years-old	Maria Gomes Primary school teacher 45 years-old
Characteristics		
• Enthusiastic and curious • Enjoys watching videos, playing games, browsing the internet, and reading stories • Uses the Tablet on average 1 h a day • Usually finds it easy to interact with games or apps • Occasionally plays educational games • Prefers puzzle, action, adventure, Legos, and memory games	• Often plays with her son • Prefers educational, puzzle, and adventure games • Has low technological proficiency	• Uses multimedia content to teach • Often uses games in class • Uses interactive platforms as an educational complement • Believes that educational games contribute to increasing children's learning motivation
Use case		
João likes to read stories and play games. He wants a fun game to play while learning new things. Because it's an educational game, maybe his parents would let him play longer	Ana has a 5-years-old son who knows how to use his tablet and loves to play games. The games that her son plays don't have educational content. She is looking for a fun educational game that her son would be interested in	Maria is planning the weekly class on the countries of the world. To complement the school manual, she looks for an engaging way to teach children about the culture of a particular country
Needs		
• Learn in a fun way • Easy to use • Accessible language	• Games with adjustable difficulty level • Interactive mini-games • Possibility to share with friends • Monitor the child's progress • Games with narrator or guidance	• Educational material with challenges • Didactic games • Solutions for creating stories • Digital solutions to complement the class
Goals		
• Learn to read better • Develop cognitive, social, critical thinking and creativity skills	• Teaching English to her son • For her son to exercise or develop cognitive skills • For her son to learn to accept defeat	• Teach her students captivatingly and effectively • Develop her students' creativity, writing and narrative skills
Frustrations		

(continued)

Table 1 (continued)

João Silva Child 5 years-old	Ana Silva Mother 40 years-old	Maria Gomes Primary school teacher 45 years-old
• Having little reading autonomy • It takes some time to read • Asking for help (can't find something, having doubts about how to play or when making a mistake) • Unknown or difficult words	• Some games are not adapted for small screens • Too much distracting information in the game • Excessive advertising in free games • Free games with additional paid features (freemium) that her son could buy by mistake	• School manuals are not attractive; they don't arouse curiosity in children • Limitation of multimedia equipment in schools • Manage conflicts because of competition in the game between students

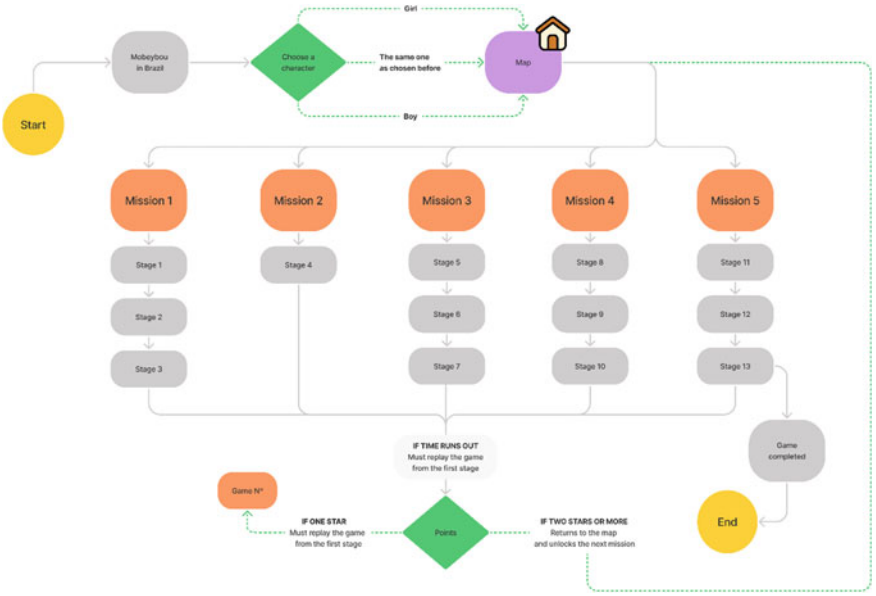

Fig. 2 User flow of the possible solution for the game

of the game. The user flow helped to organize and structure the game screens and to plan the gamification techniques.

