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Desire to Communicate (Editorial)

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Welcome to this new issue of the Journal of Digital Media & Interaction. The texts published in this issue underlie the desire to communicate, this is the challenge of humanity. Whether the challenge comes from the specificities of the subjects involved, or from the ephemerality/perpetuity of the means and communication processes, or from the layers that an immersive narrative must have, or from the artificialization of sensoriality. The ontological desire to communicate is always present, as a founding element of the human being, as a social creature, who lives or perishes if he succeeds or fails to communicate.

Francisco Feitosa, Ricardo Fragelli and Virginia Souto in "Assessing a 3D digital Prototype for Teaching the Brazilian Sign Language Alphabet: an Alternative for Non-programming Designers" present the results of evaluating the perception of users (deaf and hearing people) of a high-fidelity prototype with a non-programming method, of 3D digital artifacts for teaching the digital alphabet of the Brazilian Sign Language (LIBRAS). The study took into consideration the principles of inclusive design. The investigation was structured into four phases, the last being dedicated to the usability study, which involved the use of a structured questionnaire survey. The majority rated the user experience as overall good. It should be noted that deaf people were the ones who in the highest percentage classified the user experience as Excellent (29%) compared to hearing people, where only 13% classified it as Excellent. This result is interesting considering that the 3D platform is aimed at deaf people, thus giving reasons to continue and deepen the investigation with the inclusion of new elements in the platform.

The paper "Computational media and the paradox of permanence" by Miguel Carvalhais and Pedro Cardoso present a reflective analysis of the permanence and ephemerality of the media, contrasting analogue media with digital media. The idea of the need to develop skills to deal with the media is reinforced, which are not just media, but subsume culture and social dynamics, as they are dynamics of codes and symbols. However, the focus is on the discussion about the imitation of the stillness and stability that digital media makes of analog media, despite its nature being impermanence, which makes computational media time-based media, that is, based on time. in change, and permanence is just an illusion that the viewer creates. Which allows the authors to present the idea of paradox of computational media.

Narratives have been, since the beginning of humanity, a means of realizing the desire to communicate. In "Method for Assessing and Classifying Dimensions of Immersion in Narratives" the authors present and exemplify the use of a method that evaluates and classifies the three dimensions

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of immersive narratives: temporal, spatial and emotional. The empirical investigation was carried out in the context of Portuguese higher education, using an asynchronous teaching-learning approach. In this way, the authors contribute to studies on immersive learning and how to increase the student's subjective state of immersion.

Finally, in “The Alienated Senses: Artificial Stimuli for Sensory Perceptions in Interaction with Infomata” the authors propose an analysis of the alienation of the senses promoted through the use of personal digital home assistants and how this situation promotes an artificialization of sensory perception.

We hope that this set of texts contributes to deepening reflection on the desire to communicate, and how digital technologies promote and challenge, in a disruptive way, this desire.

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Assessing a 3D digital Prototype for Teaching the Brazilian Sign Language Alphabet: an Alternative for Non-programming Designers

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Abstract
This study aims to analyse the users' perceptions about a 3D digital artifacts prototype for teaching the fingerspelling alphabet of Brazilian Sign Language (LIBRAS). For this purpose, a high-fidelity prototype was developed with a non-programming method, and a usability test was conducted using a structured questionnaire with 31 participants, including Deaf and hearing people. Most users (96.7%) rated the learning experience with the tool as positive, with 67.7% rating the experience as "good", 12.9% as "very good", and 16.1% as "excellent". Comparing the evaluation between Deaf and hearing people showed that both target groups mostly rated it positively. However, most hearing people rated it "good," while the majority of the Deaf rated it as "excellent" (29%) or "outstanding" (14%) compared to 13% and 12%, respectively, among the hearing. In summary, considering the variables presented, the experience was well rated and did not encounter solid obstacles or resistance.

Keywords *instructional design, inclusive design, educational multimedia, 3D animated interpreter.*

1. Introduction

Brazilian Sign Language (LIBRAS) is legally recognised as an official language in Brazil, as is Portuguese. It can represent an essential function of inclusion and accessibility for about 10 million people with some degree of deafness in the country (Oliveira, 2012). According to Gesser (2020), making the legitimacy of sign language visible changes the view of deafness as a disability and gives way to a view of deafness as a linguistic and cultural differential. Although the Brazilian Inclusion Law mandates digital accessibility (Lei No 13.146, 2015), mastery of this language is still not sufficient to promote the inclusion of the Deaf community at all desirable levels.

In this sense, the use of teaching tools and the facilitation of communication in LIBRAS, together with efforts to disseminate it in society, contribute to giving more visibility to issues related to inclusion and empowerment. Information and communication technologies (ICTs) have been used to reduce this inequality (Debevc, Kosec, & Holzinger, 2011), as Article 74 of the Brazilian Law on Inclusion (Lei No 13.146, 2015) states that "people with disabilities are guaranteed access to assistive technological products, resources, policies, practices, procedures, methods and services that maximize their autonomy, personal mobility and quality of life." The use of bilingual LIBRAS interpreters in public spaces also contributes to promoting inclusion. Therefore, forms of training and techniques that promote the emergence and development of this professional group are of great importance.

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Signing avatars have the potential to become increasingly valuable to making content more accessible for Deaf people (Kipp, Nguyen, Heloir, & Mattheus, 2011). Computer Graphics Imagery (CGI) has evolved in this sense, along with the spread of computer graphics programs. Added to this is the presence of technology that can enhance the display of LIBRAS signs and the reproduction of interpreters' facial expressions through motion capture devices. Williams (2009), in a debate on the innovations of computer graphics and motion capture technologies, states that "we just need to decide what we want to do because now that the technology exists, we can do anything." Information and Communication Technology (ICT) and Augmentative and Alternative Communication Systems (AACS) can provide broad support for the bilingual education of Deaf students directly through games, apps, e-books, videos, websites, social networks, and multimedia, and indirectly through teachers (Perry & Quixaba, 2019).

Video resources facilitate sign language teaching, communication, and inclusion. About using such formats in digital environments, according to Pezeshkpour, Marshall, Elliot, and Bangham (1999), “phrases synthesized by concatenating video clips of individual signs can be extremely irritating”. Their study shows that the ‘jumps’ between clips are intrusive, making them think reading is tiresome and difficult. Otherwise, a virtual character can alleviate this, allowing smooth interpolation between consecutive signs. However, it is more complicated and can be more expensive to modify and substitute video content after production, which makes it impossible to use this format in dynamic or interactive platforms (Kipp, Heloir, & Nguyen, 2011), and video formats difficult the just-in-time translate generation of websites contents, for example (Kacorri, Huenerfauth, Ebling, Patel, & Willard, 2015).

Using three-dimensional (3D) resources can sometimes surpass this media model. It is important to emphasize that we are not referring to using a video format with 3D animation but a user-manipulable virtual 3D environment. Namely, creating a digital environment allows for navigation that can be explored to enhance the visualization of the signals by zooming into specific areas, rotating, and moving the camera around the avatar. The possibilities for manipulating the visualization of 3D scenes allow for exploring more complex scenarios. In addition, it is common to observe that sign language teachers in video lessons often rotate the torso and hands to show the students the signs from different angles. This visualization flexibility can be essential for people having their first contact with the language since the perception of hand configurations may vary according to experience and contact with the sign language.

Moreover, in the 3D model, there is the possibility to adapt visual resources according to the users' subjectivity and culture. For example, the characters portrayed in 3D animations in the film industry can represent a wide range of emotions and reactions, such as joy, empathy, sadness, happiness, and anger. Also, virtual avatars are user-controlled to display emotional responses and perform various gestures and actions (Peterson, 2005). Thus, it is believed that an animated character can satisfactorily reproduce the richness of facial and physical expression of a human interpreter once that sign language for the Deaf is based on the movements of the hands, face, head, eyes, lips, and body (Debevc et al., 2011). Furthermore, technological advances have made it even easier to generate movements in 3D models, such as motion capture gadgets, combining video models to generate machine animations,

and even using Artificial Intelligence (AI) to create 3D animated models (Kipp et al., 2007; Parton, 2006; Williams, 2009; Wolfe R. et al., 2022).

2D or 3D animation models can be very attractive to children and young people once at these stages, learning different languages is facilitated. For Vygotski (1996), toys and ludic tools are desirable since they stimulate imagination and symbolism, in addition to focusing on the zone of proximal development. Through them, children perform activities that are impossible for them in the real world. Furthermore, studies about Vygotskian psychology point to the possibility of developing hearing and Deaf children concerning linguistics, being essential to teach LIBRAS as a second language as a resource for hearing children. Thus, sign language facilitates the two groups' linguistic exchanges (Marques, Barroco, & Silva, 2013).

Using animated avatars inserted in a 3D environment also has the benefit of anonymity, preserving the identity of possible human interpreters and issues related to the right to use images. In addition, with a 3D digital environment, there is flexibility in using these resources combined with programming, enabling the development of gamified platforms, for example. For some designers, developing an entire front-end platform may not seem easy. However, some alternatives can make it easier than it appears, which can be satisfactory when a complete team with programmers and many resources are unavailable.

We believe that generated data can be used by other researchers and developers of digital artifacts once this kind of research mostly has researchers not members of the Deaf community (Kipp et al., 2011). Also, presenting a way to create 3D teaching tools without the need for in-depth programming languages may represent a stimulus for designers to develop more independent projects and be able to better display and test their ideas through more elaborated prototypes.

The main objective of this work was to analyse the users' perceptions about a 3D digital artifacts prototype for teaching the fingerspelling alphabet of LIBRAS. To reach this goal, (1) a method for non-programming designers to develop a 3D virtual phototype was applied to teach the alphabet in LIBRAS using the concepts of Instructional Design, Inclusive Design, and Information Design; (2) the prototype was tested with potential users; and (3) the users' perceptions about the platform was assessed to understand the facilitating and hindering aspects of using the 3D platform for teaching the LIBRAS letters.

2. Background on LIBRAS and design

2.1 Signing avatars

In summary, an avatar is an online representation of persons in a virtual world designed to enhance interaction in that environment (Peterson, 2005). It represents the users as an extension of their identities, self-images, or desires (Lopes, 2015). Despite being common in online games, avatars are also valuable as virtual tools for teaching sign language or machine translation, as they are ludic, with

production costs lower than the video format, and because they present easier and faster post-production adjustments (Kipp, et al., 2011).

In the game universe, avatars represent the player's figure with the possibility of customization. In contrast, in signaling tools, the representation of the interpreter's figure is more common, with little or no possibility of personalization. According to Lopes (2015, p. 100), the customization aspect is relevant in games, evidenced by the time the users have taken to choose characteristic combinations for their avatars of game platforms. It is worth emphasizing that in an online gaming environment, where avatars are in contact with or visible to other players, additional factors must be considered, such as the need for acceptance or self-assertion (Lopes, 2015, p. 111). In fact, more specific studies are needed to confirm whether the statement is also true for users of digital sign language artifacts, once avatar creation depends on the activity context for which the avatar is created (Zimmermann et al., 2023).

Research involving a focus group with eight participants evaluated some aspects of existing avatars, such as style and personality, upper body movement, movement synchronization, technical remarks, and avatar appearance (Kipp et al., 2011). The study was complemented with the analysis of three avatars by 317 online participants. The feedback from both groups showed that much improvement in the performance of sign language avatars is still needed. The developers of sign language platforms disproportionately prioritize hand animation over other non-manual factors such as facial expressions and mouth patterns, as well as head, shoulder, and torso movements.

The expectation for avatars with more naturalness and emotions also shows that the general appearance should be refined. However, the study shows that animated characters can reach high acceptance levels.

Non-manual expressions are fundamental in many aspects of sign language communication, although being classified as a secondary category. They are very evident in signaling interrogative and negative structures, for example. In some cases, the wrong use of facial expressions can compromise or change the meaning of sentences, and in others, they can express the quantity or intensity of the meaning of a signal (Vieira, Corrêa, Santarosa, Cristina, & Biasuz, 2014).

Other aspects are targets of criticism in existing avatars, such as problems in the visual representation with a low level of realism in the representation of clothes, accessories, textures, and skin. In addition, the high cost of motion capture equipment, such as smart gloves, and the low accuracy of RGB capture technologies or depth sensors (Stefanidis, Konstantinidis, Dimitropoulos, & Daras, 2020). The study conducted by Kacorri (2015, p. 2) brings another variable regarding the evaluation of avatars by the Deaf community: the experience in technology. The study shows that users with technological experience positively evaluated the signing avatars. Since the new generations are more familiar with technology, it is to be assumed that the use of animated avatars will tend to be more common and accepted over the years.

2.2 Relevant LIBRAS grammatical aspects

The language's peculiarities must be considered in developing any tool intended to deal with or teach LIBRAS, whether with a human interpreter or a digitally animated avatar. In this sense, knowledge of grammar and its phonological and morphological levels is essential. For the present study, some of the principles that proved relevant were listed.

LIBRAS is a language of visual-spatial modality structured conventionally and systematically (Brito, 1993; Gesser, 2020). Therefore, people often succumb to the error of considering language as a pantomimic representation, i.e., referring to mime or the art of demonstrating feelings, thoughts, and ideas through gestures or facial expressions without using words.

Stokoe listed three basic parameters that make up the signals, in 1960, namely: HC - hand configuration, AP - articulation point, and L - lease in motion. The palm orientation was later (in the 1970s) included by Battison, Klima, and Bellugi and concerns the direction in which the palm points when the sign is executed (Gesser, 2020). Hand configuration is the shape that the hand and fingers will take. The position refers to where the hand will be placed in relation to the different parts of the body. The movement, which may or may not be present in the characters, is how the hands move (Gesser, 2020). In addition, there are two parameters related to non-manual expressions, which include facial expressions and body expressions (trunk, shoulder, mouth movements, and gaze direction) (Vieira et al., 2014).

Changing the direction of the palm orientation can change the meaning of the sign. As in oral languages, there are also "minimal pairs" in LIBRAS (when the variation of a single lexical component changes the meaning). For example, in Portuguese, "lata" has a different meaning when only the phoneme /l/ is replaced by /c/: "cata". Some examples in LIBRAS (Figure 1) are the signals "free" (grátis) and "yellow" (amarelo), which differ only in hand configuration (HC); "steakhouse" (churrascaria), and "provoke" (provocar), which differ in movement (M); and "to have" (ter) and "Germany" (Alemanha), which vary location (L) (Gesser, 2020).

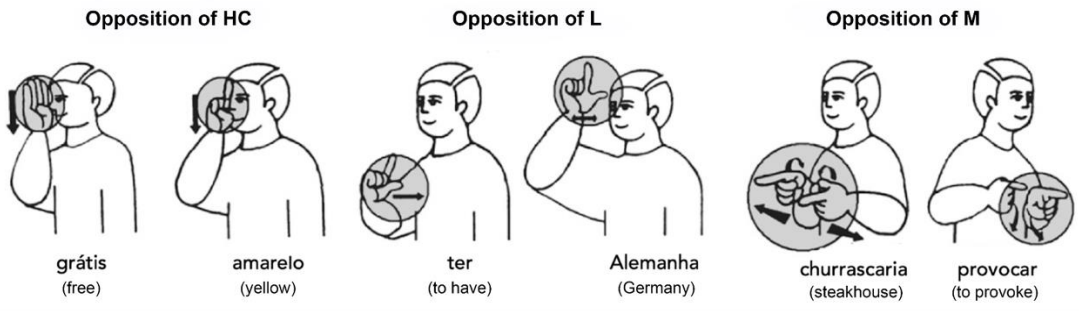


Figure 1: Examples of minimal pairs in LIBRAS. Source: Adapted from Capovilla & Raphael (2001)

It is important to note that signs can be executed with one or two hands. Characters that are performed with only one hand, such as the letters of the typewriter alphabet, can be performed with the

left or right hand without changing the meaning. Moreover, hands are not the only means used in LIBRAS communication.

LIBRAS, like any language, has many other complex features, but only those mentioned are considered for simplicity and to isolate the relevant variables. Once this universe involving LIBRAS and aspects of the Deaf community is minimally established, in addition to information and interaction design issues, the sequence continues with its practical application through the methods used.

2.3 Inclusive design conceptualization

Discourses involving Deaf people, sign language, and deafness reveal two worlds that are relatively unknown to each other: that of Deaf people concerning the hearing world and that of hearing people concerning the Deaf world (Gesser, 2020). Many people do not want or feel comfortable interacting with people with functional differences (Gomes & Quaresma, 2018). According to (Barros, Meserlian, Barros, Ogawa, & Fialho, 2012), the biggest challenge for Deaf people is to belong to a world dominated by auditory-oral communication instead of spatial-visual communication.

Gesser (2020) points to the damage caused by a mistaken attempt at inclusion by analyzing the Deaf. According to the researcher, the quest to regain hearing and attempts to develop Deaf vocalized language are translated into negative feelings, such as: 'longing, pain, deprivation, recognition, oppression, discrimination, and frustration.

One way to reduce these feelings would be to spread communication between hearing and Deaf people in LIBRAS or the sign language of their respective countries. The LIBRAS law (Lei nº 10.436, 2002), which guarantees the obligation of interpreters in institutional spaces where people do not speak sign language, the LIBRAS interpreter acts as a mediator for the inclusion of Deaf persons. Mostly, they are looking to learn sign language because they need to communicate with Deaf family members or friends. The opportunity to act as a professional interpreter has created an even greater demand for hearing people to learn LIBRAS (Gesser, 2020).

Designers can act as facilitators of learning in this context by designing instructional materials using the principles and techniques of instructional design, which is defined as: "the process (a set of activities) of identifying a problem (a need) of learning and designing, implementing and evaluating a solution to that problem" (Filatro, 2008). In this sense, Kipp et al. (2011, p. 12) argues that the involvement of Deaf people is fundamental in usability and evaluation studies, but above all, as developers and animators.

The term "design humanism" used by Bonsiepe (2011b) refers to the exercise of design skills to interpret the needs of social groups and develop viable, emancipatory proposals, whether in the form of instrumental or semiotic artifacts. Thus, it is impossible to recognize the nature of the designer's social responsibility without considering his or her field techniques, methods, projects, and concepts that involve people with special needs and consequently promote their inclusion. One of the goals of inclusive design is to understand the real needs of minority groups.

In this sense, it is essential to realize that accessibility and inclusive design are different concepts. While the former tends to look for solutions with adaptations in environments, products, or services to meet functional differences, the latter looks for solutions where 'looking at diversity' is the essence of the project (Gomes & Quaresma, 2018). In addition, the designer must satisfy users' material and psychological needs, considering materials, manufacturing processes, standards, patents, costs, economic viability, and industrial productivity (Bonsiepe, 2011a).

Inclusive design, also known as design for all, avoids creating exclusive products and environments for people with functional differences and focuses on ensuring that everyone can use all components of the environment and all products. In 1997, the Center for Universal Design established seven principles for universal design: equal use; flexible use; simple and intuitive use; perceptible information; tolerance for error; low physical effort; size and space for approach and use (Gomes & Quaresma, 2018). In practice, one of the most well-known platforms for making the concepts of web accessible and applicable to everyone is the w3c.org portal. It is an international community that develops open tools to ensure the long-term growth of web while also working on internationalization, security, and privacy.

2.4 Principles of information and interaction design

The technological resources, tools, and applications available on the web are part of a powerful information and educational tool with integrative potential. Using such resources in student-centered learning environments supported by electronic media technology can facilitate learning by stimulating visual and cognitive experiences (Alexander, 2001; Hannafin & Land, 1997). The imagery appeal and the use of visual artifacts must be presented in the pedagogical practice of Deaf people due to the possibility of reading the image as text, as well as the visual cues they present (Lopes & Leite, 2011).

In this context, an adequate understanding of the relationships between formal visual aspects such as color, organization, form, and composition and the cultural signals embedded in visual communication is critical to successful and effective design approaches (Noble, 2011). Therefore, it is essential to recognize and apply the principles of information and interaction design practice. Lipton (2007) identifies information design principles as consistency, proximity, encounter, alignment, hierarchy, structure, balance, and eye flow. Pettersson (2016) presents 16 principles for the information and message design process, divided into four groups, namely:

1. Functional principles: Define the problem, Provide structure, Provide clarity, Provide simplicity, Provide emphasis, and Provide unity.

