Once Upon a Time: A Kit of Tools for Reading and Telling Stories

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ABSTRACT

This paper discusses the contribution of Design in the development of a kit of tangible and multimedia tools for children to collaboratively read and create stories about the world. Here, we detail the design process, including the investigation of visual concepts, the prototyping and the user studies carried out during the development of the tools. We discuss the contribution of Design in the development of each step both through the adoption of theoretical concepts from the field, and by following a participatory Design and a User Centered Design approach. In the context of an investigation that combines a range of different fields, we argue that the Design has acted as the element that materializes and unifies the multidisciplinary contributions, leading to the creation of compelling engaging materials, which have the potential to involve users in the creation of multicultural narratives.

CCS CONCEPTS

• **Applied computing**; • **Education**; • **Interactive learning environments**;

KEYWORDS

Tangible Interfaces, Storytelling, User-Centered-Design, Prototyping, Playful learning, Children

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1 INTRODUCTION

This paper addresses the following research question: what is the contribution of Design in the development of a kit of tangible and multimedia tools for children to collaboratively read and create stories about the world? More specifically: (i) what design decisions must be taken, both in the development of the visual identity and the different interfaces; (ii) and what possibilities have been created for children to read and tell stories that convey different ways of seeing and knowing the world? To answer these questions, we will detail the different development phases of the Mobeybou set of tools, highlighting the design decisions in each of them. Our approach builds on the notion that Design plays a fundamental role in creating empathy between the users and the object [1] An empathy created through the visual component results not only in increasing the focus and interest of the users in the object, but also in a more effective transmission of pedagogical content [1] The contribution of Design in mediating the educational message requires the adoption of methodologies associated with areas such as User Experience (UX) and User Interface (UI), the creation of wireframes, information architecture and workflows [1] , [2]. As well as the involvement of the users in the design process.

In the following, we present the concepts that underpin the development of the Mobeybou kit, and then detail the design and development process of the tools.

2 UNDERPINNING CONCEPTS

Mobeybou presents a kit of tools that complement and inform each other, i.e., a digital manipulative (that uses physical blocks for manipulating digital narrative elements), a digital storyMaker (that replicates the digital manipulative, and can be used without the physical blocks), a set of interactive story apps, and games. The development of a multicultural story environment was motivated by today's superdiverse communities [3] and the growing importance of learning, from an early age, to know other cultures, increasing sensitivity to cultural differences, and openness to new and different ideas [4]. Together, the tools aim at offering children opportunities to read and explore the diverse world in which they are growing up by providing opportunities to create and share multimodal, multilingual and multicultural stories [5] .

Multimodality has a prominent role in the Mobeybou materials with each tool playing an important part in the integration of the various dimensions that are addressed by the different materials, namely: Multimodal communication, collaboration, creativity, playfulness, embodiment, interactivity, and multiculturalism.

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Multimodal communication and collaboration are considered important skills in overcoming cultural, geographical and language boundaries [6], [7] Creativity and playfulness are essential for children's natural learning and development; being core aspects of early childhood education [7] , [8].

Embodiment plays an important role in thinking and reasoning, as body and mind are tightly connected [9]. Interactivity is a central aspect in learning when we consider the mediative nature of learning, either by means of signs or by means of human mediation [10]. Finally, multiculturalism is of major importance in today's education, having the potential to increase sensitivity to cultural differences and promote openness to new and different ideas [11].

The relevance of these dimensions in early childhood has been demonstrated by extant research, however their articulated integration is a key distinctive design feature of the presented pedagogical tools. Thus, one of the main challenges posed during the design process of the Mobeybou materials was to incorporate the different tools in a way that children would embrace, despite the complexity of these concepts.

To achieve these goals, we started by creating a visual identity that aimed at communicating a message aligned with the project's goals. The main objectives of the Mobeybou materials are (i) to create an appealing story environment that fosters children's collaboration and playful exploration (by using physical block to create their stories); (ii) to provide children information about the represented cultures, nourishing their imagination and creativity in a playful way, while providing ideas to feed their stories (through the story apps and the games). A major challenge in the design of the story world was to create empathy between the users and the represented elements, while avoiding stereotypes. Having developed the different tools, the final design challenge was to aggregate them, creating a coherent entire communication system.