As previously referred, the game is integrated into the story app Mobeybou in Brazil. Like the reading activity, the user can choose between the boy or the girl character to play the game. The game is made up of a series of missions, some consisting of several stages. A stage refers to the task that the user must complete. For example, in the first mission, the stages are the objects that the user must find. The missions, including their stages, have a time limit for completion. The time limit

must be sufficient for the user to solve the task while preventing her from randomly trying out various options.

Along the missions, the user needs to remember parts of the Mobeybou in Brazil story to complete the tasks of each stage. To facilitate this, we created a feedback button. When clicking the button, the user accesses information about the respective task. In some stages, it is possible to use the feedback functionality twice. Since the missions have a time limit for completion, the user needs to learn to manage the time s/he spends reading the hints. For each completed stage, the user receives one star. The only exception to this rule is the second mission, which only consists of one stage. At the end of each mission, the user is awarded stars according to his performance. The following mission is only unlocked when the user gets at least two stars, otherwise, she will have to repeat the mission.

3.3 Phase 3—Ideation

This stage is aimed at generating and testing different interface solutions. Outgoing from the user flow previously created we designed various wireframes and created a visual system for the construction of the game screen, considering typographic, chromatic, and the choice of UI elements.

Development of Wireframes. Following the creation of the persona's models and the user flows, we created the wireframes of the various screens of the game. Wireframes are structural drawings, in the form of a sketch that represents the content of the screens of an interface (see Fig. 3). The sketches make it possible to quickly experiment with various interface concepts without compromising the visual aspect.

Fig. 3 Low-fidelity wireframes with and without the Mobeybou's graphics applied

Their purpose is to investigate not only the usability but the information architecture of the interface, without considering visual design options, e.g., choice of colors or fonts. The sketches helped to organize the content of the application and to communicate ideas, allowing us to gather feedback and validate possible solutions with the Mobeybou team. Getting feedback early in the design process prevents wasting time on solutions that may not be feasible.

As the game is part of the Mobeybou set of materials, to test the flexibility of Mobeybou's graphic language and to understand its limitations, we have developed several low-fidelity wireframes using the Mobeybou's graphical elements to organize the interface and gamification elements, as well as to open the discussion to the rest of the team who might have difficulties interpreting grey wireframes. The wireframes made it possible to discuss ideas and adjust the direction of the project with the Mobeybou team, which was fundamental for the design. The wireframes showed that the game interface would need several elements that did not exist yet.

Development of the Visual Design. Following the wireframe studies, we began developing the visual elements of the game interface. The design of the interface elements followed Frost's atomic design system [30], a methodology that starts from the design of smaller components for the constitution of larger components. This process is inspired by an analogy observed in science where atoms compose the main structures of nature, which in turn build other elements. In the case of design, this can be seen in web pages that can be divided into smaller elements. For example, a web page can be split into sections like the header, which in turn can be split again into smaller elements, like text and images.

This method ensures the cohesion of the interface and the visual language, as well as producing reusable elements. Therefore, the smallest elements of the game interface, e.g., typography, color, iconography were first defined and were followed by the layout of the mission screens.

Regarding the font, Mobeybou uses the Sassoon typography, a sans-serif typeface, with a calligraphic and rounded design, inspired by the writing of children. It was created by Rosemary Sassoon, who investigated which are the best typographic forms for children to read [31]. In partnership with font designer Adrian Williams, she developed several typefaces intended for teaching reading and writing. As Sassoon is a font developed to meet the needs of the children, this typography was also used in the development of the game interface.

Regarding the color scheme, the colors used in Mobeybou were used to create a chromatic palette. We have identified three main colors: red, the ground color of Mobeybou, which is also the color of its logo; green, obtained by the vegetation and landscapes of the countries; and, browned yellow, which is used in text boxes of the apps (see Fig. 4). To make the color palette more versatile, a darker color was added for each color.

The green and red colors were chosen because they have useful connotations for the game. Red is recognized as representing danger, while green has the opposite meaning. Since in the game it is necessary to indicate the result of the users' actions, this chromaticism is convenient as it forms part of a universally recognized code.