2. Administrative principles: Access to information, Information costs, Information ethics, and Quality assurance.

3. Aesthetic principles: Harmony and Aesthetic proportion.

4. Cognitive principles: Facilitate attention, Facilitate perception, Facilitate processing and Facilitate memory.

In the context of inclusive design, experts from North Carolina State College in the United States (Center for Universal Design) have published the book 'The universal design life', which presents seven

principles for designing universal products and environments to maximize usability for the widest possible audience. The principles are (1) equality of use; (2) flexibility in use; (3) Simple and Intuitive Use; (4) perceptible information; (5) tolerance for error; (6) low physical effort; and (7) Size and Space for Approach and Use.

The usability elements on the web are inserted into this context. Visual aids should be understood as cues that encourage or suggest the user's behavior or response to an action. The more evident these cues are, the more efficient the use of the tool will be (Krug, 2014). However, we can fall into a paradox: to present all the cues we think are necessary or to maintain a clean and aesthetically pleasing user interface? The answer is both. Not all cues should be "flashy," but visible or obvious enough to be reached (*idem*). In either case, there must be a balance: informational materials must be exciting but not distracting or disruptive. It is not a rule that everything must follow strict parameters. Petterson (2016) distinguishes between formal and informal balance, warning that the former can become tedious when fully symmetrical and aligned, while the latter can contribute to a sense of dynamism (Fleming & Levie, 1993; Petterson, 1993). The aesthetic appearance of interfaces is not just a whim but a functional requirement. The unbalanced and inconsistent use of colors, graphics, and typography can reduce the learning effect (Bradshaw, 2003).

This balance is achieved when all design elements are harmoniously arranged, i.e., when all units fit together to form a consistent and orderly whole (Petterson, 2016). Harmony is related to unitary components (Wileman, 1993). Three essential elements for the proposed design are highlighted below: typography, color, and shapes.

Harmony in typography exists when there is a good relationship between the individual elements of the design and the "wholeness", respecting hierarchies and logical consistency throughout the content. Balanced typography is easier to read and view and gives an impression of credibility and quality. To ensure good contrast in the texts, color is essential. It provides the difference between the lightest and darkest parts of the design. Color can also emphasize hierarchies, structures, and relationships (Petterson, 2016). One way to achieve good contrast and harmony is to use color palettes with balanced spacing on the color wheel, such as any two opposite colors on a color wheel, any three colors evenly spaced to form a triangle on the color wheel, or any four colors forming a square or rectangle on the color wheel (Sutton, 2020).

The shapes then complete this triad of important elements for the design surface. One of the ways to maximize the understanding and use of digital interfaces, in general, is to explore conventions, which are the commonly known patterns that already exist (Krug, 2014). Conventions can quickly convey to users, for example, that an element is clickable, draggable, or manipulable and that they can wait for a response from the interface after their action. In addition, humans naturally tend to arrange elements in a regular, symmetrical, and generally simplicity-based manner (Noble, 2011).

3. Methods and procedures

An empirical study was conducted by applying usability testing with high-fidelity prototyping and quantitative analysis of data collected through a structured questionnaire.

To select volunteers, we considered different profiles of people who might be interested in learning LIBRAS, such as deaf individuals, interpreters, teachers, and students of the language. We also included some laypeople who may be interested in learning LIBRAS in the future and, thus, to have a standard for comparison of the results. As a result, the research involved 77.4% hearing volunteers and 22.6% deaf volunteers, with 67.7% of these having some level of knowledge of LIBRAS.

Based on the literature review on theories of information design, instructional design, and inclusive design, a prototype of an instructional tool accessible through a Web browser was created. Considering that the focus of design projects should be more on the desired task and how users perform it (Gomes & Quaresma, 2018; Petterson, 2016), the prototype was designed with a focus on simplicity and intuitiveness. For this purpose, the design scheme ISD (Instructional System Design), also known as the Addie model (Analysis, Design, Development, Implementation, and Evaluation), was used to develop the tool, which divides the development of educational activities into successive phases that: 1) analyse the need, 2) design the solution, 3) develop the solution, 4) implement the solution and 5) evaluate the solution (Figure 2) (Filatro, 2008).

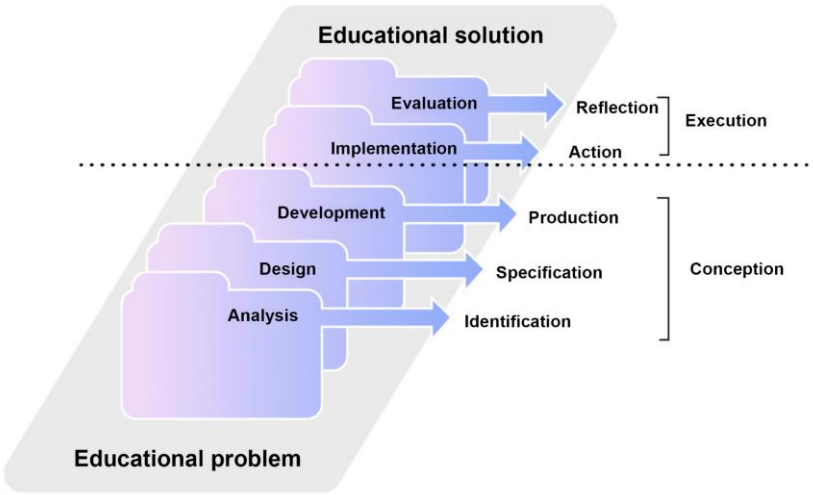
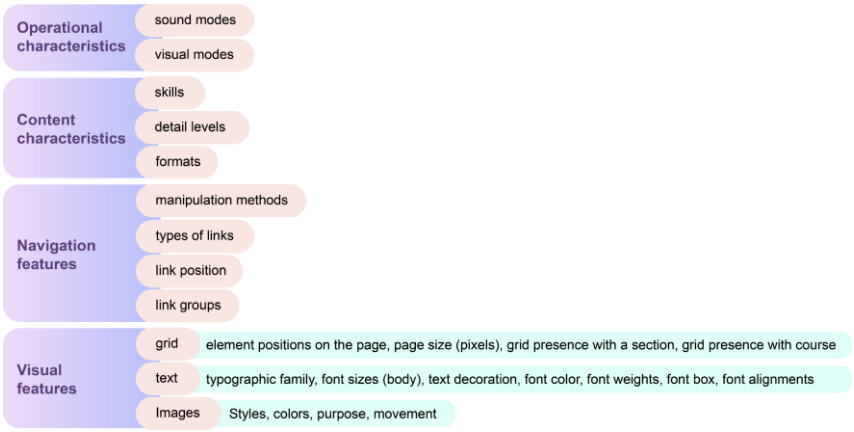


Figure 2: Phases of the instructional design process. Source: Adapted from Filatro (2008)**.**

For the tool development, the paths proposed by (Cooper, Reimann,Cronin, & Noessel, 2014) were followed, starting with the definition of the framework, understood as the phase in which the designers create the general concept of the products, which includes the behaviour, the appearance and, if necessary, the physical form. In parallel with the framework model, two other methodological tools were used: (1) a set of interaction design principles and (2) a set of interaction design patterns. The framework model is based on the model proposed by Souto (2008), as it incorporates aesthetic-visual

factors of online language courses, which is relevant to the study. The framework model is divided into



four main categories: Content, Visual, Navigation, and Audiovisual (Figure 3).

Figure 3: Descriptive framework for analysis and comparison of online language courses. Source: Adapted from Souto (2008)

For the model of electronic learning as a classification of information and communication technology, interactive information instruction was assumed, i.e., of the one-to-one type, where the student faces a more active agent who tends to learn in isolation, a model usually focused on skill development. This model has little or no virtual interaction with the instructor, administration, or platform development team. Instead, it is a fixed (or closed) model in which the instructional designer makes decisions about the parts of the learning flow that occur in an "automated" manner, as well as the rules for sequencing and information structure. The result of this format is a fixed instructional design (Filatro, 2008).

Cooper et al. (2014) emphasize that the designer plays an essential role in this process to guide the development of digital products that satisfy and do not annoy users. The testing phase was always present even when designers were not involved in the product development. Design is about understanding how the people who use the products live and work to shape the behavior and forms of the product. The most important thing is understanding how the users want to use the product, in what way, and for what purpose.

To simplify and optimize the test with users, the platform was reduced to learning the letters of the LIBRAS alphabet for dactylology since the central point of the study is the users' perception of how to use the 3D animated avatars and resources that incorporate the 3D environment. LIBRAS goes far beyond the alphabet, but the use of fingerspelling is significant among users to spell proper names and places, acronyms, and words that do not exist in sign language (Gesser, 2020).

When it comes to testing, prototypes are a powerful tool to find out what users need. Experimental prototypes are used to validate system requirements (Chandler, 2012). The prototype developed in this study has experimental characteristics with high fidelity, i.e., a dynamic and functional real-scale model of the tool was created with the highest possible degree of similarity and representation of the experience to what would be implemented to validate the proposal with potential end users.

According to Pettersson (2016), the physical materials used by artists influence the characteristics of the resulting artwork to some degree. When making the same statement for the design field, the tools used must be considered as they may have influenced the project's outcome. The construction of the prototype was done using the tool "verge3D™", which combines a programming language with 3D software (in this case, Blender™) and intuitively allows the user to program without requiring great knowledge of programming languages, so that even design professionals without programming skills can create games and interactive interfaces.

3.1 Experimental design

3.1.1 Phase 1 - Analysis: identification

The analysis phase involved identifying the instructional design problem (Filatro, 2008). This phase identified functional principles, as providing structure, clarity, simplicity, emphasis, and unity (Petterson, 2016). So, the means and tools used, the content, and the elaboration of the learning navigation flow (Figure 4) were selected, adopting the criterion of simplifying the mechanics of the learning journey available in the evaluation version to optimize the time spent by volunteers to answer the questionnaire (Krug, 2014). The user had to make two key decisions: study LIBRAS through the available lessons and/or customize the avatar. Despite the simplification, the learning flow suggests to the participant the possibility of a version with a greater flow, which will be critical in exploring the student's interest in continuing to use the tool in the future or even recommending it to others.

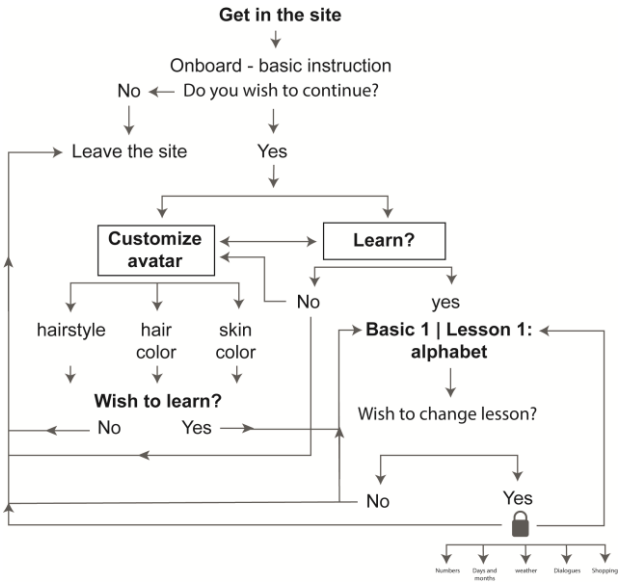


Figure 4: Learning journey diagram. Source: Authors.

During this stage, we identified the requirements for creating the 3D avatar. We referred to literature on the subject, which included the uncanny valley theory (Mori et al., 2012), a study on how users perceive avatars (Adamo-Villani et al., 2016), and a study on the representativeness of avatars in sign language (Wolfe et al., 2022). These studies showed that users are more comfortable with avatars that

are less realistic. We also considered several other factors, including technical flexibility requirements, error tolerance, physical effort of use, and available resources for the research. Finally, we decided to create a single avatar that blends cartoon style and realism to avoid the uncanny valley reaction. The avatar represents a female figure only, making it simpler and more objective to use. Users can customize the avatar's hair shape and color, as well as its skin color to represent different races.

3.1.2 Phase 2 - Design: specifications

Following the ISD development sequence, the design phase is where specifications take place. The previous flow was distributed in an interface wireframe model that would meet the optimization criteria of the design principles, focusing on the user experience through elements that are intuitive, pleasant to use, and based on pre-existing conventions. In this way, it would be ensured that usability problems would not interfere with users' responses, so that the variable related to the level of satisfaction and acceptance of using the LIBRAS interpreter in the form of a 3D avatar was isolated as much as possible.

The user interface consists of a character in the center of the eye flow, a customization menu, a lesson identification menu, lesson action buttons, and clear instructions for use.

After the wireframe was finished, our goal was to identify the elements that meet the design principles to provide an adequate visualization and user experience for the platform. The result of this was the prototype interface (Figure 5). These include aesthetic factors, such as the choice of contrasting colors for the avatar's clothes and skin tones, and the background. Additionally, the buttons' colors with lesson labels are analog to the background image to not cause distraction and visual pollution. We also incorporated visual effects, such as the volume of letters of the alphabet that suggest clickable elements familiar to users (Krug, 2014; Lipton, 2007; Petterson, 2016). Organization standards such as consistency, proximity, meeting, alignment, hierarchy, and structure were also adopted for the positioning of icons separated into categories clearly defined by approximation, alignment, and shape, such as the customization icons positioned in the screen's left-side corner and the letters of the alphabet located on the right side of the screen, in a larger size, representing greater importance in the hierarchy about the other icons on the platform (Lipton, 2007). Cognitive and inclusive principles were applied to develop simple and intuitive mechanics, enabling understanding and use, even without resorting to explanatory texts.

Figure 5: Interface layout design and design principles applied. Source: Authors, based on Petterson (2016)**, Lipton** (2007)**, Krug** (2014) **and Noble** (2011)**.**

3.1.3 Phase 3 - Development: production

The production of the prototype in the final test version was performed in the ISD development phase. At this point was defined the basic mechanics related to activating a lesson and watching how the 3D interpreter renders the signal. The goal for production was to use a platform that makes it easy for non-programming designers to develop prototypes. So, was used the Blender software to make the 3D modeling and animation, and the Verge3D™ platform to host the 3D environment prototype.

The tool allowed programming without advanced knowledge, with a puzzle system that uses logical reasoning and combines elements of the 3D platform with HTML resources. The tool allowed programming without advanced knowledge, with a puzzle system that uses logical reasoning and combines elements of the 3D platform with HTML resources. Allow us to clarify how our customization features work by an example of how we provided programming instructions for changing the avatar's hair. The three different kinds of format mesh of hair available were named “mesh hairstyle 1”, “mesh hairstyle 2”, and “mesh hairstyle 3” at 3D software, and the HTML buttons were named “hairstyle 1”, hairstyle 2”, and hairstyle 3”. So, to switch between different hairstyles, these were the instructions: If you click on the “hairstyle 1” button, make “mesh hairstyle 2” and “mesh hairstyle 3” hidden, and “mesh hairstyle 1” will be visible. Or if you click on the "hairstyle 2" button, "mesh hairstyle 1" and "mesh hairstyle 3" will be hidden, and "mesh hairstyle 2" will be displayed. Finally, if you click on the "hairstyle 3" button, "mesh hairstyle 1 " and "mesh hairstyle 2" will be hidden, and "mesh hairstyle 3" will be shown. This logic was the same to change the color of the avatar’s hair and skin.

For a better user experience, some features were integrated: (a) navigation: camera rotation, and zoom (which was limited to -20º and 20º from the center of the character on the horizontal axis and -10º and 10º on the vertical axis), ensuring greater clarity in the visualization of hands configurations signs (Gesser, 2020), and ensuring the principle of flexibility in use, ; (b) customization: a menu in the upper left corner of the screen allows for character customization (to simplify the prototype, three skin tones, three hair formats, and three hair colors were provided to represent at least the yellow, white, and black races); and (c) activation resources: the right side of the screen displays lessons buttons in intuitive formats and distribution (Krug, 2014). The character immediately plays the signal

corresponding to the activated button and repeats it as often as the user deems necessary, providing clarity, and facilitating perception, and memory (Peterson, 2005).

Finally, the methodology adopted to conduct the research combined a set of guidelines and assumptions about demographic, experiential, objective, and subjective factors relevant to this research. In this sense, the following are highlighted: age group, gender, hearing condition, level of knowledge in sign language, level of education, exposure to technology, perception of avatars, and perception of the reproduction of signs (Huenerfauth & Kacorri, 2015; Kacorri et al., 2015).

After presenting and justifying the technical choices, we proceed to the presentation of the data obtained by applying the research questionnaires. The methodological tools and theoretical foundations presented so far have been essential for discussing the results obtained, which are presented next.

4. Results

The present study proposes to create a digital artifact developed for the high-fidelity prototyping stage and then evaluate it with potential users. For the application of the usability testing experiment, it was hypothesized that the use of animated interpreters in 3D, as well as the availability of easy access to the artifact on the Internet, would be met with overwhelmingly positive acceptance and thus could configure a promising tool to support teachers and students in the teaching-learning process of LIBRAS. Usability testing helps measure satisfaction and acceptance, identifying and addressing what confuses or frustrates users (Krug, 2014). Below are the results of this research, which represent phase four of the ISD method.

4.1 Phase 4 - Implementation (action) and evaluation (reflection).

About the system requirements, understanding the characteristics of sign languages and the differences between spoken modalities are the primary challenges in this type of project. Additionally, developing the technology necessary to display the signs and creating a representation that can act as the connection between the corresponding text of a spoken language and the geometry of sign display technology are also crucial requirements (Wolfe et al., 2022).

The prototype's system requirements, or the conditions or capabilities needed by a user to solve a problem or achieve an objective, were determined based on market research and related studies. The functional requirements included teaching the LIBRAS manual alphabet, allowing for avatar customization and manipulation of the view, enabling the modification of the background image, providing online access, utilizing simplified "click-to-play" mechanics, offering direct access without registration, and ensuring data security for anonymous users. The non-functional requirements focused on restrictions to the system's functioning, such as requiring internet access, consuming high RAM, overloading the device's image processor, ensuring responsiveness and portability, and featuring an avatar with sufficient characteristics to reproduce manual alphabet signs accurately. Below are the data collected from volunteers who used the prototype (Bjørner, 2006).

The platform implemented in an online environment was analyzed in its high-fidelity prototype phase. The data was collected via a structured questionnaire, which was available in an electronic format. The research was conducted in three stages: first, volunteers were contacted via email; then, they filled out the questionnaire; and finally, the results were tabulated and interpreted. In the first phase, volunteers were contacted through email lists and received instructions that participation provided for a minimum use of the prototype, which included: access to the platform via the link provided, customization of the avatar, and reproduction of the alphabet signs manual using a computer. In the second phase, the evaluation is carried out anonymously, remotely, and autonomously, without the presence, mediation, or interference of the interviewer. The anonymous questionnaire with 16 mandatory objective questions and one non-mandatory discursive question examines: (1) education, (2) level of understanding of LIBRAS, (3) familiarity with digital resources, (4) listening situation, and (5) assessments related to use of the tool in terms of perceptual, aesthetic, specific, and usability criteria (Huenerfauth & Kacorri, 2015; Kacorri et al., 2015).

The field research was conducted with 31 Brazilians. The profile of respondents consisted of 58.1% women and 41.9% men, aged between 18 and 53 years, with 77.4% of users hearing and 22.6% Deaf. The difference in target groups reflects the national scenario and highlights that the Deaf target group is not the only one interested in learning LIBRAS, considering the interest of bilingual listeners, interpreters, students, and teachers of the language in question.

In this scenario, 32.3% declared that they did not know LIBRAS, 38.8% declared knowledge levels up to 5, and 29% considered their knowledge between medium and advanced, assigning grades from 6 to 10, covering the different levels of knowledge. A total of 35.5% of respondents declare that they teach or have taught LIBRAS classes.

The vast majority (93.5%) reported no difficulty in using digital devices such as apps, games, and internet browsers, and 87.1% had already used or were using apps or websites to learn a second language. This information could be related to the participants' educational level, ranging from having completed high school (9.7%) to having a college degree (45.2%). The factor of familiarity with digital tools and browsing the Internet is an essential criterion for the study, since we know that a lack of familiarity could be an obstacle to the acceptance of the platform, not because of the feature of using an animated avatar, but for technical and capacity reasons that are not part of the purpose of the survey.

Regarding evaluating the teaching platform for LIBRAS proposed in the study, the majority (96.7%) indicated that they considered the learning experience with the tool using 3D avatars to be generally positive. Of these, 67.7% rated the experience as "good", 12.9% as "very good", and 16.1% as "Excellent". Only 3.2% considered it poor (Figure 6), and there was not a single "very poor". That is, at least 96.7% of the ratings were positive.