2.1 Methodology

The development of the Mobeybou materials follows an iterative and participatory design methodology, involving children and teachers along its development, thus undergoing several iterations. The data is collected through observations, field notes, video and audio recordings, semi-structured interviews with the children and the teachers, and design sessions. In the design sessions, we use low-fidelity paper and functional prototypes to gather information on how the children use tangible elements to collaboratively create narratives and navigate the story apps. The design is also informed by research on the use of props to promote the creation of narratives [12] ,[13], as well as studies on embodiment and tangible interaction [9],[14].

3 DESIGN AND DEVELOPMENT PROCESS

In this section, we detail the design and development process of the tools. We begin with the development of the visual identity and then describe each of the tools that are part of the Mobeybou materials.

3.1 Visual Identity

An identity system is not limited to the design of a logo, it also has the function of aggregating and making coherent an entire communication system, integrating its different elements [15] . All these elements need to be calibrated to converge in the construction of a message that is tuned with the brand and its products [16] ,[17],[18]. In the creation of an identity the technical component is also a factor that has to be considered. For example, our selection of the typography seeks not only to graphically reflect an environment that is appealing to children, but also to be technically adaptable to the different situations in which it is applied, particularly in terms of legibility. For the development of the visual concept, we started by gathering visual information that we then used to create panels and as a reference for developing shapes and extracting colors and forms that we transformed into typography. As a result, we have created a flexible brand that allows a variation of elements (Figure 1).

Figure 1: The Mobeybou Logo.

3.2 Digital Manipulative and StoryMaker

The central tool of the Mobeybou materials is a digital manipulative. Digital Manipulatives [14] are objects with embedded computational properties that serve as interfaces for manipulating digital content. They promote collaboration [19], particularly supporting exploratory and expressive learning activities [20] .

3.2.1 The Digital Manipulative: From Paper to Digital. The current version of the digital manipulative underwent several iterations and was informed by various user studies that were carried out with children using low fidelity prototypes. In these studies, we began by investigating how children would use illustrated paper cards to create stories. The sessions took place at school with a class of 3rd graders and their teacher. The children interacted freely with the paper prototype in groups of six. They started using the paper cards like domino pieces, placing them together and creating rows (Figure 2, left). It was interesting to observe how the children used the cards and to talk with them about it. Their ideas informed and inspired the modelling of the story world, and some suggestions were implemented in the final version of the digital manipulative.

After having implemented a digital prototype, we carried out a second user study to validate our developments. The prototype consisted of an electronic board (connected to the computer via USB) with six slots for placing the blocks that represented story elements. Placing a block on the board triggered its digital content (Figure 2, middle). Children could create their stories by placing the blocks on the electronic platform.

The children easily understood the functioning of the system and the modelling of the story world and were enthusiastic about the materials. However, they expressed the wish to create longer stories than it was possible with the prototype (the electronic board offered six slots).

Figure 2: (From left) Children using the paper cards, interacting with the previous prototype, and with the blocks' prototype.

To overcome this limitation, we decided to use blocks that connect to each other through magnets placed on the lateral of the blocks. The current DM is composed of 61 wooden blocks that communicate with a computer device via Bluetooth and are used for manipulating the digital content.

Each block represents a story element. Connecting the blocks to each other triggers the embedded multimodal digital content (static and animated images, ambient sounds, and music) (Figure 2, right). The children create their stories by connecting the blocks to each other while they verbalize their stories. The stories can also be recorded.

3.2.2 The StoryMaker. The storyMaker is a digital version of the DM that was developed to overcome the need of having the physical digital manipulative. Although the digital version does not offer the same possibilities as the DM, specifically concerning the promotion of collaboration, it has the advantage of allowing for an unlimited use, boosting the accessibility to the tool. As there is no narration incorporated, and the stories are visually and verbally created by the children themselves, there are no language barriers, and the system is available to all children independently of their language.

To create their stories the children can access the different countries on the top of the display. Each country is represented through its flag (Figure 3, left). Once they click the icon of a country the respective library opens displaying the elements of the culture on a vertical bar on the right side of the screen. From there the children can drag the elements and start creating their stories. A random button placed next to the countries randomly displays elements from the various cultures on the vertical library bar. The weather icons are located on the left of the screen. From there the children can customize the weather in their stories. A recording button allows recording children's oral narratives. The interface is designed to use both versions, i.e., the digital manipulative and the storyMaker.