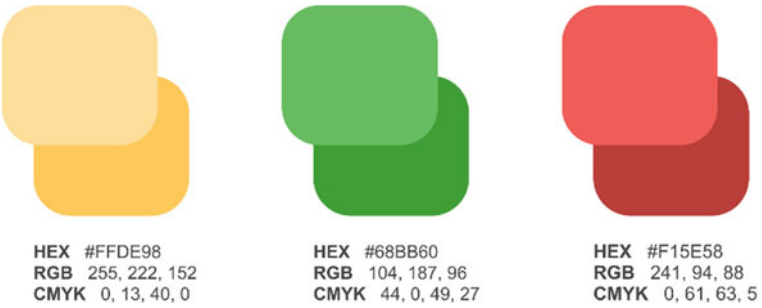

Fig. 4 Mobeybou's color palette

Mobeybou's iconography has a defined and justified visual style, inspired by the crayons used by children. For this reason, we decided to keep the visual appearance of the icons and create new ones based on the existing graphic standard (see Fig. 5).

One of the problems detected through the wireframes was the visual inconsistency created by the different shapes and dimensions of Mobeybou's illustrations. We have explored alternatives to visually balance the illustrations presented on the game screen by using a shape to delimit the area of the images (see Fig. 6).

Using a shape to contain the illustrations helps create congruence in the images. After several explorations, we have decided to use a square shape with relief at the bottom, which gives it a three-dimensional appearance.

This option was chosen because it is a reference to Mobeybou's DM, which is composed by square blocks. Thus, a child who was used to playing with the blocks would recognize their functionality through the shape. The previously defined color scheme was used to create the visual feedback of the elements when they are chosen correctly or incorrectly. The crayon texture used in the icons and the rest of Mobeybou's visual language were used in the outline of the game blocks.

The three-dimensional appearance of the blocks was the key concept for the interface. Based on this concept, the remaining UI elements of the interface were developed, namely, the time bar that shows how much time the user has to complete the mission and the text boxes, e.g., the tips and the text at the beginning of the missions.

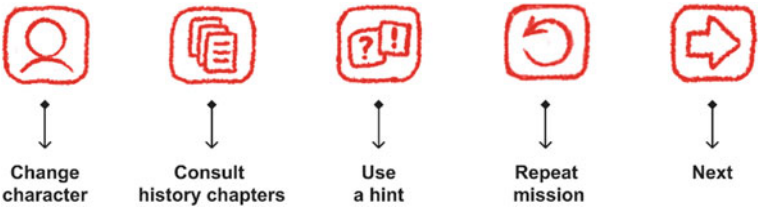

Fig. 5 Mobeybou's iconography

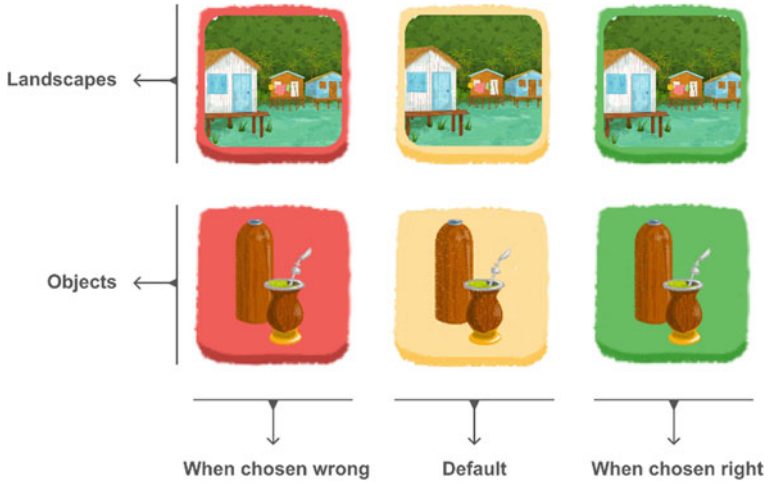

Fig. 6 Game blocks stages

The time bar makes use of the defined chromatic palette. The bar is divided into three parts. At the beginning of the mission the bar starts filling and over time when reaching the intermediate and end time, the bar changes its color.

Concerning the feedback hints, the graphics of the blocks were also used, creating a legible area where text could be placed. This solution was not only used for the feedback hints but also in other representations, for example, for the initial text of each mission, for modal windows, or other types of pop-ups.

Having defined all the necessary elements, we created a layout to inform the construction of the game prototype.

3.4 Phase 4—Development of the Prototype

Development of a High-Fidelity Prototype. During the design process, several partial prototypes were created to help understand the navigation flow through the game and support communication with the Mobeybou team. The prototype was something that evolved throughout the project and underwent several changes as the design process unfolded.