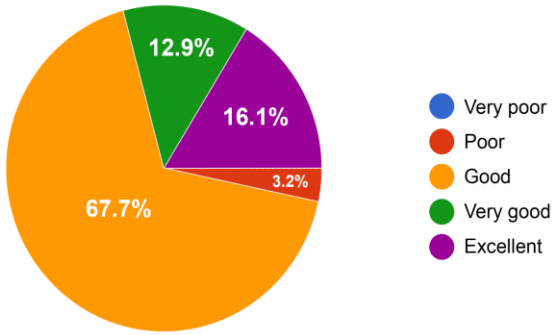


Figure 6: Overall rating of the 3D tool learning experience. Source: Authors.

The question was reinforced at the end of the questionnaire, where a 0-10 score was asked for, with the experience expressed in numbers. The obtained scores ranged from five to ten, with 16.2% giving scores between five and seven and 83.9% giving scores between eight and ten, resulting in an average score of 8.7 (Figure 7). Although the majority chose the grade "good" (which is considered average), the highest grade "10" appeared more frequently in a numerical ranking.

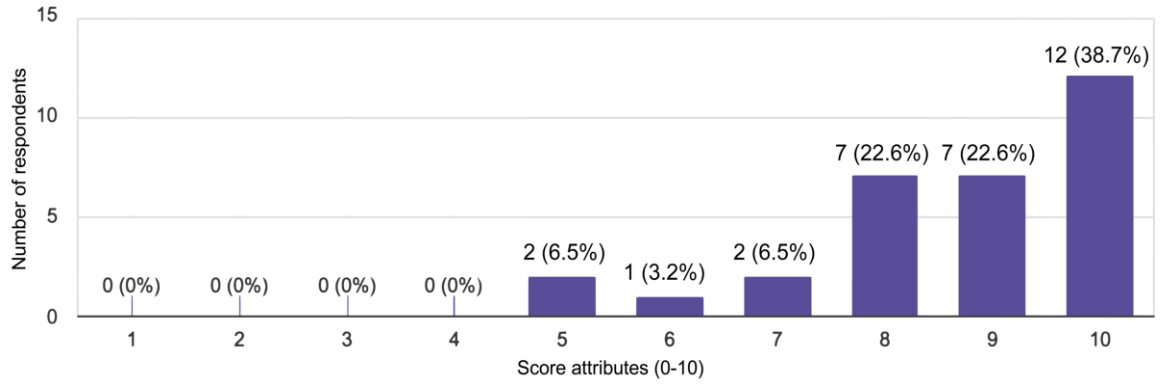


Figure 7: Score attributed by respondents for the using experience. Source: Authors.

For the aesthetic factors, 12.9% of the respondents gave scores below seven, and 87.1% of the scores were equal to or higher than seven, with an average final score of 8.5 (Figure 8). From this, it can be inferred that the aesthetic factors contributed to a good tool evaluation. According to the discursive question, this is one of the desires among users, who expressed dissatisfaction with the appearance of the applications with which they were familiar. One of the respondents from the Deaf group stated, "I thought the 3D model was a little better than the models I know, and I think the available customizations are good to make the children's audience more engaged". It is important to remember that the "informational material should be interesting but not distracting or disruptive" (Petterson, 2016). In addition, using more elaborate visuals, such as a character modelled with a more complex mesh or multiple elements modelled in the scene, requires more computing power, and means that equipment with greater reproducibility is needed. Another report along these lines was that: "the aesthetic factors are quite beautiful, but the website seems to overload my PC, so the commands are slow". In addition,

the importance of being able to customize the avatar was stressed more than once, as it can represent different races and styles.

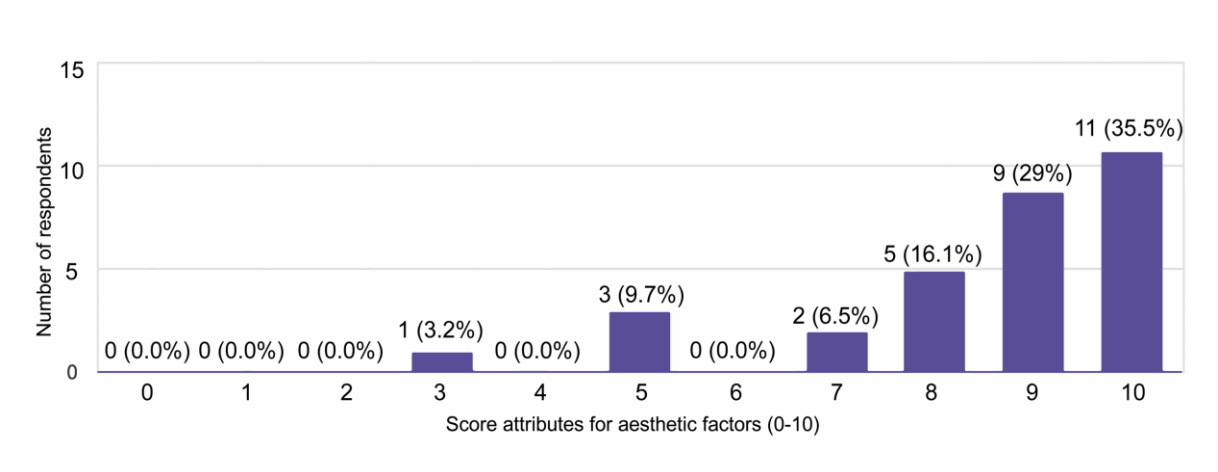


Figure 8: Evaluation of aesthetic factors. Source: Authors.

Most also rated the platform positively regarding usability factors (ease of use, intuitiveness, and simplicity of use). Thirteen percent of respondents gave ratings of less than seven, with ratings between seven and ten reaching 87%. The average rating of the usability factors reached 7.3 (Figure 9). In addition, 62.3% of respondents rated the difficulty of use as easy, 38.7% as moderate, and none as difficult. The positive rating of these factors is relevant to the harmlessness of the research result. One respondent pointed out that caution should be exercised when using much content written in Portuguese without translation in LIBRAS, as a large proportion of the Deaf public has difficulty reading Portuguese. In fact, it has already been shown that about 80% of Deaf people worldwide do not understand the languages spoken in their countries well (Debevc et al., 2011).

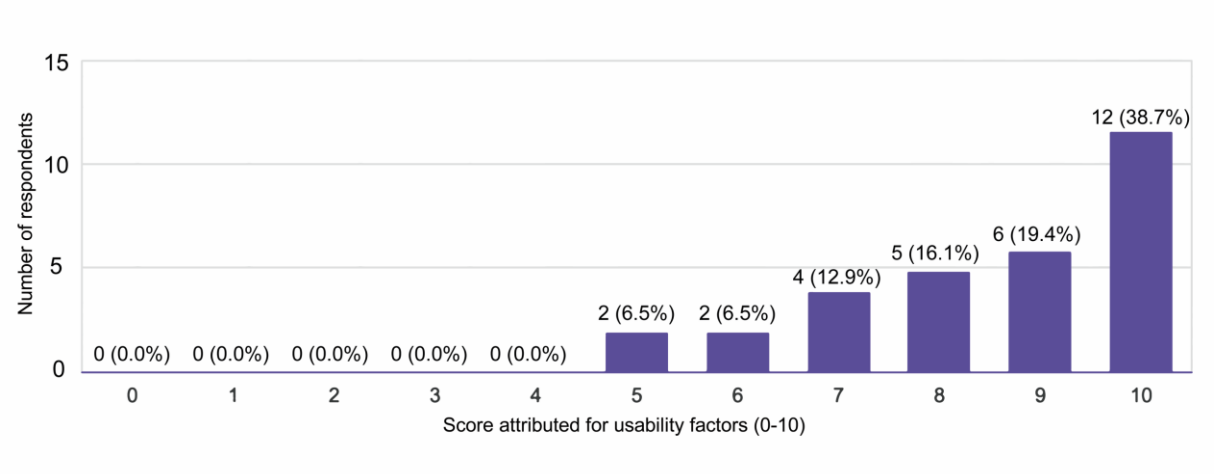


Figure 9: Classification in terms of usability factors. Source: Authors.

In one of the questions on the applied questionnaire, respondents were asked to name adjectives that reflect their opinion about the platform, equally divided between negative and positive adjectives. Positive adjectives were ticked more often (Figure 10). The negative attributes were tedious (9.7%),

confusing (9.7%), distracting (6.5%), and tiring (3.2%), and none of the respondents chose the options boring or ugly. The positive adjectives ticked were: beautiful (71%), fun (58.1%), intuitive (58.1%), educational (41.9%), exciting (32.3%), and enthusiastic (32.3%) (Figure 9). Since the adjective "beautiful" occurred most frequently, we have another indication that aesthetic factors may have had a major influence on the overall positive evaluation of the platform, suggesting that it is a desire of the audience in question.

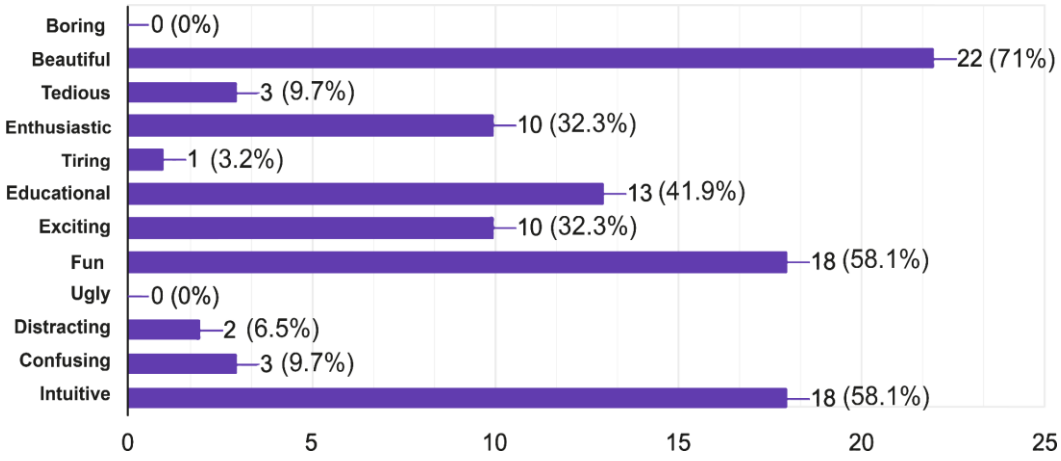


Figure 10: Adjectives attributed to the tool. Source: Authors.

The Net Promoter Score (NPSTM) is widely used in practice as a performance indicator. The index provides a single measure to predict future growth and popularity (Klaus & Maklan, 2013). The score measures customer satisfaction based on respondents' likelihood of recommending the brand or product to others (Reichheld, 2003). More than half of the respondents (58.1%) said they would continue to use the tool to learn LIBRAS in a more advanced version; 32.3% answered maybe, and only 9.7% said they would not use it. When asked if they would recommend the platform to other users, 64.5% answered that they would recommend it, 32.2% would maybe recommend it, and only 3.2% would not. These figures underline the positive evaluation and acceptance of the platform.

A comparative analysis of the general experience of using the 3D platform between the profiles of the respondents shows that there is not a very large discrepancy. Comparing the analysis between the genders (Figure 11), the evaluation by women is more positive. For men, 2.23% rated the experience as poor, but the figure is still insignificant and does not represent disapproval. One reason for this difference in rating can be seen in the use of the 3D interpreter as a female figure, which evokes a greater sense of representation among women. This factor points to the importance of representativeness and the possibility of customizing avatars.

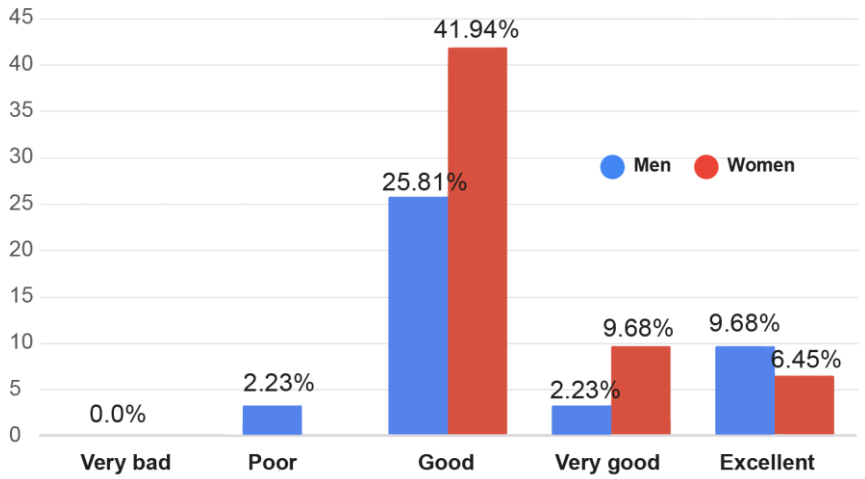


Figure 11: Overall assessment of platform uses by gender. Source: Authors.

When comparing the level of education at LIBRAS, the knowledge reported by respondents was ranked from 0 to 10 as follows: 0 is reported as a layperson, those who reported between 1 and 3 are considered to have little education, between 5 and 6 are considered to be moderately educated, and between 7 and 10 are considered to be advanced. One can thus conclude that the experience at the four levels of education was predominantly "good". The positive rating in the lay public, i.e., people who have no contact with LIBRAS, may mean that there is an interest in learning the language in the general population or that there is an interest in the platform given the variables presented. The most negative rating was among the audience with low education in LIBRAS, with 3.23% of the ratings classified as 'poor'. The audience with advanced education rated it positively, with responses ranging from 'good' to 'very good' to 'excellent'. The proportion of this audience has a relevant weight, as they can more accurately identify potential problems with the representation of characters by an animated avatar.

Regarding the comparison of the use of the artifact between Deaf and hearing people (Figure 12), both target groups were mostly positive in their judgments. There was a greater concentration of hearing people rating the artifact as "good". However, a more significant proportion of Deaf people rated the artifact as "excellent" (29%) and "very good" (14%), compared to 13% and 12%, respectively, for hearing people. Furthermore, no member of the Deaf community rated the experience as bad or terrible. These figures may indicate greater enthusiasm among the Deaf community for several reasons that deserve to be explored. It is clear that part of the population longs for technological innovations that represent them and facilitate their everyday life. Seeing themselves as protagonists of innovative projects may indicate the possibility of occupying new spaces, facilitating and enabling learning, and improving communication.

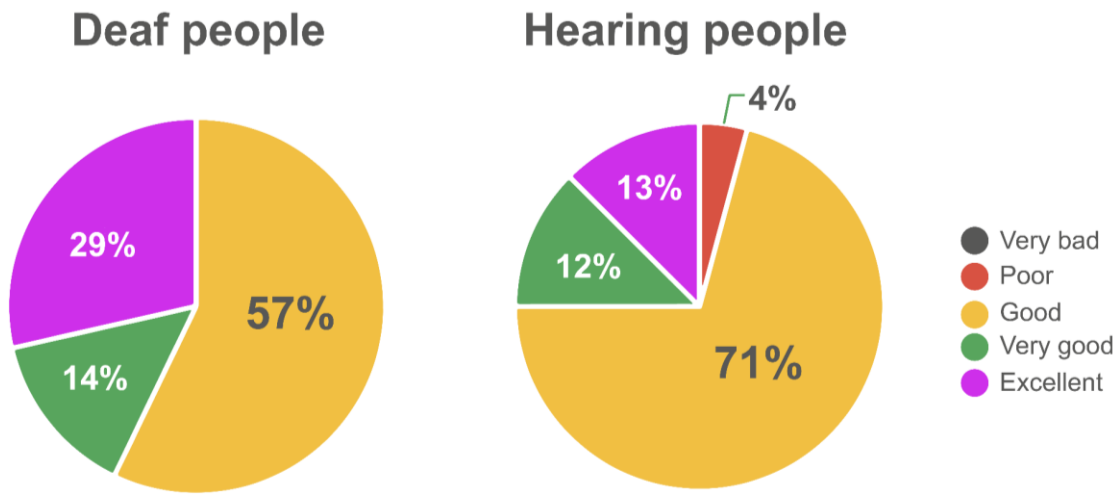


Figure 12: Comparison of evaluation of the use of the platform between Deaf and hearing people. Source: Authors.

5. Conclusions

This research exposes a path to develop an interactive virtual platform by non-programming designers. Moreover, data obtained from the experience of using the 3D platform, such as the overall approval of the learning experience (average score of 8.7), the satisfaction with the user experience (96.7% "good" or "very good"), and usability evaluation (average score of 7.3) leads us to conclude the LIBRAS teaching tool with 3D animation was considered satisfactory by the users with no significant resistance to its use. It corroborates with the study that shows that, in principle, animated characters can show a high level of acceptance (Kipp, Nguyen, et al., 2011).

This positive result was possible because some information and instructional design principles were applied to developing the digital interface, such as usability and aesthetic factors. In addition, most participants declared they are comfortable using the internet and related technologies, verifying that more experienced technology users better evaluate the use of animated avatars in sign language (Kacorri et al., 2015).

The specificities of the communities involved were also considered during the development of the tool once the “actual development of animated avatars needs a much deeper involvement of Deaf individuals” (Kipp et al., 2011); (Gomes & Quaresma, 2018).

Features such as the good looks of the avatar, the possibility of customization (Lopes, 2015), and the animation of the character's hands, head, mouth, and torso also contributed to the excellent acceptance of the prototype, once movement quality and appearance significantly impact users’ ratings of signing avatars (Quandt et al., 2022). Many of the studies of tools with animated 3D avatars aim to create automatic animation conversion (such as those based on video reference, motion capture, smart clothes, and scripts). In the present research, hand-animation was produced through a careful process of posing the character by keyframes (Kacorri et al., 2015, p. 3), which according to Kipp et al. (2011),

presents the best evaluations among the existing avatars. This modus operandi can provide refined results animations and represent more time demand in productions.

Favourable ratings for aesthetic factors (average score of 8.5) indicate that a public need has been met but may represent a performance loss. For platforms that use 3D, it is essential to consider that the aesthetic factors and more elaborated visual resources may mean higher equipment requirements in order not to compromise use on devices, especially if it is an online tool where the quality of playback is tied to the available internet speed. Indeed, some users have reported difficulty handling features such as zooming, rotating, and playing the animation, as well as a wait on the initial loading screen (which could be improved in a possible final and marketable version of the prototype). However, there were no reports of a complete inability to use the platform.

The evaluation of the 3D platform was positive but not unanimous. In fact, 3.2% rated it as "poor." The use of animated figures should not be seen as a substitute for the human interpreter, and 3D digital artifacts should not be seen as a substitute for classrooms (albeit virtual) with real teachers. Instead, they should be viewed as a tool for working together in situations where they are viable and exciting for students and teachers, considering the context in which they are used, their specificities, purchasing power, skills, and culture. In other words, such artifacts should be used as an aggregating and democratic factor, not as an exclusionary and privileged one.

Finally, the inclusion of new elements in the artifact in a complete version that goes beyond teaching the LIBRAS typewriter alphabet, such as words and phrases or sentences and dialogs with hierarchical levels of difficulty, will be able to expand the possibilities of research, including the assessment of learning levels that could be core drivers, such as the perception of development, ownership, empowerment, social influence, and meaning through the use of gamification.

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Computational Media and the Paradox of Permanence

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Abstract
Throughout our history as communicative beings, we sought permanence from media that we used to store information, communicate, and help us deal with the ever-changing world. For the longest time, analogue media carried out these tasks despite their slow, but inevitable, processes of physical decay, but nowadays, computational technologies are generally proposed as fast, cheap, and convenient alternatives to the limitations of analogue technologies. This paper argues that regardless of how computational technologies are perceived as upgraded versions of the analogue media forms that preceded them, their effectiveness as media is limited because computational forms are anything but permanent. We claim that it is our refusal, and our fear, of impermanence that drives the desire to construct a worldview that is biased for permanence, even when the opposite lies before our eyes, as happens with computational media forms. This leads to a dissonance between the world as it is and the world as we perceive it, and to a paradox at the heart of computational media forms. This dissonance limits our relationships with these media, our literacy, and the ways how we can develop meaning and nurture creative relationships with them.

Keywords: *Computational Media, Meaning Making, Paradox, Permanence.*

1. Us and media

For most of human history we developed media with the goal of storing information and transporting it over space and time (Lévy, 1997). All our somatic communication acts, such as talking, miming, pointing at things, showing intents or emotions through facial expressions or body stances, are transient and ultimately ephemeral. We can talk to someone, and they may later remember the gist of the conversation, perhaps even some of its details, but much of it will at best be fuzzy, blurred by our selective, imprecise, and biased memory.