If the physical blocks are present and activated, the system detects the blocks and opens the digital manipulative interface, if the system does not detect any physical hardware, it opens the storyMaker interface. A led button on the bottom-right and a written message signalize the state of the connection of the hardware, i.e., that the blocks are connected or not connected. Children can also customize their characters choosing different cloths, by clicking on the icon located next to the weather icon. Activating this function opens a menu displaying the countries (left), clicking on a country displays the respective cloths, which can be chosen to dress the characters (Figure 3, right).

3.3 Characters, Scenarios, and Interactions

The story world of the DM (and the storyMaker) comprises eight cultural sets that represent the following cultures: Portugal, Brazil, Germany, India, Cape Verde, China, and Turkey. Each set comprises: a landscape, two protagonists, an animal, an antagonist, a musical instrument, and a magical object. All elements are representative of native components of the country or are inspired by the folklore, traditions, or mythology of the culture (Figure 4).

Figure 3: The storyMaker interface (left). The interface for customizing the characters (right).

Figure 4: Examples of the cultural kits (left), examples of the Character's Interactions (right).

The visual style is neither too realistic nor over-stylized, aiming at inviting the children to a world of play and make believe. The protagonists' design is cartoonish in proportion and there is a prevalence of round features, which are more appealing and make the characters perceived as being friendly [21] .

The development of the cultural sets focuses primarily on creating story elements that have the potential to trigger children's imagination and captivate their attention and curiosity, so that they can start a dialogue, and later learn more about the world [22] .