After defining the UI elements of the interface, the visual design was implemented in the final wireframes. In addition to the visual aspect, the texts and cultural elements of each mission were also inserted. The result was a functional mobile app developed by Mobeybou's programmers, ready to be tested with future users (see Fig. 7).

Fig. 7 High-fidelity prototype screenshots

3.5 Phase 5—Testing the Game Interface

One of the ways to study, evaluate and validate the usability of a given product is through usability tests. The tests are carried out with representative users of the product and aim at detecting usability problems and identifying opportunities for the improvement of the design [15].

Based on this knowledge, in this phase, we conducted a pilot test with the target audience, to evaluate the usability and effectiveness of the solution.

Usability testing. The usability tests were carried out with a mixed group (boys and girls) of five third graders, aged between 8 and 9 years-old. The tests were performed with the high-fidelity game prototype. The children interacted with the prototype individually, and each test lasted approximately 15 min. Table 2 shows the tasks that the children need to complete.

The data collection focused mainly on qualitative analysis, observing the children's behavior and reactions during interaction with the prototype. The tasks were rated as completed/uncompleted according to each child's ability to finish the task seamlessly.

The usability tests revealed that the interface achieved a 96% success rate (see Table 2). According to the observations made during the usability tests, we concluded that all the participants were able to perform the proposed tasks.

Regarding the user experience, all children considered the experience positive and enjoyed playing the game. All said that the game was easy to play and that their peers would have no difficulty playing it.

Table 2 Usability testing: tasks and results

Task number	Task	Success rate (%)
1	Entering the game	80
2	Starting the game with the girl character	100
3	Playing the first mission	100
4	Using a hint	80
5	Consulting the story chapters	100
6/9	Playing the second, third; fourth; fifth missions	100
10	Change character	100
11	Understand in which mission are you	100
Total success rate		96

4 Conclusion

We presented a descriptive case study of the design process of the graphical interface for the game integrated to the story app Mobeybou in Brazil. The main goal of this process was to develop an intuitive and easy-to-use interface directed to pre-and primary school children, and contributing to the reinforcement of language skills, creativity, and digital literacy.

The process began by analyzing the Mobeybou materials, particularly the story app Mobeybou in Brazil. The design thinking methodology guided the development of the project. Along the design process, we have used several methods, such as surveys, personas model, user flows, wireframes, and prototyping. The design tools, especially the more visual ones, such as the user flows and wireframes, made it possible to communicate ideas and plan the next steps, aligning the entire team in the process.

During the entire process, the central point was the user's needs and cognitive limitations intrinsic to the project age group. This cooperation between designer and user was essential to achieving this result.

The limitations found in the development of this work were the restrictions caused by the COVID-19 pandemic. Given the situation, it was necessary to find alternative solutions to those initially planned. For example, the usability tests had to be carried out with a limited number of participants. Despite these limitations, the results obtained were not impaired. This change caused a slight delay in the study but did not affect its results.

The validation of the interface through a usability test revealed a success rate of 96%, thus ensuring an intuitive and effective use by the target audience. The tests also showed that the interface promoted a high degree of satisfaction by the users. Finally, the visual system developed during the project provided design patterns that may be useful in the expansion of the game or, in the future, in the elaboration of other cultural games.