Media allow us to fixate parts of these messages. A somatic communication act is multimodal, immersed in a complex and ever-changing context that affects the messages conveyed and that ultimately also contributes to them (Carvalhais, 2023). By abstracting parts of those messages to a set of signs that allow to articulate and convey them, and by then fixating these in a physical carrier — stone, wood, parchment, paper, etc. — we manage to achieve a stability — or at least an appearance of stability — that we cannot reach without technological assistance.

Our media have been static vessels for the recording of these signs: drawings, paintings, or other images; marks for tallying and counting; texts that encode speech and language. For most of our history, media were not able to capture processes but only descriptions or instructions for those processes. Before time-based media such as sound recording or cinema were developed, we could at best develop

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notations for music performance, scripts for theatre, or guides or recipes for other processes, but not quite document the processes themselves. Even media such as cinema or sound recording do not, arguably, capture processes, but simply fixate their appearance for a given span of time.

Media have always been interdependent with humans because humans create the signs that are recorded in them, and humans infuse these signs with meaning during interpretation. Media, therefore, are ideally static and inert conveyors of the outputs of the dynamic processes of creation developed by humans, bringing these to interpreters that will on their side develop dynamic hermeneutical processes (Caputo, 2018). Because of this, and for the most part, media have been unable to create signs or information on their own. If, indeed, *the medium is the message* (McLuhan, 1964), it is not because the media actively build messages but because they shape the space of possibilities within which messages are created. They do this firstly by forcing us to relinquish multimodality and choose with which modality to convey a message: alphabetic text but no sound, images but no movement, sound but no images, sound and images but no smell or temperature, or any of the many other modalities that even hot media such as television or video games force us to abdicate of. Even in this role as static intermediaries, media alter us, they shape and change how we perceive the world, how we communicate, how our brains work and "we emphasize our senses — seeing versus hearing versus touching" (Coupland, 2011, p. 13).

2. What are media after all?

It's not always clear what we describe with the term *media*. On one level it can describe the physical or material resources that allow signs to be recorded: the paint and the cave wall or the canvas; the ink, pen, and paper; or any other set of technologies that are used to construct and stabilise a message. But thinking along these lines quickly brings us to questions about, for example, what are the boundaries, if any, between the tools and the media. Are media permanent and the tools involved only more transiently? Or are these tools, transient as they may be, parts of the media forms?

More important even is how this view also has the potential to muddle things once multiple technologies with similar affordances are used. What happens when a manuscript is typeset and printed in multiple copies? And when a recorded piece of music is broadcast on the radio? Or when a movie, originally shown in cinemas, is broadcast on TV, or streamed on a laptop or on a mobile phone? In such cases, are we interfacing with different media? Are we accessing different contents? Are we accessing the same contents through different technologies? We can, of course, discuss remediation (Bolter & Grusin, 1999), to which we will arrive later in this paper, but we first need to better define what we mean by medium.

Henry Jenkins gives us a useful definition that follows Lisa Gitelman's model (2014) with a level of technologies that "enable communication" and another of associated "social and cultural practices" developed around the technologies (Jenkins, 2006, pp. 13-14). This is a model of media as cultural systems. Technologies are central to media, but technologies move in and out of the zeitgeist, while media persist "as layers within an […] information and entertainment stratum." (Ibid., p. 14) As such, more than being material devices with which we communicate, media shape the culture and ultimately

become a part of it. And media are, of course, also technologies themselves. They are cultural technologies for showing and seeing (Noë, 2015), for perceiving and thinking.

With media we develop *traditions* that are only tangentially related to technologies, that are developed from technologies but that take a life of their own and are shaped by a much wider set of forces. Media such as the newspaper or the novel are the result of chains of processes that depend on technical influences — such as paper production, ink, typesetting, binding, printing — but also on the influence of other media being incorporated in their production processes. Besides technologies, media are also the fruit of policies, economics, and other social dynamics. As they are too, let's not forget, the results of evolutionary pressures from other media (Fuller, 2005) in an ever-changing and complex ecology, that is also the ongoing discourse we call *culture*.

It is in this media space that surrounds us, and where we are immersed, that we need to develop literacies by understanding and negotiating all these traditions, always in a dialectical tension between static carriers of signs and our dynamic and changing interpretations. Media, thus, not only give us their contents — the signs — as they give us the means to organise our cultures, societies, and personal and collective lives. In this sense, they also play a philosophical role (Nöe, 2023).

It is through media that we expand the ways how we perceive the world. It is through media that we try to shape the world by stabilising something that may not, perhaps, be at any time stabilised: information. Any physical support for information is, ultimately, impermanent, because everything decays, changes, rots, or fades away. However, because the temporal scales at which these processes happen are sometimes too different from our own, and in those cases, we may not be able to recognise these decays, thus perceiving media as static, unchanging, permanent, even eternal. This speaks of a cognitive dissonance between the natural dynamics of objects and how we perceive and conceptualise them. And this may also be connected, as many other things in human life, to the constant effort of resisting death. Most likely, though, this can be the result of a drive to develop homeostasis and negentropy, which is part of what fundamentally defines us as living beings. We too fade, decay, rot, forget, and in many ways our lives are an ongoing effort to counter that. But we know that permanence in nature is nothing but an illusion. And that permanence in media, is a construction.

3. Computational media

Computational media seem to be the dominant forms in our current media ecology. This is due to the ubiquity and low-cost of computers and computer networks, but also to their capacity to shape-shift and to absorb most media forms. Before we look into this potential to act as a universal solvent (Finn, 2017), we should delve into the nature of computation and into its history as media.

When digital computers were initially developed, in the late 1930s and throughout the following decades, they were not conceived of as media but rather as tools. Computers were mathematical tools that could substitute those workers whose name they started by appropriating. When developing the principles of modern digital computation, Alan Turing (1936) did not call these machines "calculators"

but rather “automatic computing engines” (ACE), a choice that hints at their conceptual framing at the time.

To operate, ACEs needed to use media, but they were not media themselves. The first medium ACEs used, we can argue, was an infinite tape, divided in discrete cells, proposed by Turing as the source of their “unlimited memory capacity” (1948). The medium of the tape is central to the operation of the computational machine, but it just a substrate for data storage. The computer itself, or its processes, were not conceived as media (Alt, 2011).

And for the most part, the media for input, output, or storage of data that computers used, were digital but not computational, as the data stored on punch cards, magnetic tapes, or other technologies, could be read by a computer but these technologies could not themselves compute. There was, therefore, a clear demarcation between the computer and its media, a distinction that is still valid in contemporary media forms, as some technologies are unable to compute themselves and are limited to storing data to be computed by other devices.

With the progressive development of interactive computing during the 1960s, we had the first glimpses of computers becoming media forms. Systems such as Sketchpad (Sutherland, 1963), NLS (Engelbart, 1962), or SAGE (Petzold, 2000), had screens where one could type, program, or otherwise control computers in real time. They allowed computations to be developed and affected in real time, and for information to be read and produced as a result of those interactions. Incidentally, with its capacity to control radar systems and aerial defences, SAGE was also one of the early systems with capacity to act in the world.

It was at this point that computers started to become media, or that media became computational. It is here that we find the confluence of data, computation, interface, information, and human. At this point, the medium ceases to be static and becomes a dynamic system. And it is at this point that, in the background of these transformations, the paradox at the heart of computational media starts to be perceivable. It is here that a big shift starts to happen. A shift from media that are static and ideally neutral carriers, to media that are dynamic. In the first of these, signs are created by dynamic somatic processes, the medium itself is static, and the reception and interpretation of signs is once again dynamic. In the latter, when the medium also becomes a dynamic process, we find a context where hypothetically, the medium can also act as the sender or receiver. If the medium can create signs and information on its own, it may very well replace the somatic acts of creation. If the medium can read signs and information on its own — besides the operational images (Parikka, 2023) destined at it as part of its computational processes — then the medium may very well become the receiver and interpreter. And the contexts where communication is developed are not only computational as they are shaped by computation, in a post-digital culture (Cramer, 2013) where we increasingly live in code/spaces where “software and the spatiality of everyday life [are] mutually constituted” (Kitchin & Dodge, 2011, p. 16). Ultimately, the medium may play all the roles in an act of communication and leave humans out entirely (Paglen, 2014).

As computation becomes media, or media become computational, they are expanded by new affordances. As Janet Murray (2012) pointed out in her early analysis of this phenomenon, media

become procedural, and because of this they also become participatory, spatial, and encyclopaedic. They get increasingly autonomous from humans, and detach from them, while at the same time contributing to accelerate a post-human condition, as Parikka would put it, as they address “a whole other sensorium than that of the human being.” (2011, p. 256) In a McLuhanian sense, this has always been the case. Media extend humans, expand our innate capabilities and accelerate the ongoing process of emergence of humans (Lévy, 1997).

This capacity to become more than ourselves, something else than us, is a central human feature, as we are what we are through culture and society, never through individual realisation alone (Dunbar, 2014). However, technical media, and chief among them computational media, have a way of abstracting their constraints and mechanics, and of leading us to modes of collaboration where although we may be made to feel to be in charge, we are really not, because we are bound to the black box of the medium in a position of subservience and diminished agency in the relationship with it (Flusser, 1983). If efforts to increase literacy among users and producers of media are certainly useful (Heyes, 2018), often it is the very nature of computational media forms that limits our agency, in many cases simply by replacing it, and acting instead of us. This has been an increasingly strong paradigm in the current generation of systems for creative work based on artificial intelligence, but also in critical software such as semi-autonomous vehicles.

Computation is a process, not an object. Computation is the transformation of information, the way how data, bits, information, are changed according to formal, and finite, processes. This is quite unlike what other machines do when they move or transform matter, because although information always needs to be materialised, it is very unlike matter. To start with, because information has the capacity to act on itself, and to transform the machinery that is producing, reading, changing it, in a very rich and unique way.

Computation starts with data, produces data, but it is not data. Computation is not the physical machine, and it is not its code. Rather, it is something else altogether.

4. The nature of computation

From Turing’s concept of the ACE at a theoretical and abstract level, two fundamental features for its role as media immediately become apparent. The first of these is that an ACE is an imitation machine. An ACE computes by developing a specific kind of information processing that combines the acting of the hardware as the substrate for computation, the software as the set of rules that guide the operation, and the data that is fed to it. If the data changes, so does the computation, but otherwise, the ACE always develops the same process. An adding machine will always and only add, a sorting machine will always and only sort, and so on.

But Turing also discovered that it is possible to create a far more versatile machine that can change its behaviour and become another type of machine. The universal computing engine (UCE), as Turing called it — and to which we nowadays most commonly refer to as the *universal Turing machine*, after Alonzo Church popularised that term — is a device whose rules do not set it up to perform a single type

of computation but rather allow it to read the description of another computing machine and to start operating like that machine. What does this mean? An ACE that, e.g., adds numbers can read some inputs and, interpreting these inputs as numerical quantities, add them to produce a result that is, itself, also a numerical quantity. For such an ACE, any input must be a numerical quantity, because its rules preclude it from ever even understanding other types of data. So, should we want a machine that would, e.g., alphabetise a series of inputs instead of adding them, we would need to build an entirely new machine. "Machine" here is understood as the combination of hardware and operational rules. In Turing's ACEs the hardware is generic (even fungible) and only the operational rules tell the machines apart.

A UCE, on the other hand, can be fed a description of the machine that adds numbers, and will start acting accordingly and adding numbers. If at some point it is fed a description of the alphabetising machine, it will change its behaviour and start alphabetising. If it is fed with any other description, its behaviour will once again change. These descriptions are part of the software layer of the machine, they describe its rules to be, they are its *program*.

And programs are fed to the machine through the same input channels that are used for all other data (both in Turing's model of the machine and in the later Von Neuman's *stored-program architecture*, that normalised using a shared memory for program and data). Therefore, one could say, a UCE is able to imitate any other computing machine. This assertion is correct, but also incomplete, as what a UCE does, from a computational point of view, goes beyond imitation. As a UCE reads a program and starts operating as the machine that is described, the UCE *becomes* that machine. A UCE transforms into something indistinguishable from the machine described to it. A term as *imitation* doesn't quite describe this, and neither does *simulation*. A better term to describe this phenomenon is one that comes to us through its adoption by computer science: *emulation*.

An imitation is some process or object that tries to replicate the superficial features of another object or process. In Baudrillardian terms (1994) we could perhaps describe it as a counterfeit in their intention to create illusions that pass as reality. A simulation, on the other hand, is a process that aims to replicate a set of features or behaviours of another system with high precision or fidelity but with no regard to verisimilitude of other aspects such as, e.g., using fundamentally different substrates or operational principles. A good example of this can be found when physical models simulate trajectories or dynamics of moving bodies by using only mathematical functions that abstract them but do not replicate their actual physical processes. An emulation, on the other hand, consists of entirely becoming another process. Not trying to approximate it but replicating it so fully that no possible distinction between two processes can be found.

5. Imitating media

This capacity to transform turns the computer — for simplicity's sake, and because today's computers are almost without exception universal, we will refer to any sort of UCE as a computer — into a fluid machine that is able to freely shift its behaviour and actions. A machine that can change itself. Paired with its speed, and with various methods to digitise signs, the computer also becomes able to imitate media, and even to, it seems, imitate anything.

During the 1970s, Alan Kay recognised this as he described the computer as a *metamedium* (2003) that is able to transform itself into any other medium, including those media that don't yet exist and those that are not physically possible. The computer becomes Murray's *digital medium* (2012), a singular source from where all media can spring and from where a continuous deluge of *new media* forms may arise (Manovich, 2001). The computer becomes the unrivalled medium for *remediation*. If we can trace a history of media based on remediation, as Bolter and Grusin propose (1999), it is only in computational media that we find what seems to be a universal solvent for media — something that is able to scan, digitise, absorb all media forms — and a universal remediator — something able to reconstruct and communicate all media forms.

To imitate media, computers need to do something besides imitating their surface signs. They need to also imitate their permanence, their capacity to preserve information and stabilise signs. And let's keep in mind that a computer may emulate another computer, but when it comes to physical artefacts such as media, the best it can do is to simulate some aspects of them, or often, only imitate them.

And here we arrive at another of Turing's fundamental realisations: computers have a penchant for unpredictability. As Wolfram puts it, when computational processes are "not obviously simple" (2002, p. 5), they will most likely be *irreducible*. As hard as we try, we cannot predict a computation's future and the "only way to work out how the system will behave is essentially to perform [its] computation" (Ibid., p. 750) and wait until we discover it *with* the system. And even if the code is simple, it will be enacted atop the complexity of the underlying universal machine, a complexity that should be considered when evaluating the threshold for irreducibility.

In any computation that is "not obviously simple" we may find pockets of reducibility, areas of its phase-space that we can predict, but we can never fully anticipate its behaviours and outputs. Why does this matter? It matters because, as we will see, this characteristic is at the heart of a fundamental ontological paradox in computational media.

6. Imitating stillness and stability

What are the consequences of the tension between imitation and this predisposition for irreducibility? In computational media information is stored in a format that is not directly accessible by readers and that needs to be translated, i.e., transcoded and recreated every time it is mediated. Whenever a digital medium educes a message — a text, an image, a sound, etc. — it must recreate signs from stored data or from a data-generating process. For example, whenever a digital video is reproduced, all its frames

need to be recreated, several times per second. And this process needs to happen every time the same video file is played. Every time an image or text are displayed, all pixels, and all letters need to be recreated. And this process may happen dozens of times per second, as a screen refreshes. As Wendy Chun points out, within the computational, every medium becomes a time-based medium, and images and other signs "are frozen for human eyes only" (2011, p. 197). Computational media imitate stillness and stability at the surface level while activity and computation never really stop at the subface level of their computational core.

It is in this surface-subface duality, as Frieder Nake (2018) calls it, that the essence of computational media resides. Signs in the sensorial surface of the medium are what humans can directly perceive. But these signs are generated by computational activity at the subface, activity that can only be understood indirectly, inferred from the surface and the actions on it. In analogue media that exist on two levels, such as cinema, where images on the film strip are projected onto moving images on a screen, the relationship between these two levels of signs is trivial, as the secondary sign production is "dominated by the material authority of the first level" (Aarseth, 1997, p. 40). In computational media, however, the relationship between the data and processes at the subface and the signs generated at the surface is *arbitrary* (Ibid.). The same data can generate different signs depending on the processes used to transcode it or the context where it is transcribed. Because of irreducibility, even the same data and processes may lead to varying signs.

Whenever data is transcoded and signs are recreated at the surface, several techniques may allow the medium to check the integrity and completeness of the output signs. A computer can verify if all information is presented, if all signs are in their intended places, and make corrections in case they are not. But in this process many opportunities also arise for divergence. Errors, bugs, glitches, failed transcoding, etc., may not only happen on occasion, as they may happen several times per second in every part of a message: every letter, sample, pixel, etc. Every time a message is recreated within this strange and very peculiar time of the computer, there are opportunities for discorrelation, for time to become "out of joint" (Denson, 2020, p. 164) between the medium and the human. This makes the spectrality of computation concrete in every sign that mutates, in every piece of information that diverges, in every new meaning that these processes may trigger.

Computational media are always dynamic. During their unending processes, computation may find ways to express itself and to reveal its nature. As much as we check-sum messages, and of how many strategies we use to assure data integrity, we cannot stop computational media from potentially diverging, from creating new signs where we did not expect (or want) them, from creating new information. And as we structurally couple with them, be it through interaction (Penny, 2017) or through processes of computational reading and model-making (Carvalhais, 2022), we are not only expanded by new senses (Lee, 2018) but also by new meanings (Denson, 2023). We become privy to images and other signs that are not meant for us, but we are also given a glimpse of the processes behind the curtain (Lee, 2023), the processes at the subface that manage, store, mediate, and ultimately create messages.

7. The paradox of computational media

This is where we find a paradox at the heart of computational media. The goal of any medium is to stabilise information, and computation certainly seems to allow this, however, it ultimately fosters variation and discorrelation (Denson, 2020). Computation brings change and fluidity to where these are not welcome. Does this mean that computational media are inevitably failed as such? That they cannot or should not be used as media? No. But it means that when we use them as media, we should be very aware of their nature and of the influence that it can have on their role as media. And that we can never really trust computational media to fully do their job in stabilising signs. As we digitise all our information, we really do not know whether the computational processes we depend on to retrieve that information can be trusted in the long run.

Classical media also decay and compromise the information they store. But the analogue processes of decay are either much slower, or more predictable and easier to detect and correct. Furthermore, these processes of decay can easily be countered by the mechanical reproduction of multiple copies. This may lead to a loss of Benjaminian aura, but also contributes to gains in stability. Computational media, with their situatedness, their *here and now* (Groys, 2016), are always in process, creating and recreating, transforming, computing, and infusing things with new meanings.

What can we do about this? How can we, as designers, creators of media, consumers, citizens, deal with this paradox? First, we need to realise that it happens. We need to know about it and to make it known. We must spread media literacy and awareness of how computational media are not inherently bad, faulty, or flawed, but cannot be expected to be exactly like classical media. Consequently, we need to develop a critical stance towards computational media and computational tools. We need to understand them, their nature, and their influence on everything that is made with them.

Ultimately, we need to embrace these media as they are, and for what they are. We need to expose their processes, making them easier to read and understand, and breaking open the black boxes of their subfaces (Carvalhais, 2021). We need to counter the tendency towards abstraction in computation, de-abstract these media and embrace their creative potential (Carvalhais & Lee, 2022). This may make them harder to read, perhaps less friendly to operate, but more transparent in their processes.

We need to engage our computational gaze for a fully realised creation of meaning with computational media and to develop and deploy theories of these systems as hermeneutical tools (Lee, 2024), to develop theories of the system, models of their computational processes (Carvalhais, 2022) that we can use to better understand their operations and behaviour. Ultimately, we cannot regard them as neutral mediators. No medium is neutral, of course, but computational media have a much higher, and ultimately uncontrollable, potential for agency and for the creation of signs and meaning.