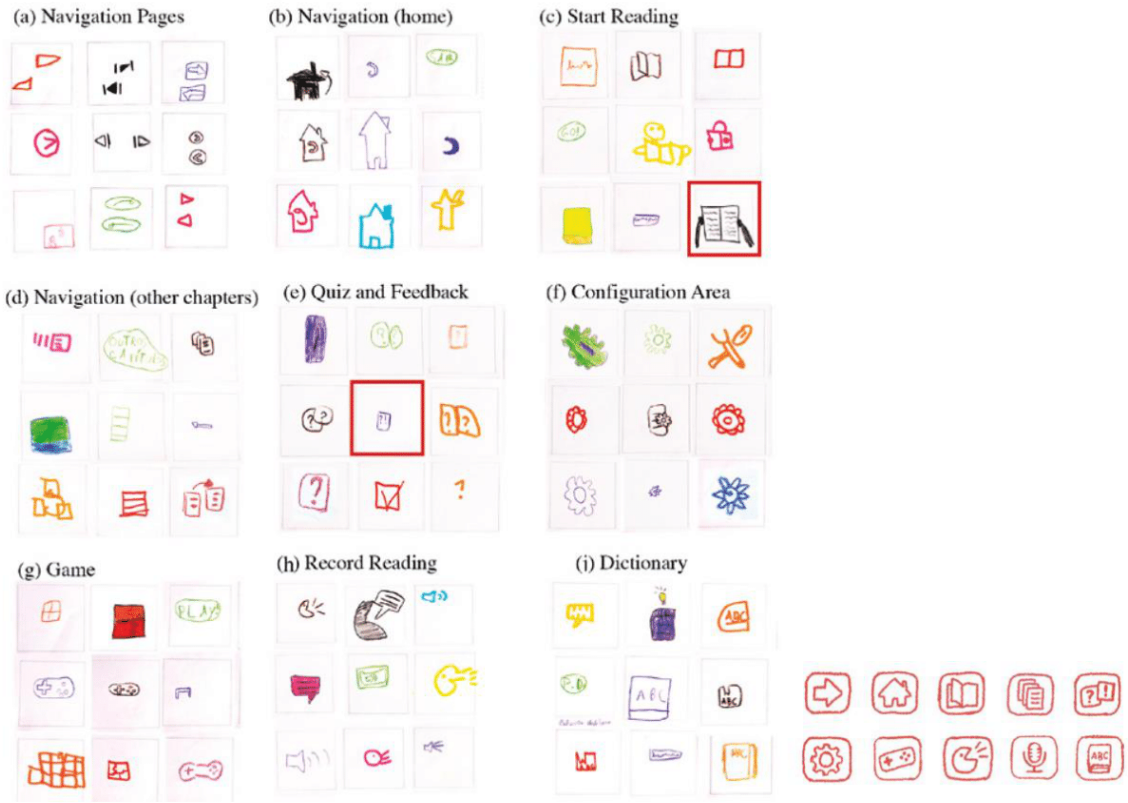

Figure 5: Drawings of icons by the children (left) and the results, based on children's drawings (right).

To convey a fair representation of the portrayed cultures we have applied the following set of criteria, adapted from [23]:
a) Ethnic, physical and gender diversity;
b) High-fidelity visual representations, based on information collect with native informants and extensive research;
c) Situated diversity (for instance, in different geographic settings, tools, music), thus avoiding stereotyping due to decontextualization;
d) Display of diversity within each cultural group;
e) Friendly and solidary relationships amongst the human characters;
f) Personal discovery and learning based on knowing the others;
g) Universal structure, allowing reflection about human diversity from the situations displayed.

3.4 Story Apps

The motivation to develop story apps was given by the opportunity to provide more information about each culture and show some of its diversity. The story apps were developed (i) to offer children information about each of the represented cultures e.g., location of the country, games involving local traditions, food or other elements that belong to each specific culture; and (ii) to nourish children's creativity and feed their stories. Each app is dedicated to one of the cultures. A 360ºpage invites children to move the tablet device around to discover the story world and a page with augmented reality invites children to bring the main characters to life. Each app has a glossary, which also presents information about the country.

The information provided in the apps is multimodal (visual, haptic, aural), provided through various resources and addressing multisensory channels. In the Brazil story app, for example, the protagonists travel from South to North, exploring different regions of the country. The reader is introduced to beautiful natural landscapes, but also to big cities, going beyond the most known sites of the country.

3.4.1 Story App's Navigation. Previous studies have identified that one of the main interaction problems in children's story apps is the graphic design of the interaction areas, i.e., the hotspots (Figure 5).