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References

1. Sarkar N, Ford W, Manzo C (2017) Engaging digital natives through social learning. Systemics, Cybernetics Info 15(2):1–4
2. Zevenbergen R (2007) Digital natives come to preschool: Implications for early childhood practice. Contemp Issues Early Child 8(1):19–29. https://doi.org/10.2304/ciec.2007.8.1.19
3. Rideout V, Robb M (2020) The common-sense census: Media use by kids age zero to eight, 2020. Common Sense Media
4. Straker L, Pollock C, Maslen B (2009) Principles for the wise use of computers by children. Ergonomics 52(11):1386–1401. https://doi.org/10.1080/00140130903067789
5. Kokkalia G, Drigas A, Economou A (2016) Mobile learning for preschool education. Int J Interactive Mobile Tech 10(4):57–64. https://doi.org/10.3991/ijim.v10i4.6021
6. Sylla C, Martins V, Sá G, Caruso A, Amaro B, Menegazzi D, Sylla F (2019) Designing narrative learning in the digital era. In: CHI EA '19: Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems, pp 1–6. https://doi.org/10.1145/3290607.3312937
7. Sylla C, Gil M, Menegazzi D, Araújo C, Fernandes R, Martins N (2021) Once upon a time: A kit of tools for reading and telling stories. In: ARTECH 2021—10th International Conference on Digital and Interactive Arts, 303–309. https://doi.org/10.1145/3483529.3483685
8. Norman D, Nielsen J, The definition of user experience (UX). https://www.nngroup.com/articles/definition-user-experience, last accessed 2021/01/08
9. UX Planet, What is UI design? What is UX design? UI vs UX: What's the difference. https://uxplanet.org/what-is-ui-vs-ux-design-and-the-difference-d9113f6612de, last accessed 2021/01/09
10. Morville P, User experience design. http://semanticstudios.com/user_experience_design, last accessed 2021/01/05
11. Dix A, Finlay J, Abowd GD, Beale R (2004) Human-computer interaction. Prentice Hall
12. Preece J, Rogers Y, Sharp H (2002) Interaction design: Beyond human-computer interaction. Wiley (2002)
13. Nielsen J, Usability 101: Introduction to usability. https://www.nngroup.com/articles/usability-101-introduction-to-usability, last accessed 2021/01/10
14. Nielsen J, 10 Usability heuristics for user interface design. https://www.nngroup.com/articles/ten-usability-heuristics, last accessed 2021/01/31
15. Moran K, Usability testing 101. https://www.nngroup.com/articles/usability-testing-101, last accessed 2021/02/16
16. Nielsen J, Why you only need to test with 5 users. https://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users, last accessed 2021/02/10
17. Interaction Design Foundation, User interface design. https://www.interaction-design.org/literature/topics/ui-design, last accessed 2021/01/06
18. Lee J, Hammer J (2011) Gamification in education: What, how, why bother? Academic Exchange Quart 15(2):1–5
19. Deterding S, Dixon D, Khaled R, Nacke L (2011) From game design elements to gamefulness: defining "gamification." In: 15th International Academic MindTrek Conference: Envisioning Future Media Environments, pp 9–15. https://doi.org/10.1145/2181037.2181040
20. Werbach K (2014) (Re)defining gamification: A process approach. In: Spagnolli A, Chittaro L, Gamberini L (eds) International Conference on Persuasive Technology. Springer, Cham, pp 266–272. https://doi.org/10.1007/978-3-319-07127-5_23

21. Klock A, Carvalho M, Rosa B, Gasparini I (2014) Análise das técnicas de gamificação em ambientes virtuais de aprendizagem. RENOTE—Revista Novas Tecnologias Na Educação 12(2). https://doi.org/10.22456/1679-1916.53496
22. Kumar J, Herger M, Dam R, Introducing game mechanics for gamification. https://www.interaction-design.org/literature/article/introducing-game-mechanics-for-gamification, last accessed 2022/03/31
23. Homer B, Kinzer C, Plass J, Letourneau S, Hoffman D, Bromley M, Hayward E, Turkay S, Yolanta K (2014) Moved to learn: The effects of interactivity in a Kinect-based literacy game for beginning readers. Comput Educ 74:37–49. https://doi.org/10.1016/j.compedu.2014.01.007
24. Miller J, Kocurek C (2017) Principles for educational game development for young children. J Child Media 11(3):314–329. https://doi.org/10.1080/17482798.2017.1308398
25. Brown T (2008) Design thinking. Harv Bus Rev 86(6):84–92
26. Tschimmel K (2012) Design thinking as an effective toolkit for innovation. Action for Innovation: Innovating from Experience. Barcelona, 1–20
27. Dam RF, Siang TY, 5 stages in the design thinking process. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process, last accessed 2021/02/22
28. Cooper A, Reimann R, Cronin D, Noessel C (2014) About face: The essentials of interaction design (4th edn). Wiley
29. Caballero L, Moreno A, Seffah A (2014) Persona as a tool to involving human in agile methods: Contributions from HCI and marketing. In: International Conference on Human-Centred Software Engineering, 283–290. https://doi.org/10.1007/978-3-662-44811-3_20
30. Frost B (2016) Atomic design. Brad Frost, Pittsburgh
31. Sassoon R, Williams A, Sassoon fonts. http://www.sassoonfont.co.uk/index.html, last accessed 2022/03/31