8. Conclusion: In tune with the world

Like other media forms, computational media decay, shifting and transforming the information they contain and convey. In analogue media forms this is often such a slow process that it gives us a sense

of permanence and stability. In computational media, however, the process is much faster and pervasive at all levels of a medium's functioning. We developed several technologies to try to assure permanence in computational media forms, that try to counter the constant processes of transformation in computation that clash with a worldview fixated on a notion of perceived, or idealised, permanence. But the world is itself in a constant process of transformation, and as such, computational media are in tune with *the world as it is*, clashing with *the world as we perceive it*. Because of this, computational media are frequently understood in biased phenomenological terms that are attached to an understanding of media inherited from analogue technologies, that, although seemingly similar at a superficial level, are ontologically very different from computational counterparts. This creates a dissonance that leads to a certain lack of literacy on computational media, and to limitations of our creative relationships with them. As impermanence is natural and permanence artificial — if it is even achievable —, computational media oddly become both the most artificial of all media we have so far developed but also those that are more natural. It is this paradoxical stand-off that profoundly affects, or even regulates, how we communicate, create, and develop meaning alongside these media. And failure to acknowledge this is to be blind to the other half of the spectrum and refuse the nature of computational media altogether.

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Método para Avaliação e Classificação das Dimensões de Imersão em Narrativas

(Method for Evaluating and Classifying Immersion Dimensions in Narratives)

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Abstract

An immersive narrative means to promote immersion of its target audience, considering three dimensions of narrative immersion: temporal, spatial and emotional. We present and demonstrate the use of a method for evaluating and classifying these dimensions in narratives, enabling reflections for their reformulation according to the pedagogical objectives of the teacher. The method was developed as an artifact of Design Science Research (DSR). It was applied empirically in Portuguese higher education, on an asynchronous e-learning course at Universidade Aberta, which uses narratives for narrative immersion and promoting self-regulation and co-regulation of learning: Software Development Laboratory. The results show that the method enables detection of differences in the level of use of the various dimensions of narrative immersion, as shown for a sample case. This analysis, beyond its usefulness for this evaluation and classification upon narratives, enables their creators (e.g. teachers and non-specialist professionals) to become aware of these situations. Therefore, it provides an overview and supports grounded reflection, inspiring interventions to reformulate the dimensions of narrative immersion that one wants to provide to the target audience.

Uma narrativa imersiva deve prover a imersão do público-alvo considerando três dimensões de imersão narrativa: temporal, espacial e emocional. Apresentamos e exemplificamos o uso de um método que avalia e classifica estas dimensões em narrativas, apoiando reflexões para a sua alteração, de acordo com os objetivos pedagógicos almejados pelo docente. O método foi desenvolvido enquanto artefacto de *Design Science Research* (DSR). Foi aplicado empiricamente numa unidade curricular do ensino superior português em regime de e-learning assíncrono na Universidade Aberta, que utiliza narrativas para imersão narrativa e promover a autorregulação e corregulação das aprendizagens: Laboratório de Desenvolvimento de Software. Os resultados indicam que o método permite detectar diferenças de nível de recurso às várias dimensões de imersão narrativa, como ocorreu no caso apresentado. Esta análise, além de permitir esta avaliação e classificação em narrativas, dá aos seus criadores (e.g., professores e profissionais não especialistas) consciência destas situações ao longo da narrativa. Possibilita, desta forma, uma visão global e uma reflexão fundamentada, que pode inspirar intervenções para reformular as dimensões de imersão narrativa a proporcionar ao público-alvo.

Keywords *Método, Imersão, Narrativas Imersivas, Avaliação, Classificação*

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1. Introdução

Narrativas são transmitidas culturalmente há centenas de anos, restritas ou direcionadas a um domínio ou contexto. São uma versão da realidade (Bruner, 1991) e um elemento fundamental no fenômeno da imersão, que emerge da combinação de sentimento de presença num espaço, do foco na realização de atividades e da absorção psicológica com a narrativa (Nilsson et al., 2016). As narrativas imersivas, provendo a imersão do público-alvo, criam situações e abordagens para promover um profundo envolvimento mental a ponto do estado de atenção do público-alvo se dissociar da realidade física (Morgado, 2022).

Contudo, boas histórias não têm garantia de serem imersivas: a imersão narrativa, conforme exposto por Ryan (2015), advém, ela mesma, de três dimensões conceptuais relevantes: a imersão (narrativa) temporal, espacial e emocional.

Ter a opção de seguir um método para avaliar e classificar narrativas nesta perspectiva da imersão pode ser útil a professores e profissionais não especialistas em narrativas, considerando que métodos para criar narrativas apresentam estruturas e visões diferentes de concepção, por exemplo, para Barthes & Duisit (1975) as narrativas devem possuir uma estrutura própria, sob a ótica da linguística para encadeamento de materiais; para Gancho (2006), devem contemplar elementos imprescindíveis à sua existência (i.e., enredo, personagens, tempo e espaço); e Cohn (2013) utiliza o arco narrativo para criar narrativas visuais em banda desenhada (i.e., início, clímax e desdobramento final).

O panorama científico, relacionado a "contextos, áreas e tipo de aplicação das narrativas que visam proporcionar imersão, ou seja, narrativas imersivas, é amplo, porém se encontra fragmentado e disperso" (Bonfim et al., 2023). Para criar ou alterar narrativas, para que fiquem imersivas é necessário saber: Que dimensões de imersão estão contempladas na narrativa existente? Qual é necessário potenciar? Para responder estas questões, este artigo apresenta um método para avaliar e classificar narrativas nas dimensões de imersão narrativa de Ryan (2015), exemplificando a sua aplicação a casos concretos. Aplica também as 20 técnicas de concepção/criação de narrativas imersivas de um trabalho prévio de Bonfim et al. (2023), como instrumento para apoiar a reformulação das narrativas avaliadas.

A aplicação do método foi feita em uma unidade curricular (UC) do ensino superior português em regime de e-learning assíncrono, que utiliza uma abordagem de aprendizagem imersiva orientada por narrativa (Fontes et al., 2021) para Autorregulação e Corregulação da aprendizagem, denominada "Laboratório de Desenvolvimento de Software", do 2.º semestre do 2.º ano da Graduação (pt-br) / Licenciatura (pt-pt) em Engenharia Informática da Universidade Aberta de Portugal (ensino superior online assíncrono).

Os resultados mostram que é possível fundamentar e detetar diferenças de grau de ocorrência das três dimensões de imersão narrativa nos textos das narrativas desta UC, bem como as técnicas de imersão narrativa empregues. Esta consciência, apresentada de forma visual, permite refletir e inspirar eventuais alterações do equilíbrio das dimensões de imersão na narrativa, em consonância aos objetivos pedagógicos do docente. Essa alteração é apoiada através do recurso às 20 técnicas acima

referidas, que por estarem mapeadas para as dimensões de imersão narrativa permitem apoiar a sua seleção em conformidade com os objetivos resultantes da análise.

2. Referencial Teórico

2.1 Imersão narrativa

A imersão é “um estado cognitivo em que os indivíduos estão absortos, ou seja, com um profundo envolvimento mental, a ponto da sua atenção se começar a dissociar das restantes ocorrências do mundo” (Morgado, 2022). Emerge das propriedades do sistema (técnico, humano, organizacional) utilizado para promover esse estado cognitivo e das possibilidades de agência do indivíduo e da sua reação à narrativa (Nilsson et al., 2016;Beck et al., 2020). Neste contexto, olhamos para a imersão narrativa como sensação de estar dentro de uma história, envolvido o suficiente para aceitar o mundo e os acontecimentos desta história como reais (Adams, 2014). Bell et al. (2018) efetuaram uma investigação onde avaliaram a experiência de 14 jogadores em um contexto de jogo interativo e grupos de leitura, usando narrativas, mostrando a possibilidade de avaliar de forma empírica aspetos fundamentadores de imersão narrativa. Apresentaram como resultados que “a imersão na ficção digital é uma experiência multimodal e totalmente incorporada, podendo ser estimulada por recursos dentro e fora do texto”, que "a relação do jogador com o avatar é percebida como uma identificação emocional", que "leitores-jogadores emergem no espaço-tempo ao vivenciar a imersão narrativa ou lúdica” e que "sons diegéticos ou não (dentro ou fora do ambiente do jogo) e extratextuais, empurram o leitor-jogador para fora do mundo da história, logo diminuem a imersão.”

A referência fundamental deste trabalho, contudo, é a revisão panorâmica de Ryan (2015), que caracterizou três aspetos como dimensões fundamentais propiciadoras de imersão narrativa: aspetos temporais, espaciais e emocionais. A **imersão narrativa temporal** (Ryan, 2015, p. 86) é como ocorre o envolvimento do leitor no processo pelo qual a progressão do tempo narrativo desloca o campo do potencial, selecionando um ramo como o real, confinando os outros ao reino do sempre virtual, ou contrafactual, e como resultado desta seleção gera continuamente novas escalas de virtualidades, (Ryan, 2015, p. 99) caracterizada por uma intensa preocupação com a narrativa devido a um forte desejo de saber o que vai acontecer a seguir (Nilsson et al., 2016, p. 115). **A imersão narrativa espacial** é uma sensação de lugar e um modelo de espaço, portanto, é uma resposta ao cenário (...) (Ryan, 2015, p. 86), caracterizada um forte sentido de lugar e do prazer de explorar o ambiente (Nilsson et al., 2016, p. 115). **A imersão narrativa emocional** é a resposta aos personagens (Ryan, 2015, p. 86), parte do princípio que (...) os personagens podem gerar reações emocionais com sintomas físicos, como o choro, embora os leitores saibam muito bem que estes personagens nunca existiram (Ryan, 2015, p. 10). É caracterizada por forte envolvimento emocional com o destino dos protagonistas ou antagonistas da narrativa (Nilsson et al., 2016, p. 115).

Em trabalho prévio de Bonfim et al. (2023), identificámos 20 técnicas de concepção/criação de narrativas imersivas, que agrupámos segundo a sua afinidade (Tabela 1), com as dimensões de Ryan (2015).

Tabela 1. Agrupamentos das Técnicas para Concepção/criação de Narrativas Imersivas

Agrupamentos	Técnicas/Temas	Descrição
Agrupamento 1: temas mais focados em Imersão Emocional	Identidade narrativa	Representa formas de criar uma identidade narrativa, usando caracterizações de personagens protagonistas e antagonistas, cenas-chave (e.g., ponto alto, ponto baixo, ponto de viragem etc.) ou a seleção e interpretação de eventos para o mesmo fim.
	Combinar narratividade e emocionalidade	Representa abordagens de desenvolvimento das diversas qualidades da narrativa para persuadir o público, aumentando a emocionalidade da narrativa.
	Inoculação	Representa o emprego dos conceitos e técnicas da teoria de inoculação de narrativas para desencadear contra-argumentos e ameaças percebidas, avisando os 11 participantes de um próximo apelo persuasivo (e.g., um aviso prévio explícito), antes de oferecer contra-argumentos (técnica de preempção refutacional).
	Personagens reagem a eventos	Representa o recurso a ações de personagens para lidar com um evento inicial e as reações dos personagens aos eventos e acontecimentos da história.
	Dar sentido à experiência pela narrativa	Representa recurso ao modo narrativo do pensamento para produzir histórias estruturadas para dar sentido a relações e captar a experiência vivida, com o objetivo de construir ou comunicar significados.
	Refletir aspectos do público nas personagens	Representa o recurso à criação de personagens compatíveis com o público-alvo.
	Propaganda	Representa abordagens deliberadas e sistémicas de manipular os conhecimentos e moldar o comportamento do público-alvo.
Agrupamento 2: temas mais focados em Imersão Temporal	Marcadores de fase	Representa o uso de eventos e personagens para identificar o início, o meio e o final da história. Inclui a sequência e consequências de eventos para terminar episódios e, por fim, as mudanças entre partes da história causadas por personagens.
	Combinar/complementar narrativas ou contra estereótipos	Representa abordagens que combinam ou complementam narrativas alternativas em contraposição às narrativas dominantes em determinado contexto, o que inclui o uso de exemplos contra estereotipados.
	Estruturar a história com base em eventos	Representa o uso de eventos para estruturar a história, e.g., uso da sequência de eventos para auxiliar a sua memorização. Inclui o uso de eventos como cláusulas independentes e a utilização da ordem de acontecimentos para apresentar uma construção social do mundo que sirva ao interesse do narrador.
	Enredo sequencial	Representa a estruturação *do* enredo em uma sequência com princípio, meio e fim, levando a narrativas que são interpretações de eventos sequenciais.
	Fluxo hierárquico dos estados da narrativa	Representa a estruturação da narrativa em uma sequência de estados que se decompõem em estados internos ou subjacentes; inclui abordagens interativas nas quais o percurso pela narrativa pode não ser uma sequência, mas sempre respeitando a hierarquia de estados.
	Contranarrativas	Representa o uso de contranarrativas face às narrativas dominantes para criar novas associações no público-alvo.
	Gramáticas de histórias	Representa o recurso a uma estrutura da história organizada por elementos, e.g., exposição, conflito, clímax e resolução. Inclui o recurso a episódios enquanto gramáticas de história compostas por cenário, ação, evento e consequência.
Agrupamento 3: temas mais focados em Imersão Espacial	Intervenções desafiantes	Representa o uso de intervenções orientadas que desafiam as narrativas dominantes, o uso de desafio nas interações dos jogadores com os videogames e a conceção de jogo que alinha as tarefas do jogo com a narrativa global.

	Combinar personagens, história e ambiente	Representa abordagens que associam o desenvolvimento do enredo e histórias dos personagens com o ambiente no qual essas histórias são contadas.
	Ambiente para introduzir elementos	Representa o uso de cenários para apresentar personagens principais ou o contexto social, físico ou temporal da história.
	Elementos da história como narrador	Representa abordagens que recorrem ao ambiente ou às personagens para desenvolver a história.
	Narrativa emerge das interações	Representa o estabelecimento de condições para que a narrativa emerja das interações com o público-alvo, e.g., opções tomadas pelos jogadores no decorrer de um videojogo.
Agrupamento 4: temas isolados entre si, intermédios entre imersão temporal e emocional	Imersão por fatores narrativos e concepção em jogos	Representa o desenvolvimento da *imersão* por recurso a focos de atenção na narrativa ou aspectos da concepção dos jogos. Inclui fatores narrativos, como: a curiosidade do jogador para explorar a narrativa do jogo, a concentração, a compreensão, a empatia, a familiaridade, o desafio da narrativa de um jogo, as capacidades do jogador e o controle proposto pela narrativa do jogo.

Fonte: Adaptado de Bonfim et al. (2023)

A aplicação do método para avaliar e classificar as dimensões de imersão em narrativas utilizou as 20 técnicas (Tabela 1). Foi realizada pela primeira vez em narrativas já existentes, na UC referida na introdução, que é detalhada na seção 3. A classificação das narrativas é apresentada na seção 5.

2.2 Narrativas

A criação de narrativas é uma atividade complexa e requer conhecimento sobre formas de as conceber. Embora a história contada em uma narrativa não tenha obrigação de ser verdadeira (Bruner, 1991), seu enredo deve ser crível, o leitor precisa acreditar no que lê (Gancho, 2006). Para Gancho (2006) "toda narrativa se estrutura sobre cinco elementos, sem os quais ela não existe" (i.e., Enredo, Personagens, Tempo, Espaço e Narrador), possui também, uma estrutura própria, sob a ótica da linguística e de como inserir um novo material, mesmo que este se ancore ao material anterior para maior sustentação argumentativa (Barthes & Duisit, 1975).

Considerando a complexidade da atividade de criação de narrativas, os métodos para criação de narrativas:

> *"são instrumentos que apoiam a conjugação de todos esses fatores, por especialistas ou não especialistas, para diversas aplicações, como jogos sérios, ambientes de realidade virtual ou contextos não tecnológicos"* (Bonfim et al., 2023)

A Tabela 2 apresenta três abordagens de criação de narrativas com diferentes estruturas e estratégias.

Tabela 2. Métodos para Criação de Narrativas

Autor	Estrutura de criação
(Paracha & Yoshie, 2010)	Utilizam a inteligência artificial (IA) para interagir com crianças na criação das histórias, utilizando três estruturas básicas: cenário, episódio e ações da narrativa.
(Cohn, 2013)	Estrutura narrativa visual (em banda desenhada), na qual um arco da história é criado, seja com eventos ou ações de personagens até atingir o clímax e a partir dele, desenvolver a narrativa ao desfecho final.
(Koenitz, 2010)	Narrativa Digital Interativa (IDN) e uma forma de narrativas expressiva em mídia digital realizada em um sistema que contém narrativas potenciais e

	experimentadas por meio de um processo que resulta em produtos que representam narrativas instanciadas.

A estrutura simplificada de Paracha e Yoshie (2010) opta por minimizar a quantidade de elementos da narrativa, para viabilizar a interação com crianças. A estrutura visual de Cohn (2013), permite uma complexidade maior e mais extensa para criação do arco narrativo, uma vez que, se o leitor não entender o desdobramento da história, é possível revisitar com rapidez a mesma até o pico desse arco narrativo. A estrutura interativa de Koenitz (2010), utiliza eventos da narrativa como vetores narrativos (i.e., o desaparecimento de uma pessoa, uma pane em um veículo etc.) que permitem a compreensão das estruturas narrativas além das noções herdadas da estrutura da história (Gancho, 2006) e (Barthes & Duisit, 1975) e do arco narrativo (Cohn, 2013). É composta por um sistema (arfefacto digital) e um processo (usuário interagindo com o sistema) em relação à visão centrada no produto da mídia tradicional.

As narrativas apresentadas neste artigo foram concebidas de forma sequencial e não interativa em consonância com os objetivos pedagógicos da UC usada como caso. A imersão narrativa se apoia em Ryan (2015), contudo, a interação com as narrativas mediada pelo sistema (ambiente virtual de aprendizagem Moodle) pode ocorrer à medida que o estudante lê a narrativa e se vê envolvido na participação em fóruns, na realização de testes, na entrega de trabalhos, na realização de projetos em grupo e assim por diante.

Para apoiar o complexo processo de elaboração de narrativas imersivas, a visualização quantitativa das dimensões de imersão narrativa (Ryan, 2015), contempladas na mesma, pode ser útil. Assim, um método para avaliar e classificar dimensões de imersão em narrativas, é apresentado seção 4.

3. Metodologia

Para desenvolvimento do Método de Avaliação e Classificação de Narrativas, enquanto artefacto de *Design Science Research* - DSR (Hevner & Chatterjee, 2010) seguiu-se a abordagem de Peffers et al. (2014). As perguntas de entrada foram: Como avaliar e classificar narrativas imersivas? Que dimensões de imersão estão contempladas nas narrativas existentes? Que dimensão de imersão é necessário potenciar? Este artigo apresenta a aplicação de um método para avaliar e classificar as dimensões de imersão narrativa como apoio à criação de narrativas imersivas por professores e criadores não especialistas.

Para desenvolvimento do Método utilizamos os já referidos conceitos de imersão narrativa temporal, espacial e emocional (Ryan, 2015), a caracterização da resposta do usuário às mesmas dimensões de imersão, por Nilsson et al. (2016) e um trabalho prévio de Bonfim et al. (2023), que identificou 20 técnicas para concepção de narrativas imersivas agrupadas nas 3 dimensões de Ryan.

Experimentámos o método empiricamente na UC “Laboratório de Desenvolvimento de Software”, do curso de Licenciatura (pt-pt)/Graduação (pt-br) em Engenharia Informática da Universidade Aberta de Portugal, em regime de e-learning assíncrono. Esta seguia a abordagem pedagógica e-

SimProgramming, onde se recorre à técnica OC2-RD2 (Rosa et al., 2018) para conceber um contexto de aprendizagem baseado em narrativas (Fontes et al., 2021). Castelhano et al. (2022) validaram a adaptação à cultura portuguesa dos nomes das personagens (*Boss*, Meiabola, Patavinas, Ada, Fezada e Catmming) que desenvolvem diálogos entre si e algumas falas direcionadas aos estudantes ao longo dos tópicos da UC, considerando-os (estudantes), como novos estagiários da empresa fictícia SimProgramming.

As personagens têm funções específicas na empresa: o *Boss* é um "chefe" (gestor intermédio). O Meiabola, o Patavinas, a Ada e a Fezada são programadores. A Catmming é uma (fictícia) assistente de inteligência artificial (que é também uma gata – liberdade criativa da narrativa), que apoia e incentiva os estudantes a avançarem, utilizando desafios metacognitivos (Pedrosa et al., 2021). Nessa empresa há quatro cenários nos quais a história decorre, assim descritas textualmente: Sala de estagiários (descrita como tendo armários com documentação de apoio); Sala dos desenvolvedores (com mesas de trabalho e computadores, etc.); Sala do *Boss* (com mesas de trabalho e de reuniões). Por fim, a sala de convívio dos estagiários (com mesas para café e lazer).