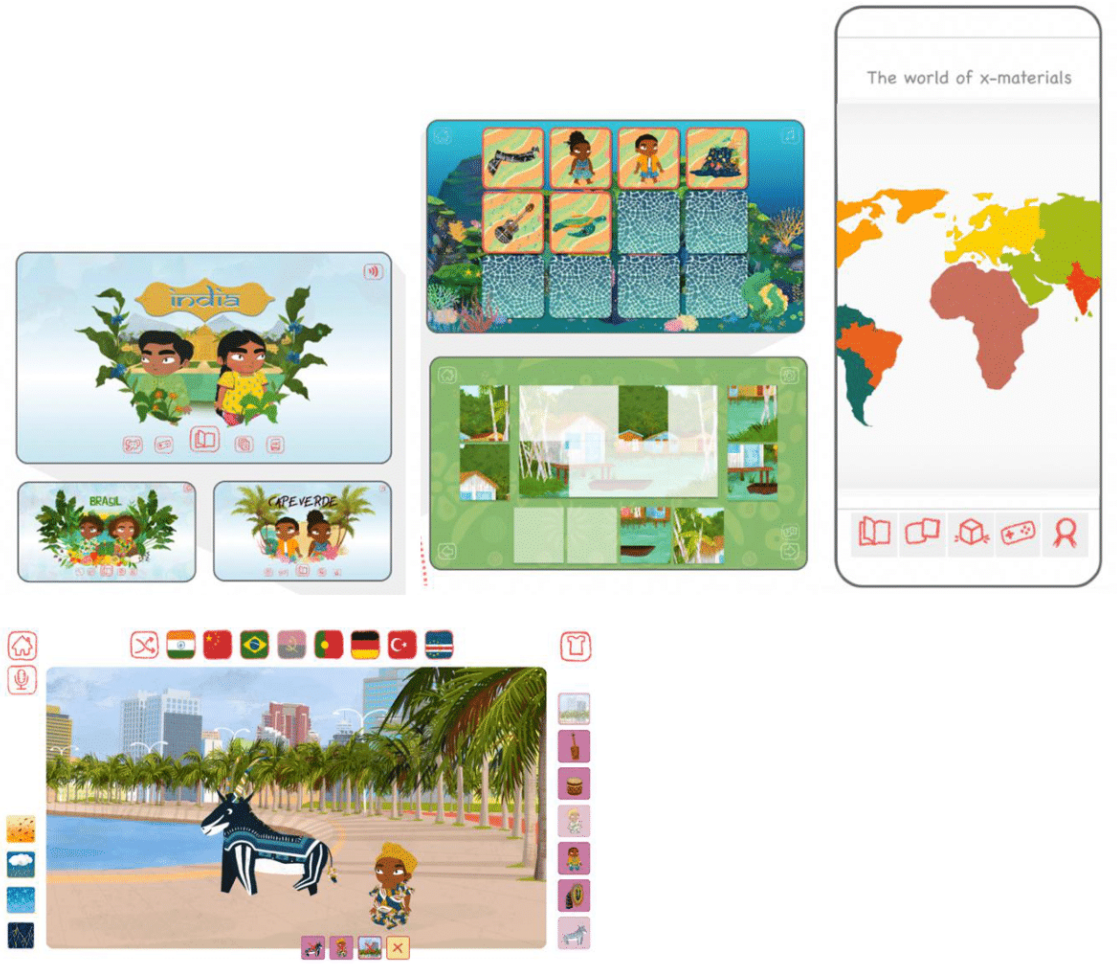

Figure 6: The Integration of the Mobeybou World.

To assure a fluent and intuitive navigation in the story apps, we carried out user studies with children. In these studies, we investigated: (a) if the representations of the navigation icons were clear for the children, (b) if they identified with the visual representation of the icons, (c) and if the children could easily find the location of the items [24]. Here we present a brief description of the study related to the design of the hotspots, to illustrate our point in this paper. Following the identification of the most used hotspot icons in a sample of ten commercial interactive story apps for children, we chose for each hotspot the three icons that appeared most frequently. We printed each icon on a small paper card and created a paper prototype simulating two pages of an interactive story app. We then asked the children to choose the icons and navigate the paper prototype. At the end, we invited the children to draw their own version of the hotspots.

3.4.2 Playground. In addition to the story apps, we are developing a set of games that explore the information conveyed through the story apps. The playground includes various mini games related to the cultures presented on the DM and the story apps and aim at reinforcing the knowledge acquired in reading the stories in a playful way.

3.5 The Mobeybou World

Having developed a set of different materials that inform and complement each other, the next design challenge was to aggregate and create a coherent entire communication system, integrating visual, audio, and interactive elements. In this context, we propose to develop a combination of these components into a single application. This work is still in its beginning; therefore, we are exploring various possibilities.

To develop a frame for aggregating all the various materials, we have applied the Double Diamond Design model [25], a methodology composed of four stages: Discovery, Definition, Development and Delivery. The initial stage, the *Discovery* aims to clarify and deeply understand the problem and the needs of the future users. The *Definition* stage aims at gathering insights from the data obtained in the previous phase to further help define the problem and determine the user's needs.

The *Development* stage marks the start of the actual design process, the actual making of the solution to the problem defined in stages one and two. Finally, the last stage, the Delivery, aims to test the medium/high fidelity prototype with the target users, to iteratively improve the final solution. Since this work is still in progress, in the following, we describe part of the Development stage, that is, the initial development of the design of the screens. At this stage, we have prioritized the level of satisfaction of the users regarding the visuals and the organization of content.

The first stage of the development phase consisted of an initial wireframe study of the information architecture with the objective of defining the concept and organizing the navigation system. Regarding the integration of the story apps, since the main concept behind the Mobeybou materials is multiculturalism, the navigation experience is carried out through the representation of the world map in a flat way, which facilitates children's understanding of the location of countries and continents. The story apps can be accessed through the world map, for this, the user selects a country to have access to the respective app. We organized the navigation on the bottom of the screen, so that the users can have access to all the tools on the main screen (Figure 6).