A UC está organizada em 6 Tópicos, com a duração de 15 dias cada, com a seguinte base de conteúdo: 1. Design de software: (Princípios e Estilos arquitetónicos, incluindo Model-View-Controller (MVC); 2. Separação de interesses: Conceito e Abordagens; 3. Testes de software: Tipos de testes Tratamento de erros, incluindo exceções em MVC e 4. Separação entre interface e implementação: Conceito e abordagem; e Técnicas de Implementação.

Testamos, avaliamos e classificamos as narrativas e a partir das visualizações, fomos reformulando o esquema do Método para Avaliar e Classificar a narrativas apresentado na Figura 1.

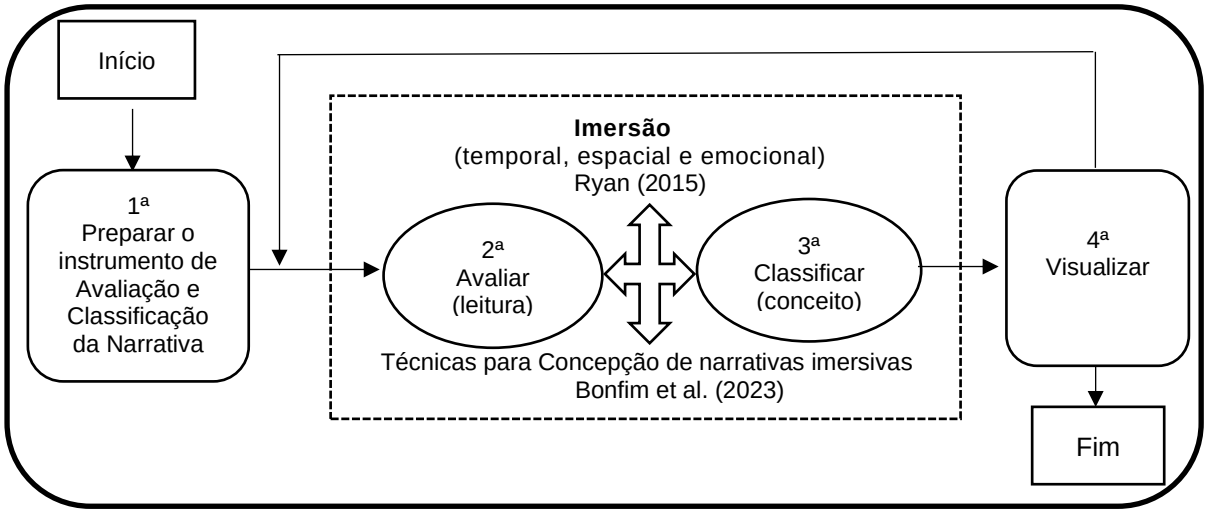

Figura 1. Método para Avaliação e Classificação de Dimensões de Imersão em Narrativas

A sequência apresentada na Figura 1 é descrita na Tabela 3 e foi repetida para todos os excertos de narrativa ao longo dos 6 Tópicos da UC.

Tabela 3. Descrição das atividades do Método de Avaliação e Classificação de Dimensões

Etapa	Descrição
Início	Escolher a narrativa a avaliar e classificar pelo método
1.ª Preparar do instrumento de Avaliação e Classificação da Narrativa	Criar uma matriz bidimensional (linha x coluna). Separar os excertos da narrativa (linha por linha) por tópico ou história a ser avaliada. Nomear as colunas com as 3 dimensões de imersão narrativas (Ryan, 2015) e as 20 técnicas de criação de narrativas (Tabela 1, Bonfim et al., 2023).
2.ª Avaliar	Realizar uma leitura atenta do excerto e submetê-lo ao conceito de imersão narrativa da Ryan (2015). Em seguida submeter às Técnicas para criação de narrativas imersivas (Bonfim et al., 2023).
3.ª Classificar	Marcar um "x" na coluna da dimensão de imersão à(s) qual(is) o excerto se enquadra no conceito Ryan (2015) e um "x" na coluna da técnica correspondente (Bonfim et al., 2023), quando houver ocorrência de alguma delas.
4.ª Visualizar	Visualizar os gráficos para verificar o panorama da classificação. Analisar se há necessidade de fazer outra avaliação do excerto. Este é um ponto de reflexão que permite ter consciência, refletir e tomar decisões. Tome notas para decisões de alterações futuras, considerando os objetivos pedagógicos que o docente, ou outro profissional, ambiciona que as suas narrativas possuam.
Fim	Finalizar a sequência do Método de Avaliação e Classificação da Narrativa.

A sequência de avaliação e classificação do método, permite a visualização quantitativa à medida que a narrativa vai sendo avaliada e classificada qualitativamente. A etapa de visualização possibilita ao docente ter a consciência da prevalência (ou falta) de uma ou outra dimensão de imersão narrativa. Permite tomar decisões sobre quais aspetos podem aumentar a imersão narrativa (Ryan, 2015) e pode refletir e decidir as Técnicas para Concepção de Narrativas Imersivas (Bonfim et al., 2023) deseja aplicar.

4. Método para avaliação e classificação das Dimensões de Imersão em Narrativas

Para aplicação do Método, adotamos a sequência apresentada na Figura 1, **Início:** Escolher a narrativa a avaliar e classificar pelo método. Para Avaliar e Classificar selecionamos parte da narrativa do Tópico 1 – "Precisa de ajuda?" e "Ritual de iniciação dos estagiários", (Figura 2). O tópico inicia com uma pergunta que faz parte da narrativa na UC.

1.ª Preparar o instrumento de Avaliação e Classificação da Narrativa: Criamos uma planilha (matriz bidimensional) para separação dos excertos da narrativa em cada linha (Figura 2). Nominamos as colunas com a dimensão de imersão narrativa (Ryan, 2015) e as 20 técnicas de criação de narrativas (Bonfim et al., 2023), considerando que, um mesmo excerto pode ser classificado em uma dimensão de imersão e em uma técnica de criação de narrativa. A UC é organizada em 6 Tópicos, portanto, criamos uma aba na planilha para cada Tópico (Figura 2), segmentando as narrativas como estão implementadas no Ambiente Virtual de Aprendizagem.

Tópico 1 (Etapa 1: Integração na empresa)	Narrativa Analisada	Imersão Narrativa			Temas
					T8
		Temporal	Espacial	Emocional	Combine characters, story and environment
Precisa de ajuda?Fórum	**Catmming:** - Olá, sou a Catmming, a assistente automática inteligente da SimProgramming.			X	
	Tomo conta desta sala onde se esclarecem dúvidas, nesta fase de iniciação na SimProgramming!		X		X
	Usufruam deste espaço e interajam também com os vossos colegas estagiários!		X		
	Tasklist: Iniciar uma nova discussão, caso possua alguma dúvida.				
	Tasklist: Visualizar as discussões iniciadas pelos colegas.				
	Tasklist: Interagir com os vossos colegas, participando nas discussões.				
Ritual de iniciação dos estagiários	**Catmming:** Bem-vindo à sala de acolhimento de estagiários (T) Esta sala tem vários posters na parede com projetos realizados pela empresa (ES), e aguardam por vós quatro funcionários: a Ada, o Patavinas, o Meibola e a Fezada (EM).	X	X	X	

Figura 2. Planilha de avaliação e classificação das Dimensões de Imersão Narrativa - Elaborada pelos autores

2.ª Avaliar e 3.ª Classificar (Imersão): Foi realizada uma leitura atenta para perceber em quais conceitos de imersão narrativa (Ryan, 2015) e quais técnicas de criação de narrativas (Bonfim et al., 2023), o excerto mais se adequava conceitualmente para ser classificado. O tópico a seguir da Figura 2: Tópico 1 *Precisa de ajuda?* **"***Olá, sou a Catmming, a assistente automática inteligente da SimProgramming*", foi submetido às definições de Imersão de Ryan (2015), dentre as quais "a imersão emocional é a resposta aos personagens", portanto o excerto foi **classificado** como **imersão emocional.** Na sequência o excerto: "*Tomo conta desta sala onde se esclarecem dúvidas, nesta fase de iniciação na SimProgramming!*", se adequa ao conceito de imersão narrativa espacial uma vez que transmite "uma sensação de lugar e um modelo de espaço, portanto, é uma resposta ao cenário (...) (Ryan, 2015, p. 86). As salas da Empresa Simprogramming fazem parte do cenário da narrativa e são "lugares" fictícios, que só existem na narrativa. O excerto foi **classificado** como **imersão espacial.** A fala da ***Catmming***, denota sua ligação com a sala e sua disponibilidade para interagir com os novos estagiários (alunos) da SimProgramming. O ambiente (sala) e a personagem (*Catmming*), fazem parte do enredo da narrativa. Neste ambiente (sala), as dúvidas podem ser esclarecidas e essa dinâmica faz parte da história, à medida que vão ocorrendo interações entre os estagiários (alunos) e a ***Catmming,*** *logo, o* mesmo excerto se adequa ao conceito da técnica **Combinar personagens, história e ambiente** (Tabela 1).

No mesmo subtópico, *a* ***Catmming*** *prossegue a narrativa: "Usufruam deste espaço e interajam também com os vossos colegas estagiários!",* este excerto remete a formas de explorar o espaço para interagir com os colegas (Nilsson et al., 2016), sendo portanto, **classificado** como **imersão espacial.**

Passando a **avaliar** o subtópico Ritual de iniciação dos estagiários, fizemos 3 marcações (T), (ES) e (EM) em azul (Figura 2), como estratégia operacional para auxiliar a avaliação do excerto, uma vez que o mesmo contempla as 3 dimensões de imersão: "*Bem-vindo (T) à sala de acolhimento de estagiários",* **imersão narrativa temporal**, uma vez que utiliza no tempo narrativo no presente (Ryan, 2015), é o momento da chegada do estagiário (aluno) à sala independente do dia ou da hora que o aluno ler narrativa. A segunda parte se refere "*à sala de acolhimento de estagiários",* que é um lugar, logo tem-se a imersão espacial, de igual forma, prossegue

a narrativa**:** ***"****Esta sala tem vários posters na parede com projetos realizados pela empresa (ES*)", assim, os dois últimos excertos foram **classificados como imersão espacial.**

No último excerto desta fala "e aguardam por vós quatro funcionários: a Ada, o Patavinas, o Meibola e a Fezada" (EM), a expectativa criada nos alunos para as apresentações destas personagens da narrativa, cria uma "intensa preocupação com a narrativa" (Nilsson et al., 2016), podendo gerar uma curiosidade e identificação com os personagens no decorrer da narrativa, se adequa ao conceito de **imersão emocional** (Ryan, 2015)**,** e foi assim classificada**.** A etapa de avaliação e classificação pode ser repetida, até ser possível afirmar que todos os excertos avaliados estão conceitualmente classificados.

4ª Visualizar Na visualização da classificação de todas as narrativas da UC (Figura 3), a seta identifica o Tópico 1 utilizado neste exemplo. A visualização permite a reflexão sobre o estado atual de imersão narrativa, podendo (por exemplo) se concentrar em refletir as dimensões com menor ocorrência identificadas, com objetivo de equilibrar as três dimensões de imersão narrativa (Ryan, 2015), ou (outro exemplo) aumentar a imersão de uma dimensão específica. Estas opções dependem da intencionalidade do autor da narrativa.

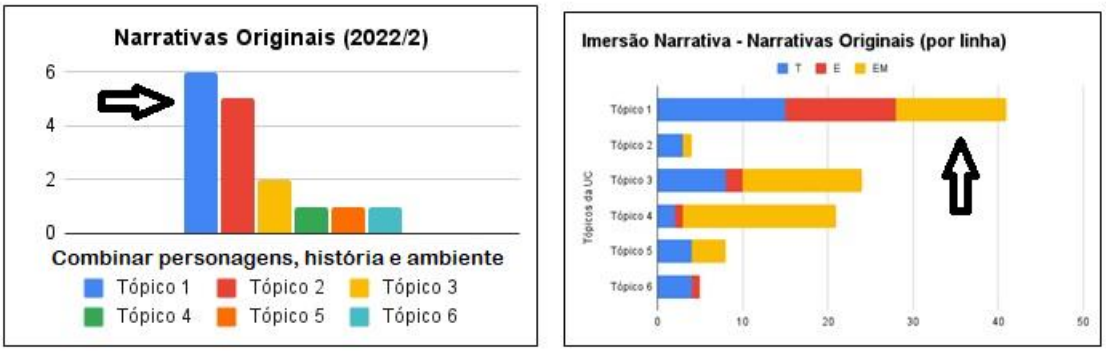

Figura 3. Visualização das Classificação dos Excertos - Elaborada pelos autores

Esta reflexão deve-se apoiar no registro de notas, para decisões de alterações futuras da narrativa, sempre em atendimento aos objetivos pedagógicos do docente. Chegamos ao fim do ciclo do Método de Avaliação e Classificação de Narrativas. A próxima seção apresenta os Resultados da Avaliação.

5. Resultados da avaliação e classificação

Nesta seção, apresentamos os resultados de excertos classificados na etapa de aplicação do Método, nos 6 tópicos da UC (Figura 4). Ao longo desta seção, os nomes das personagens quando referidos, estarão destacados em negrito.

5.1 Imersão (temporal, espacial e emocional)

Após a classificação das narrativas, é possível visualizar no gráfico da Figura 4, todos os tópicos da UC e, tomar consciência das dimensões de imersão narrativa (temporal, espacial e emocional) contempladas em cada tópico. Pode-se perceber que nos tópicos 2 e 5, há ausência da dimensão de imersão espacial e não representa um problema em si, é, apenas um retrato da imersão encontrada nas narrativas.

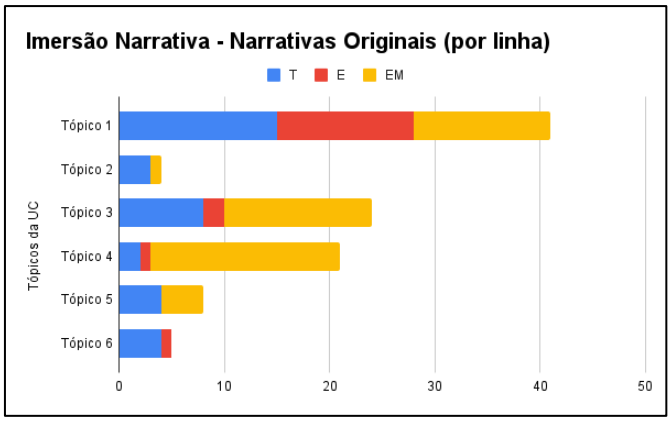

Figura 4. Gráfico de Imersão Narrativa por Tópicos da UC

Na Tabela 4, apresentamos alguns excertos resultantes da etapa de avaliação e classificação as Dimensões de Imersão em Narrativas, considerando os conceitos de cada dimensão apresentados na seção 2.1.

Tabela 4. Excertos por Dimensão de Imersão Narrativa

Dimensão de Imersão (Ryan, 2015)	Exemplos de Excertos Classificados da Narrativa da UC	Tópico
Temporal	***"Patavinas: Malta, vocês que cá chegaram agora**, que estão animados, vamos aproveitar e pôr mãos à obra!"*	1
	***"Meiabola:** Temos muito trabalho a fazer e o **Boss** pediu que vos entregássemos dois post-mortems"*	
	"Patavinas:** Post-mortems!! Ele faz sempre isso a todos os que cá chegam! E a partir desses post-mortems, desenvolvemos uma linha do tempo!" **(..)	
	***"Ada:** Posso dar uma ajuda! Vejam a tabela abaixo, já lhe inclui alguns fatores de complexidade. Agora completem a linha do tempo, indicando quando foi que eles ocorreram!"*	
Espacial	***"Ada: Lembrem-se sempre que nesta sala de documentação de apoios há recursos de apoio**. Eles ajudarão a entender os princípios que a empresa usa para o desenvolvimento de software."*	1
Emocional	***"Boss:** Excelente! ***emoji a bater palmas* Estou a gostar de ver que estão a fazer planos de testes para identificar falhas!** **Contudo,** lembrem-se do que vos disse há dias: ao corrigir uma falha, podem ter de fazer código para lidar com situações de erro."(..)*	4

Fonte: Elaborada pelos autores

No excerto do Tópico 1 (Tabela 4) da dimensão **temporal**, encontramos o ramo real na fala do ***Patavinas***: "***Malta, vocês que cá chegaram agora",*** progredindo o tempo narrativo confinado ao reino sempre virtual (Ryan, 2015, p. 99), quando o ***Meia Bola*** entrega os ***post-mortems,*** *a pedido do* ***Boss*** *(tempo passado).* Na sequência ***Patavinas*** e ***Ada*** prosseguem o diálogo, trazendo novas

informações sobre a atividade, pois é suposto que a partir da entrega do ***post-mortems***, todos os estudantes (estagiários) queiram saber o que vai acontecer a seguir (Nilsson et al., 2016, p. 115).

A imersão espacial enquanto uma sensação de lugar e uma resposta ao cenário (Ryan, 2015, p. 86). A **Ada** provoca a exploração do ambiente quando indica a disponibilidade de recursos de apoio ***, logo é um convite à exploração do ambiente (sala)*** (Nilsson et al., 2016, p. 115). A decisão de inserção ou descrição de um cenário, cabe ao autor, e deve fazer sentido ao contexto e ao público-alvo (e.g., evento como uma reunião, café etc.). **A imersão emocional** enquanto uma resposta aos personagens (Ryan, 2015, p. 86). A fala do *Boss* é um ***feedback*** positivo a respeito do plano de testes, gerando uma reação emocional (Ryan, 2015, p. 10), nos estudantes, pois indica que as personagens estão agindo bem tecnicamente. Neste momento, pode já haver uma identificação com as personagens da narrativa conforme seu papel na narrativa (protagonista, antagonista etc.) (Nilsson et al., 2016). Nesta cena, o Boss, aproveita o momento para dar um recado conceitual que importa ao tópico: ***(Contudo...)***.

5.2 Técnicas mais Focadas por Dimensão de Imersão

Na sequência da análise, pode-se visualizar as técnicas para concepção de narrativas imersivas utilizadas por agrupamento mais focado em cada dimensão de imersão de Ryan (2015). As Figuras 5 a 7, correspondem às técnicas dos respectivos agrupamentos, constantes na Tabela 1.

Agrupamento 1 – Temas/Técnicas mais focados em Imersão Emocional

Figura 5. Agrupamento 1 - Temas mais focados em Imersão Emocional

Os resultados da extração dos excertos (Tabela 5), seguem a sequência da esquerda para a direita dos gráficos da Figura 5.

Tabela 5. Excertos classificados nas Técnicas/temas mais focados em Imersão Emocional

Técnicas (Bonfim et al., 2023)	Exemplo de Excertos Classificados da Narrativa da UC	Tópico
Identidade narrativa	***"(Ponto baixo) Meiabola:*** *Malta, estou com um problema aqui. Estou há horas às voltas com o código-fonte de um programa que não consigo perceber…"*	1
	(Ponto baixo) *"**Patavinas:** Ihhh... Já tentei entender, mas ando sem muito tempo para trabalhar nisso, a documentação não está muito boa Foi feito por aquele programador que saiu da equipa e foi colocado em outsourcing no Dubai!"*	
	(Ponto de viragem) "Ada: *Isso não interessa! Podemos ver exemplos semelhantes, talvez isso nos ajude!"*	
	(Ponto Alto) "Fezada: *Que acham se pedíssemos a opinião das outras equipas?!"*	
Combinar narratividade e emocionalidade	***"Meiabola: C'um caneco! 'bora lá, analisar as API sugeridas e imaginar como podem originar produtos novos para a empresa desenvolver.****"*	2
	"Ada: *Exato. Temos de refletir acerca das API para imaginar desenvolver uma boa aplicação de demonstração"*	
	"Patavinas: *Onde estão? Qual analisamos primeiro?"*	
	Fezada: *Bem,* ***oh Patavinas... dãää! Olha aqui o material, a Lista de API sugeridas"***	
Personagens reagem a eventos	***Meiabola****: Epá, mudando ou não mudando de variante do MVC, temos que avançar com a escolha que fizermos..."* ***(evento inicial foi a escolha que fizeram)***	3
	"Patavinas*: Bolas! Mas vai demorar muito tempo programar isso tudo!* ***(reação ao evento inicial)***	
Dar sentido à experiência pela narrativa	*"O* ***Boss*** *conta sempre aquela história do Office 97 que tinha dependências do Exchange Server 4 e passado um ano o Exchange Server 5 tinha dependências do Office 97… há de ter sido lindo."*	4
Refletir aspectos do público nas personagens	***"Ada:*** *Olá, sou a* ***Ada****, tenho 36 anos. Nas horas de lazer, gosto de estar com a minha família e de ler um bom livro. Já trabalhei no desenvolvimento de aplicações para telemóveis, para a Web e em jogos, gosto de trabalhar em equipa e de tomar iniciativas. Estou aqui na empresa há alguns anos: por isso, eu e os meus colegas fomos encarregados de vos receber!"*	1
Propaganda	***"Boss:*** *Ora muito bem, como estamos, pessoal?! Isso vai? Aqui na SimProgramming não somos cowboys de consola que só disparam código sem se preocupar com o utilizador e a equipa! Por isso, não fazemos programas arrogantes, que quando detetam um erro se limitam a dizer "houve um erro", ir abaixo e catapum...! Não deixamos o utilizador a ver navios."*	4
Inoculação	Não se aplica	NA

Fonte: Elaborada pelos autores

Passamos à análise da aplicação das técnicas (Tabela 5):

Identidade narrativa possibilita criar uma identificação com a narrativa utilizando caracterizações de personagens, ou cenas-chave. O excerto utilizou a cena-chave, contendo: ponto alto, ponto baixo, e ponto de viragem.

Combinar narratividade e emocionalidade, tem foco em modular a narrativa para impactar o público-alvo de forma emocional. O excerto inicia com uma expressão informal do ***Meiabola*** *("*C'um caneco!"), a ***Ada*** e o ***Patavinas*** dão prosseguimento ao assunto (API) e a ***Fezada*** em tom descontraído ("oh Patavinas... dããã") indica o material.

Personagens reagem a evento, as personagens ***Meia Bola*** *e* ***Patavinas,*** estão reagindo a necessidade avançar no desenvolvimento do código de programação pela escolha de implementação (evento inicial) que fizeram. A dinâmica de desenvolvimento das atividades pelas personagens (i.e., iniciar ou reagir a um evento), também são vividos pelos estudantes ao acompanhar o desenrolar da narrativa vivenciando o contexto real de trabalho em grupo, no desenvolvimento de sistemas e testes que devem ser executados e entregues no decorrer da UC.

Refletir aspectos do público nas personagens, pode ser utilizada para o público-alvo se espelhar nas personagens, permitindo transmitir, pela narrativa, mensagens intencionais. Os arquétipos das personagens, foram projetados com foco no público-alvo, aumentando a possibilidade desta identificação.

Dar sentido à experiência pela narrativa, foi aplicada como abordagem interpretativa do *Boss* para compartilhar a experiência e crença individual da "*história do Office 97"*, para facilitar o conhecimento e gerar reflexões e respostas nos estudantes.

Propaganda*,* abordagens sistematizadas para formatar a perceção e ação do público-alvo*.* A fala do Boss dá o recado aos funcionários da SimProgramming sobre como a Empresa trabalha e trata seus clientes.

Inoculação, não foi aplicada, pois o objetivo da narrativa é fomentar uma postura ativa do estudante aos desafios cognitivos propostos, sem imposição. Esta técnica pode ser utilizada na concepção de narrativas para outros contextos onde seja necessário introduzir uma narrativa que vise confrontar uma narrativa dominante.

Agrupamento 2 - Temas/Técnicas mais focados em Imersão Temporal

Figura 6. Agrupamento 2 – Temas mais focados em Imersão Temporal

Os resultados da avaliação e classificação do agrupamento 2, técnicas mais focadas em Imersão Temporal, são mostradas na Tabela 6.

Tabela 6. Excertos classificados nas Técnicas/temas mais focados em Imersão Temporal

Técnicas (Bonfim et al., 2023)	Exemplo de Excertos Classificados da Narrativa da UC	Tópico
Marcadores de fase	*"Passado um tempo…. **Ada:** Oh pessoal, partilhem aqui connosco como fizeram na vossa aplicação demonstradora: (Submeter no fórum 1 ou 2 casos curtos)"*	3
Combinar/complementar narrativas ou contra estereótipos	*"**Patavinas**: Ihhh... Já tentei entender, mas ando sem muito tempo para trabalhar nisso, a documentação não está muito boa. Foi feito por aquele programador que saiu da equipa e foi colocado em outsourcing no Dubai! **Ada:** Isso não interessa! Podemos ver exemplos semelhantes, talvez isso nos ajude!"*	1
Estruturar a história com base em eventos	***"Catmming**:Truz-truz Olá! sentes que vale a pena estar a refletir sobre a estrutura interna da aplicação, separando-a por componentes com responsabilidades distintas? Ou parece-te que é um trabalho perdido, sem eficácia real? Que aspetos foram mais críticos para tomares as decisões de estruturação? Consegues antever alguma situação futura onde alterações aos requisitos ou a reação a novos problemas que possam surgir sejam facilitados por esta estruturação? Vamos pensar sobre isso..."*	2

Enredo sequencial	***(Início)*****"Fezada:** *Pessoal, estou aqui a "pensar com os meus botões": se conseguimos fazer algo tão facilmente e tão eficaz analisando o acoplamento, será que podíamos fazer algo parecido para os outros indicadores de qualidade?*	3
	(Meio)**"Patavinas:** *Ãhn? Mas há outros indicadores?*	
	(Meio)**"Meiabola:** *Sim, não leste o livro de normas da empresa? Por exemplo: o acoplamento aparece ligado à coesão. Preconiza-se acoplamento fraco com coesão forte (pp. 85-86).*	
	(Meio)**"Ada:** *Os indicadores de qualidade exigidos pela SimProgramming, estão descritos nas normas: no livro, são as secções 6.1 e 6.2, pp. 153-163. Por isso, vamos lá a ler…. Pois assim podemos ir vendo como usar esses princípios nas aplicações demonstradoras, para terem mais qualidade.*	
	(Fim) ***Fezada:** E há outra vantagem. Se o **Boss** nos perguntar isso mais tarde (p-fólio/exame), já saberemos responder… Além de que se surgirem dúvidas é melhor esclarecê-las agora, confrontados com o nosso código, do que mais tarde só para parecer bem numa reunião"*	
Fluxo hierárquico dos estados da narrativa	*"Olhem aqui: <Figura Log de erro: Desenho de uma forma aleatória> <hiperligação>.*	4
	***Ada:** Muito bem, Patavinas! É uma excelente opção! **Eu e a Fezada** fizemos o mesmo, mas para um caso diferente. Considerámos uma situação em que os dados de input não sejam aceitáveis para um processamento interno eficaz. E também fizemos um diagrama de sequência para isso. Espreitem aqui: Caracter inválido na entrada de dados (Figura) (..)"*	
Gramáticas de histórias	***(Exposição)*** ***"Meiabola:** Uauuuuuuu! Eh pá, a vossa minuta de plano de testes é espetacular! Está bastante completa! Isso vai-nos ajudar…. Assim não nos vamos esquecer de considerar nada!*	4
	(Conflito) ***Patavinas**: Oh...Oh! Estás doidoooo! Não vamos é ter tempo de fazer isso tudo! *Emoji com carinha com monóculo/desconfiado* **(Climax)***	
	(Resolução) ***"Ada:** Pois, nós também não! Calma, a ideia não é fazer tudo de uma vez. Simplesmente, é melhor saber o que nos falta, ter um panorama, do que nem sequer fazem ideia, não é? Se não fizermos ideia do panorama, é a "morte do artista". Como disse um ministro da defesa norte-americano, o Donald Rumsfeld: "há o que sabemos que conhecemos, há o que sabemos que desconhecemos, mas o pior é sempre o que não sabemos que desconhecemos!(..)*	
	***Fezada:** É que mesmo que não tenhamos tempo para os fazer todos, ao termos um plano de testes podemos priorizá-los e decidir por onde começar. Ou seja, decidir quais iremos fazer primeiro dentro do tempo que temos disponível e considerando o contributo que esses testes podem dar para o projeto"*	
Contranarrativas	Não se aplica	NA

Fonte: Elaborada pelos autores

Segue a análise dos gráficos das técnicas (Figura 6) e respectivas técnicas e excertos (Tabela 6):

***Marcadores de fase**,* foi classificada nos seis tópicos da UC e representa o recurso a momentos na narrativa ou às personagens para iniciar, terminar ou transitar a história. Este tema é bastante versátil para criar transições de fases como por exemplo "*passado um tempo*" no excerto do Tópico 3 (Tabela 6), esta passagem de tempo, pode ser classificada como imersão temporal, pois envolve o leitor no processo pelo qual a progressão do tempo narrativo se desloca (Ryan, 2015). Desperta também, a curiosidade sobre o que está por vir na narrativa, aumentando a imersão temporal .

Enredo sequencial também foi classificada em todos os tópicos da UC (Figura 6), apresenta uma sequência com início, meio e fim, desenvolvida a partir do ponto da cena onde a ***Fezada*** faz uma pergunta e após as falas da **Ada**, **Patavinas** e **Meia Bola**, finaliza com o encaminhamento sobre tirar dúvidas. Esta técnica possibilita a elaboração da narrativa em pequenos blocos com esta estrutura.

Gramáticas de histórias, possibilita a organização da narrativa para contemplar uma estrutura de desenvolvimento da situação (i.e., conflito, clímax e resolução). Contempla, o uso de cenários e eventos, como possibilidade para criar narrativas com imersão temporal-espacial, embora o presente agrupamento explore as técnicas mais focadas em Imersão Temporal.

Contranarrativas foi uma técnica não contemplada nas narrativas, seu uso se aplica para proporcionar novas perspetivas, confrontando narrativas dominantes.

Agrupamento 3 – Temas/Técnicas mais focadas em Imersão Espacial

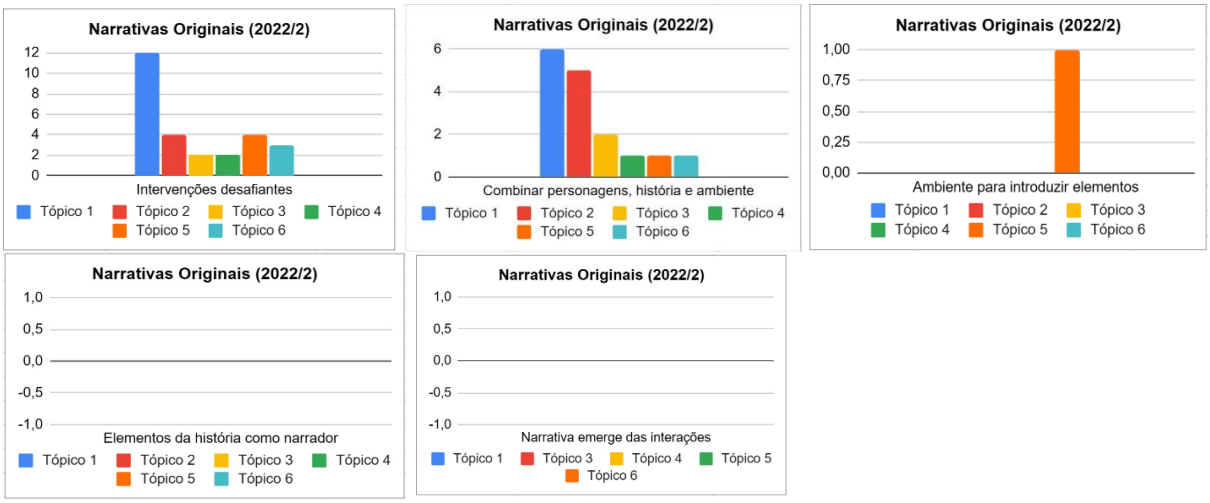

Figura 7. Agrupamento 3 – Temas/Técnicas mais focados em Imersão Espacial

Os resultados da avaliação e classificação do agrupamento 3, técnicas mais focadas em Imersão Espacial, são mostradas na Tabela 7.

Tabela 7. Excertos classificados nas técnicas mais focadas em Imersão Espacial

Técnicas (Bonfim et al., 2023)	Exemplo de Excerto Classificados da Narrativa da UC	Tópico
Intervenções Desafiantes	***Fezada:*** *Vá, façam lá isso, vão ver que vai ser essencial nas próximas etapas (submeter a lista de acordo com o template disponível).*	5
Combinar personagens, história e ambiente	***Meiabola:*** *Malta, vejam: aqui os nossos projetos são desenvolvidos em C#. O Boss sempre sugere que usemos o Visual Studio para desenvolver os nossos projetos.* ***(Combina personagens e ambiente de trabalho da SimProgramming)***	1
	Fezada: *Olhem, se ainda não tiverem o Visual Studio nas vossas máquinas, está aqui o link para a instalação: Software: Visual Studio Community.*	
Ambiente para introduzir elementos	*Quero-vos chamar a atenção para uma política que a empresa SimProgramming adota: em todas as aplicações demonstradoras de API é necessário evidenciar a viabilidade dessas API serem usadas a longo prazo na empresa. Portanto, deve-se ter sempre presentes os princípios de qualidade do desenvolvimento de software (pp. 154-161). (..)* ***A nossa empresa mantém relações duradouras com vários clientes. Relações a longo prazo.*** *Neste sentido,* ***os nossos programas mudam para reagir às solicitações dos clientes: corrigir falhas que foram, entretanto, detetadas… adaptar-se a novas funcionalidades que nos solicitam ou que queremos proporcionar... De facto, os nossos programas estão sujeitos a muita atividade de manutenção e adaptação. E isso é feito pelas nossas várias equipas. Ao longo dos anos, vai havendo muitas mudanças de elementos****. Por isso, é muito provável que quem usa um método, hoje, não seja a mesma pessoa (pode nem ser a mesma equipa) que o produziu. Podem ser pessoas e equipas completamente diferentes, com anos de diferença(..)* ***a SimProgramming dá particular valor nas suas práticas de código a boas qualidades de adaptabilidade e manutenção, boa qualidade de independência entre componentes****. (..)*	5
Elementos da história como narrador	Não se aplica	NA
Narrativa emerge das interações	Não se aplica	NA

Fonte: Elaborada pelos autores

Seguindo análise dos gráficos das técnicas (Figura 7) e respectivos excertos (Tabela 7).

Intervenções Desafiantes*,* foi classificada em todos os tópicos da UC, esta técnica utiliza intervenções que desafiam narrativas dominantes ou pode utilizar desafios entre interações de jogadores e a concepção de jogos que contemplam tarefas alinhadas à narrativa global. Nas narrativas da UC, os desafios vão sendo lançados para o desenvolvimento de atividades, cumprimento de prazos e reflexões metacognitivas.

Combinar personagens*,* ***história e ambiente*** também foi classificada em todos os tópicos da UC, considerando ser abordagens que associam no desenvolvimento do enredo e histórias das personagens com o ambiente onde as histórias são contadas. Considerando que, as narrativas ocorrem em uma empresa de desenvolvimento de Software*,* chamada *SimProgramming*, que existe de forma fictícia no contexto da narrativa, as personagens são seus funcionários e as histórias retratam

o quotidiano desta empresa. Esta ficção narrativa, cria possibilidades de imersão potenciada pela combinação destes três elementos (i.e., personagens, história e ambiente).

Ambiente para introduzir elementos utiliza cenários para apresentar personagens ou o contexto social, físico ou temporal da história, a técnica foi utilizada para mostrar o contexto o social e temporal da SimProgramming no setor de desenvolvimento de Software.

Duas técnicas não foram classificadas em nenhum tópico da narrativa: ***Elementos da história como narrador***, utiliza abordagens que recorrem ao ambiente de jogo ou personagens para desenvolver a história e ***Narrativa emerge das interações***, com o público-alvo (e.g. decisões tomadas por jogadores durante um videojogo). As duas técnicas emergem em um contexto de jogo não contemplado na UC. Pode-se observar na Figura 4, que não houve ocorrência de dimensão espacial nos tópicos 2 e 5, portanto a reflexão sobre estes dois temas, pode ser aplicável para ajustes das narrativas destes tópicos após esta avaliação e classificação.

Agrupamento 4 Formas mais isoladas entre si, intermédios entre imersão temporal e emocional

Figura 8. Agrupamento 4 – Formas mais isoladas entre si, intermédios entre imersão temporal e emocional

Imersão por fatores narrativos e concepção em jogos (Figura 8), não foi aplicada, pois não houve desenvolvimento de jogos no decorrer da UC.

6. Conclusão

Os conceitos de dimensão narrativa temporal, espacial e emocional por Ryan (2015), foi o ponto de partida para refletir a importância e aplicação destes conceitos para aprendizagem imersiva (Morgado, 2022).

O contributo deste artigo, é proporcionar uma forma estruturada, reproduzível, de avaliar e classificar narrativas quanto às suas características de imersão. Desta forma, confere aos autores uma visão nova para apoiar a sua tomada de decisão no processo de criação e/ou reformulação das narrativas: a visão das suas dimensões de imersão narrativa.

Foi aplicado o método para avaliar e classificar narrativas empregues numa unidade curricular de ensino superior em regime de e-learning assíncrono em Portugal, “Laboratório de Desenvolvimento de Software”, do 2.º semestre do 2.º ano da Graduação (pt-br) / Licenciatura (pt-pt) em Engenharia Informática da Universidade Aberta de Portugal.

A aplicação do método permitiu verificar se recorremos mais a uma dimensão de imersão (Ryan, 2015) e menos a outra, ou se havia ausência de alguma dimensão, como foi detetado no tópico 2 e 6 da Figura 4, nos quais há ausência da dimensão de imersão espacial, que pode ser ajustada para contemplar estas dimensões se for o objetivo do(a) autor(a) da narrativa.

Foi possível, ainda, saber se os tópicos analisados estão a utilizar mais recorrentemente alguns temas/técnicas para criação de narrativas imersivas e menos outros (Bonfim et al., 2023), que podem ser aplicados em novas versões da narrativa, para que se tornem mais imersivas, explorando os temas dos respectivos agrupamentos, não contemplados nas narrativas originais ou potenciando temas mais adequados ao propósito da narrativa na respectiva dimensão de imersão.

Este trabalho tem como principal limitação ter sido aplicado apenas a um caso concreto (a UC referida). Esse caso não incluía excertos com algumas das técnicas: "Inoculação", "Contranarrativas", "Elementos da história como narrador", "Narrativa emerge das interações" e "Imersão por fatores narrativos e concepção em jogos". Além disso, o método não foi confrontado com outros casos de narrativas, que pudessem revelar-se desafiantes para a sua aplicação ou utilidade. Também a interpretação de características de imersão da narrativa de forma isolada pode não refletir aspetos holísticos da imersão narrativa. Esses aspetos podem advir da articulação de várias das técnicas identificadas ou emergir de forma mais complexa da narrativa global. Finalmente, a validação do método foi efetuada apenas pelos autores, com uma proximidade elevada aos seus pormenores e pressupostos.

Desta forma, propõem-se como trabalhos futuros abordar estas limitações, nomeadamente sujeitando o método a uma avaliação mais alargada, com novos casos e com aplicação por pessoas não associadas à sua conceção, com perfis profissionais e contextuais diferenciados.

Propõe-se ainda que possam ser analisados os efeitos concretos da sua aplicação, quando à alteração fundamental ou não do fenómeno da imersão narrativa no público-alvo das narrativas sujeitas a esta técnica. Por fim, propõe-se a exploração da confrontação deste método com visões holísticas do fenómeno e da narrativa, para constatar eventuais linhas de conflito, corroboração ou complemento.

Esta análise pretende ser útil, para avaliação e classificação de narrativas, para possibilitar a seus criadores (e.g., professores e profissionais não especialistas) tomar consciência de quais temas e dimensões de imersão estão sendo aplicados ao longo da narrativa, possibilitando uma visão global e um espaço para reflexão, que pode inspirar intervenções para aumentar o estado subjetivo de imersão necessário ou que se deseja potenciar no público-alvo em seu contexto.