4 CONCLUSIONS

The Mobeybou materials build on the contribution of different areas of knowledge. Particularly interesting is the interplay of the different materials, while the story apps convey cultural and linguistic information (e.g., learning of new vocabulary, structure of the narrative) and stimulate the user's imagination, the digital manipulative and the storyMaker offer an open environment where the children can let their imagination and creativity flow, playing around with the different story elements, creating a myriad of different and original narratives.

Each tool can be explored independently, however its integrated use enhances the possible learnings. The Design contributed to the development of the tools through the adoption of theoretical concepts from the field, as well using User Centered Design strategies and Participatory Design. The involvement of the children during the different development phases, allowed developing child centered materials that have the potential to involve them more profoundly. The design process was also fundamental for developing the Mobeybou world, which is still in development. The next steps will be carried out with children to understand its pedagogical potential and usability. To summarize, the investigation underwent the following steps.

We started (i) by developing a visual identity that conveys a clear and playful message to the target audience; (ii) we carried out user studies and created prototypes that informed the development of the digital manipulative and the digital storyMaker; (iii), the definition of a visual style was a key element: the story elements should be visually appealing to children and, at the same time, represent multicultural aspects; (iv) we addressed the navigation design, the interaction design, as well as the organization of content areas and the suitability of the applications for children users; (v) these concepts had to be retrieved in order to extend the initial developments and articulate them in an application from which the user could have access to all the developed tools, being able to explore them in an integrated way. This work is still in progress.

The main contribution of this study is the design of a set of tools that inform and complement each other, and resulted from investigations that join different knowledge domains, i.e., Education, Linguistics, Engineering, Human-Computer Interaction and Design. This paper particularly highlights the contribution of Design, as the unifying element that materializes all these components, leading to the creation of engaging materials, which have the potential to involve users in the creation of multicultural narratives.

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REFERENCES

[1] Pedro Beça, Sofia Ribeiro, Rita Santos, Mónica Aresta, Ana Isabel Veloso, Cláudia Ortet. 2021. Design and Initial Evaluation of an Online Portal-Repository: The Case of Gamers4Nature Project. In: Advances in Design and Digital Communication, N. Martins, D. Brandão (eds). Digicom 2020. Springer Series in Design and Innovation, vol. 12. Springer, Cham. https://doi.org/10.1007/978-3-030-61671-7_13

[2] Nuno Martins, Heitor Alvelos, Abhishek Chat Terjee, Inês Calado, Mariana Quintela. 2020. Multimedia as mediator of knowledge between older generations and present-day students of art and design. In: 4th International Conference on Education and Multimedia Technology (ICEMT 2020), July 19–22, Kyoto, Japan. ACM, New York, NY, USA. https://doi. org/10.1145/3416797.3416827

[3] Steven Vertovec. 2010. Towards Post Multiculturalism? Changing Communities, Conditions and Contexts of Diversity. International Social Science Journal 61, 199, 83-95.

[4] Partnership for 21st Century Skills. 2008.

[5] Cristina Sylla, Iŕis Pereira, Gabriela Sa: 2019. Designing Manipulative Tools for Creative Multi and Cross-cultural Storytelling. In *Proceedings of the 12th conference on Creativity & Cognition*, C&C'19, pp. 396-406, San Diego, CA, USA, June 23-26. doi>10.1145/3325480.3325501.

[6] Heather Lotherington. 2017. Elementary language education in digital multimodal and multiliteracy contexts. In: Language Education and Technology (3rd ed.), S. Thorne and S. May (eds.), New York, Springer, 1-15. doi: 10.1007/978-3-319-02328-1_7-1.

[7] Lev Vygotsky. 2004. Imagination and Creativity, Childhood. Journal of Russian and East European Psychology 42, 1, 7-97.

[8] Mitchel Resnick. 2017. Cultivating Creativity through Projects, Passion, Peers and Play. The MIT Press, Cambridge, Massachusetts.

[9] George Lakoff, Mark Johnson. 1999. Philosophy in the flesh: the embodied mind and its challenge to western thought, New York, Basic Books.

[10] Lev Vygotsky. 1978. Mind in Society. Cambridge, MA, Harvard University Press.

[11] Mary Lenox. 2000. Storytelling for Young Children in a Multicultural World. Early Childhood Education Journal 28, 97–103. https://doi.org/10.1023/A:1009599320835

[12] Vivian Paley. 2004. Child's Work: The Importance of Fantasy Play, Chicago, Chicago University Press.

[13] Judy Van Scoter. 2008. The Potential of IT to Foster Literacy Development in Kindergarten. In International Handbook of Information Technology in Primary and Secondary Education, J. Voogt, G. Knezek (eds.), Part One, 149-161, London, Springer.

[14] Mitchel Resnick. 1998. Technologies for Lifelong Kindergarten. Educational Technology Research and Development, 46 (4).

[15] Daniel Raposo, Fernando Oliveira, Luís Farinha. 2020. From Identity into Brand Visual Identity: Finding and Defining the Intangible Brand DNA. In: Handbook of Research on Driving Industrial Competitiveness with Innovative Design Principles, Luis Farinha, Daniel Raposo (eds.). IGI. Global, 66-85. http://doi:10.4018/978-1-7998- 3628-5.ch005

[16] Daniela Oliveira, Daniel Raposo, José Silva, João Neves. 2021. Visual Representation of Design Process: Research Projects in Communication Design. In: Advances in Design and Digital Communication. Digicom 2020, N. Martins, D. Brandão (eds.) Springer Series in Design and Innovation, vol 12. Springer, Cham. https://doi. org/10.1007/978-3-030-61671-7_56

[17] Nuno Martins, Juan-Ramon Martin-Sanroman, Fernando Suárez-Carballo. 2020. The Design Process in the improvement of the experience between a brand and its target audience through a digital product: The Lexus Portugal's used car website case study, Advances in Science, Technology and Engineering Systems Journal, 5(5), 620-629. https://dx.doi.org/10.25046/aj050576

[18] Vera Barradas, María Victoria Durán, Daniel Raposo. 2020. The Creation of Brands in the Online Experience: A Study About the Brand Image of Children's Clothing. In: Perspective on Design, D. Raposo, J. Neves, J. Silva (eds). Springer Series in Design and Innovation, vol 1. Springer, Cham. https://doi.org/10.1007/978-3-030-32415-5_12

[19] Eva Hornecker. 2005. A Design Theme for Tangible Interaction: Embodied Facilitation. In: Proceedings of the 9th European Conference on Computer Supported Cooperative Work (E CSCW'05) Kluwer/Springer, 23-43.

[20] Paul Marshall. 2007. Do tangible interfaces enhance learning? In: Proceedings of the 1st international conference on Tangible and Embedded Interaction (TEI '07). Association for Computing Machinery, New York, NY, USA, 2007,163–170. https://doi.org/10.1145/1226969.1227004

[21] Gabriela Sa; Cristina Sylla, Douglas Menegazzi, Ana Paula Caruso. 2019. Multiculturalism and Creativity in Storytelling – Visual Devel- opment of a Digital Manipulative for Young Children. In *Proceedings of the 12th confer- ence on Creativity and Cognition*, C&C'19, pp. 369-381, San Diego, CA, USA, June 23-26. doi>10.1145/3325480.3326571

[22] Homi Bhabha. 2006. Cultural Diversity and Cultural Differences. The Post-Colonial Studies Reader, ed. B. Ashcroft, G. Griffiths, H. Tiffin, Routledge, New York, 155–157.

[23] Carlinda Leite, and Lourdes Rodrigues. 2001. *Jogos e contos numa educação para a cidadania.* Lisboa: Col. Práticas Pedagógicas, Ministério da Educação/Instituto de Inovação Educacional.

[24] Douglas Menegazzi, Cristina Sylla, Stephania Pa- dovani. 2020. Rethinking the Design of Hotspots in Children's Digital Picturebooks: Insights from an Exploratory Study. In: T*echnology, Innova- tion, Entrepreneurship and Education.* TIE 2019, Cristina Sylla, Ido Iurgel (eds). Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engi- neering, vol 307. Springer, Cham. https://doi. org/10.1007/978-3-030-40180-1_2

[25] Design, C. (2019). What is the framework for innovation? Design Council's evolved Double Diamond. Disponível em: https://www.designcouncil.org.uk/news-opinion/what-framework-innovation-design-councils-evolved-double-diamond