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The Alienated Senses: Artificial Stimuli for Sensory Perceptions in Interaction with Infomata

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Abstract
This is a qualitative study of exploratory nature, that investigates the senses alienated by the transformation of domestic objects into media, adding to communication and information technologies a functional meaning of interaction. This article aims to substantiate that environment perception through the senses changes when dealing with media infomata, which that have become ways of both media distribution and information storage. The high-tech revolution brought new questions, while household appliances act as media by providing, actively, interactively, or passively, connections between people, infomata, databases and objects. It bets on the alteration of subjectivities from the modulation of experience by interaction human-technology and, therefore, uses the theory of materialities in communication, of the human mechanization and modulations between bodies, technologies, and environment. The qualitative research evolved personal testimonies from 14 volunteers from Rio de Janeiro e São Paulo, during the first semester of 2023. The sample as non-random, purposive sample, constituted of subjects that are knowledgeable individuals in the context of the study. Analysis reveals layers of alienation about the use and role of domestic digital personal assistants and an imminent artificialization of sensorial perception.

Keywords *Domestic Media, Infomata, Sensorial Capitalism, Sensorial Communication.*

1. Introduction

The focal point of this research is related to the problem of sensory alienation when interacting with "smart" objects and systems which have recently been regarded as media – such as lamps, dolls, washing machines, robot vacuum cleaners, personal assistants. Our hypothesis asserts that, when interacting with this class of domestic media/objects, present-day individuals are mostly incapable of discerning their senses and naming their perceptions; therefore, being subjective to artificial stimuli to gather evidence of their experience – a kind of Sensory Capitalism. According to Erthal (2021), the notion of Sensory Capitalism pervades the commodification of sensory stimuli (demands or objects of consumption) made artificial by (new) technologies and (new) intelligent digital media[i]. It consists of convergent and divergent discourses, either complementary or independent, aiming to connect human senses into consumer experiences through digital technologies. This hypothesis is derived from what Han (2018) calls "emotion capitalism" – the exploitation of emotions through economic processes in which consumers abandon most reasoning to become "sentient creatures" (Han, 2018). According to it, economic exploitation, in order to increase human productivity, would increasingly reduce transparency – of relationships, affections, and objects of consumption – to raise instability, which would cause the emotional transformation of the production process. According to the

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philosopher, “communication acceleration also favors emotional transformation, for rationality runs slower than emotionality” (Han, 2018). Thus, modern consumers no longer purchase things. They acquire emotions instead.

This line of thought establishes a consumption environment, in which emotions – instead of things – can be purchased indefinitely. While traditional forms of capitalism expressed emotions to create consumer demands, Sensory Capitalism uses persuasion and the sensory unconscious to establish new and emerging demands.

Common daily life has been managed, monitored, and reported through networked systems. The effects of this new life arrangements in contemporary environments tend to shape most of human experience into adapting one’s perception of self (as a human being), of the lived environment, and most relationships established with the natural world. The popularization of infomata[ii], virtual assistants, artificial intelligence, together with the coupling of digital technologies with mechanical technologies have intensified these changes, therefore changing sensory stimuli and perceptions.

This article has the general aim to substantiate that environment perception through the senses – consequently, the formation of subjectivities – changes when dealing with infomata, which that have become ways of both media distribution and information storage. The adoption of these systems and tools would trigger an alienation of the senses (a deliberate absence of sensory perception) and the institution of a sensory capitalism (in which the senses are used as commodities). We employ the conception of “subjectivity” from the psychological perspective of González-Rey, who theorizes from a historical perspective and states that subjectivity can be regarded as the experience of an historical subject. This way, it expands the meaning of subjectivity beyond a form of rational construction of an external reality, to a system in which both an individual daily chronicle and all meaningful lived social contexts are also considered. Subjectivity is conceived by the author as a complex and multi-determined system, affected by the very course of society and its constituents, within the continuous movement of the complex networks of relationships that characterize social development (González-Rey, 2003).

> *“The concept of subjectivity, from the perspective from which we assume it, opens a zone of meaning in the construction of psychological thought, oriented to signify the complex organization of meanings and meanings that characterize the individual human psyche and the social scenarios in which the subject acts. Subjectivity represents a theoretical construction of ontological value, while it is a concept oriented to generate visibility over the forms of reality that the concept delimits” (González-Rey, 2003, p.XI).*

Being a system affected by the environment and social relations, it would be correct, therefore, to state that subjectivity has been intersected by the transformations brought from technological and digital objects, in the same way which it was transformed in modernity with the acceleration of industrial and urban development according to Simmel [1902]/(1973). Human experience in contemporary everyday life, with technologies and tools connected in net and ubiquitus, consists of a fragmented, dispersed, desynchronized, and alienated combination of natural experiences. As a result, contemporary humans move away from their own nature, renouncing their natural senses while handing interactions over to technological objects. Sensory alienation is this condition of renunciation,

distancing, loss of consciousness about one's own senses, which could be the result of a mechanization of processes, in a way of protecting the perceptual system.

For all we know, as a resonance from the hyper stimuli of modernity (Singer, 2004), we are creating symbolic and sensory filters for everyday objects, attenuated by their triviality. In addition to the struggle to appropriate the senses, the absence of an adequate vocabulary for sensory expressions could also be a counterpoint to explore (Erthal, 2018). The inability to describe sensory experiences permeates the unconsciousness of perceptions and stimuli, for there is no attention dedicated to sensory landscapes, since they would be synesthetic arrangements – a web of data coming from each sense – in which the world is presented by the convergence of this information. But one can easily define with precise language what is seen, heard, inhaled, tasted, or touched. In the movement of alienation of the senses, the sunset on a beach is replaced by a simulation of a sunset on a beach created by a smart lamp connected to a virtual assistant.

1.1. Infomata Cartography

Domestic computer systems are versions designed for use in a domestic private environment, and for the sole use of its inhabitants. In the age of technology consumption, the need for connected objects becomes a hallmark of contemporary culture. Repeatedly, speech highlights the relevance of their presence in human life, the power to free the individual from the burden of memory and logical effort, and the promise of a more organized, more productive, and pleasurable life. Minimal scales have transformed technologies into digital objects, rich on utilities and playful seduction. Computers created from the high-tech revolution for domestic and individual use are celebrated. With every launch, or each system update, technophiles are overwhelmed, eager for new things. They legitimize the idea that technology exists to make life easier and free up work. In general, appreciated devices and media constitute an inseparable part of contemporary culture. However, people's understanding of the media that inhabit their private domestic space is overlooked by a veil of alienation.

When connected to the Internet, Infomata initiate communications with people, connected devices, and non-device digital agents (data, algorithms, artificial intelligence systems). In their cartography there are refrigerators sending messages about shopping lists; washing machines finishing their cycles right before their owners come home, while also updating their maintenance status; lights turning on and off in separate environments, at different schedules and intensities, according to residents visual demands; surveillance cameras recording movements and changes in monitored environments; personal assistants organizing and managing the lives of their users, providing and storing all information for later review; robot vacuum cleaners carrying out personalized cleaning routines; and many other connected appliances, objects and dolls that inhabit domestic environments tampering silently with everyday life. Information systems are perceptive artifacts among people, practically invisible in their discretion, communicating with human agents, with other media in the environment, with other computers via the Internet and with large databases. The electronic and digital revolution takes the form of personal and domestic objects connected to cloud computing,

promising human beings the ability to control homes remotely, therefore liberating them from the constraints of space and time, allowing them to become Homo Mobilis (Lipovetsky, 2016).

This structure of segmented communications can act like a small sample of most social relations of the 21st century, in which people communicate with other people and with technology, technology communicates with itself and other technological manifestations, and back with people. The condition for the existence of technology would be expressed in the same way as that of the human condition: the ability to relate. According to Domingues (2019), objects initially not perceived as media have become parts of the most complex media in the history of communication, as they spread information while capturing data for surveillance, control, and marketing purposes: a system in which the user is outside the central core of the mediation.

The long conversion of household objects into media was addressed by Silverstone in the 1980s, who added to communication and information technologies a functional meaning of interaction among family members. The high-tech revolution brought new questions forward, as household items started to behave as media, providing – actively, interactively, or passively – connections between people, computers, databases and other information sources. It entails complex remodeling of subjectivities based on the modulation of experience through the interaction between human and technology.

Silverstone [1988]/(2007) addressed the media moral significance as a primary way of understanding the world by individuals, a crucial object in human life inscribed in social, cultural, political and economic processes. According to him, this happens because: a) technologies are absorbed into everyday life and daily practices; b) technology users and environments are constantly changing, adapting to technologies; c) the reaction to technological adaptations creates opportunities for the creation of new technologies and services; and d) lastly, technology reflects domestic cultures based on their uses and demands.

The modulation between technologies and domestic life constituted a problem for Silverstone because technological objects such as “televisions, telephones, videos and computers”, “are not just objects: they are media” (Silverstone; Hirsh, 1992). In this way, the theory of domestication considered practical and symbolic aspects of media technologies adoption in daily life and how this modulation could be linked to a transactional system of values, production and exchange of goods, and the symbolism that supports the economy.

Orgad (2007) suggested the inclusion of the Internet in Silverstone's theory, for it is an intrinsic part of the contemporary environment, it is made of connections and interconnections with other media, and it is inseparable from human life, constantly formatting it and being formatted by it. These propositions show that technologies – especially networked ones – have been gradually assimilated by the individual in such a way that the body and mind have become modulated to them, adjusting perceptions to new stimuli, while also altering the subjective constitution of individuals, and reprogramming the senses, in a way that they can adapt and be adapted to emerging technologies. For each technological innovation, gestural codes are created that the body learns, adjusts its sensorialities to perform and absorbs as ordinary daily acts, so automated that it forgets them. It has become natural, for example, to talk to Alexa to adjust your schedule, to program the washing

machine cycle or turn off the light in the room that was left on. Individual and machine are domesticated by omnipresent and ubiquitous digital media technologies.

According to Csikszentmihalyi and Rochberg-Halton (2002), things that people interact with are not just tools for survival or to make survival easier and more comfortable.

> *"Things embody goals, manifest abilities, and shape the identities of their users. Man is not just homo sapiens or homo ludens, he is also homo faber, the maker and user of objects, himself an extension of the things with which he interacts. Thus, objects also create and use their creators and users. To understand what people are and what they can become, it is necessary to understand what goes on between people and things" (Csikszentmihalyi & Rochberg-Halton, 2002, p. 1).*

As the authors advocate there is a misunderstanding about the true nature of things, their symbolic dimensions, and their effects. Most current research in diverse fields of investigation query the autonomy (especially after the spread of Artificial Intelligence) of information and media. Expanding this thought would demand researching on how these new technological objects challenge and condition their users, how they adjust the very concepts of time, space, body, subjectivity, sensoriality and affectivity[iii]. This would be the new topic for debate.

1.2. Artificial stimuli

Any debate on pleasure and well-being disguises the continuous incorporation of technologies, which satisfy the human senses, and with which we relate as "servomechanisms" to McLuhan [1964]/(2003). For McLuhan, the body would be "perpetually" modified by technology, extending its senses and natural abilities and, while simultaneously finding new ways to change technology itself. This continuous modulation, according to him, can be regarded as one of the main reasons for the creation of clothing (a survival technology); the wheel (a mobility technology); of books (a storage technology); and of the electric light bulb (a technology for life to be enjoyed 24 hours a day, seven days a week). The lights transgress the darkness. In the symbolic dimension, they are backers for productivity, security, and surveillance, for there is no need to stop any productive activity, nor to make it unavailable, always in a "state of uninterrupted needs" (Crary, 2016). Consumption also does not need to stop. A surgery, a football match, a classroom, can be regarded as byproducts of electric light. A technology that expands human capabilities, light can be defined as an artificial stimulus device, created by and for the demands of capitalist modernity. The industrial era established a constant rebuilding of the conditions for all sensorial experiences, in which vision performed a major role, becoming linked to scientific rationalism, capitalist expression and even an agent for the expansion of the visual field, with the emergence of printing technologies, scientific and technological instruments.

There are rare, noteworthy moments in human existence that have not been pervaded or appropriated by electric light. It once showed that there were people in an environment, and something was happening there. In a situation which someone reads, this environment must be lit, for there could be light directed onto the pages of the book, highlighting the contrast of the printed letters. However, this sensory experience will be completely changed if whoever is reading does so on a screen, which also is a light source. Therefore, reading on a screen removes the need for lighting in

an environment. Despite the harmful physiological consequences that the interruption of essential metabolic patterns for the human body implies, research shows that the use of screens gradually increases during the night, replacing books and face-to-face relationships (Crary, 2016).

The abundant artificial stimuli resulting from technology have reset the sensory experience. Music on wireless speakers or wireless headphones is now able to create soundscapes qualified to modulate emotional states. Textures that touch the skin, whether in coverings or fabrics, allow for welcoming and comfortable experiences. Smells spread in closed environments carry information to neurotransmitters that motivate emotional states such as calm, attention, excitement. Chemically prepared seasonings promote pleasant taste sensations. Lights and images create a continuum of transformation of visual regimes and a pattern of adaptability to new technological relations and social configurations (Erthal, 2018).

The smart light bulb stands out in an infomata cartography. With its expansion provided by the creation of technology-led artificial conditions, vision became alienated from a layer of virtuality in the real world. Smart bulbs (like Philips Hue) can provide distinct lighting conditions to welcome different emotional states. They not only shine in the dark, but also provide light for reading, relaxation, sleeping (simulating a soft candle flicker), and partying (flashing intense colored lights). They can simulate dawn or dusk lights, simply by being programmed. Like most information systems, they connect to personal assistants (like Alexa) and cell phones, which interact with and control them. It is possible, for example, to turn them on as the sun sets. It is not necessary to be in the room to turn them on or off, but merely by activating them via phone or assistant. This allow for a great amount of customization. It can be determined, for example, that lights turn on at 6 pm, lower their intensity down to 50% until 9 pm, then turning off. It is also possible to choose the light hue during this period: white, yellow, orange, red, green, blue, purple. Or choose from a pre-programmed range of natural lighting conditions, like a sunset in California or Rio de Janeiro. The smart lamp comprises a sophisticated set of artificial stimuli, as it not only artificializes the environment, but simulates nature.

In the wake of infomata working to expand human senses interfacing with the world, personal assistants play an important role. Embedded in digital devices such as smart speakers (Alexa), which enable some virtualization of the real, physical, and material environments. People talk to them, and they talk back. Therefore, a relationship is established, an intervention, in which they also manage objects and systems using programming, decoding the technological language for ordinary people. Their users pay attention to them when they say something like “the wash cycle is finished, please remove clothes from the laundry basket”. Hearing is pure perception: one attributes meaning to sounds heard. Sounds are present in full. Whether human, natural, mechanical or indicators (Schafer, 2001), everyday sounds can express, individually or collectively, the most unique demonstrations of human feeling and most intimate states, in a complex, semantic way. They are also engaging, even when their meanings are unknown. They would awaken and arouse emotional associations, enough to convey meaning, like a gesture, act, word, or touch. Humans are dependent on sounds like these to clarify, communicate and assign meaning to the world around (Ackerman, 1991). In the soundscape of sensorial capitalism, sounds work in a semiotic system, helping people to locate

themselves spatially and interacting with them. Personal preferences also set the tone for sound signatures, discriminating, and creating peculiarities for each environment. Contemporary times are marked by sonic chaos, and therefore, silence has also become a commodity. It can also be experimented with in artistic or commercial propositions.

The flood of artificial stimuli that everyday life routinely provides is an apt metaphor for the 21st century. We live on an abundance of stimuli, information, data, memories, experiences, virtual space, products, consumer goods, objects, and technology. In the era of hyperconnection and hyperstimulation we observe that the senses act connected: taste is supported by sight and smell, smell by touch, touch by vision and hearing, hearing by vision, vision by touch, in various combinations. In a split-second, they present what the brain believes to be the best possible perception of the real world, even in its contemporary virtualities, which are also artificial stimuli and perceptions. The sensorial surplus and its power would legitimize the senses as merchandise, contributing to an “efficient perception”, as postulated by Han (2022) and the existence of an economy of the senses, a Sensory Capitalism, which supports the arguments defended in this text. The sunset on the beach has been replaced by Philips Hue. It does the same thing, in the comfort of one’s home.

2. Method

This exploration paper aims to analyze and contextualize some partial data gathered in the research carried out in 2022-23, presenting results based on personal statements from 14 volunteers about their relationships with the domestic information based on the perceptions of artificial stimuli. The sample as non-random, purposive sample, constituted of subjects that are "specialists" or "knowledgeable" individuals in the context of the study. Our exploring methodological approach took qualitative data resulting from the collection of Personal Statements. The purpose of the method is not to guarantee representative results for a given population, but to have participants who: a) have experience on the researched topic; and b) are capable of accurately and sensitively describing their lived experiences.

Adrian van Kaam, (1989, in Polkinghorne) proposes six criteria for determining participants: (1) ability to express oneself easily with words; (2) ability to express intimate feelings and emotions without shame or indirectness, (3) ability to notice and express organic experiences that accompany these feelings; (4) relatively recent experience with the experiment being studied; (5) spontaneous interest in their experiences and (6) ability to write or report on what happens over time. This last skill also requires an environment in which matters can be thought about with sufficient time for ordering and recording. The collection of personal statements requires the establishment of a receptive environment, for it does not require the use of a probabilistic sampling process. It also recommends the use of 10 to 20 participants.

The material used for this collection method were notebooks: the researcher sent blank notebooks to the respondents, accompanied by a script, a suggested question, or a set of keywords that could help the respondent find the terms that could mean the experience, avoiding personal reports. With

digital communication systems, the mechanism used was the instant messaging application Whatsapp. For 15 consecutive days, the interviewees sent written or spoken messages, commenting on their experiences as in a diary of interactions with their household information.

The content was presented for content analysis using Bardin's (2016) thematic analysis technique, which consists of breaking down the text into thematic axes, in search of core meanings. To select among all available themes, following the research goal, a "floating reading" was carried out, indicating core statement meanings (structural decipherment). Subsequently, relationships between the statements were established, when applicable, keeping in mind the proliferation of important themes. This first reading made it possible to determine, using clinical criteria, the predominant topics in the statements, which were related to the description of the experience with the information.

2.1. Participants

Following the recruitment of the participants selected from an open invitation on the Instagram and Linkedin networks, 24 volunteers manifested interest in collaborating with the research. Researchers contacted each of the volunteers directly, informing them of the method of collecting statements, stating the criteria for participation in the collection: having at least one infomata and the personal assistant Alexa, used daily. Eight people withdrew from participating, allegating: lack of time, inability to make daily reports, inconsistent relationship with information systems, not having Alexa. The 14 voluntary respondents consented to continue with the research, provided that their identities were kept anonymous.

After confirming their participation, respondents who met the modality criteria received an open script validated by the Lawshe method (1975), in which they were invited to reflect on the relationships they were building with their information and the perception biases of this interaction, considering a replacement of natural experiences by artificial ones and the level of consciousness of these experiences.

People of ages ranging between 22 and 65 years old took part, most of them were women, with two or more “smart” household appliances, used daily. Among the five respondents aged 22 to 35, there was less recognition of artificialized stimuli, they were tagged as “curious” (DC) for the research. For the five respondents who had an analogue youth and are between 36 and 64 years old, a contrast was noted between sensitive natural experiences and those artificialized by virtual technological network systems (which contributed with positive derivations), this group was called “analytical” (DA). The four respondents over 65 years of age were more sensitized to anthropomorphic cues, personalizing their information with doses of affection, and were tagged as “experienced” (DE).

Most respondents reported that they started to use information systems more after requesting testimonials and daily interactions, as if it were an opportunity to get to know the systems better and explore their skills, which can be seen as a deviation from the standard response, since that disqualify involuntary experiences.

2.2. Theme Axes

Reading the testimonies of the volunteer respondents, six thematic axes emerged, with categories E and F – Awareness to anthropomorphic cues and Emergence of the economy of the senses – having been analyzed in another paper (Table 1).

Table 1. Theme Axes

	Theme Axes	Description
A	Infomata as body extensions	How the skills, capabilities and limitations of information systems are defined. Comparisons with users skills, capabilities and limitations.
B	Adaptability to infomata	How the adjustment to information systems occurred. How the automation of their presence developed.
C	Perception of sensory stimuli	How natural sensory stimuli are perceived and qualified.
D	Artificial pleasures	How are artificial stimuli capable of creating emotional states identified.
E	Sensitization to anthropomorphic cues	What are the relationships with infomata that present anthropomorphic clues and developed affections
F	Emergence of a sensory economy	How technologies involving sensory experience commoditize the senses.

2.2.1. A) Infomata as Body Extensions

This theme axis indicates the analysis of the statements that addressed the abilities, capabilities, and limitations of information systems, as well as making comparisons with human abilities, capacities, and limitations. These reports refer to how the use of computers extended body possibilities, partially replacing tasks in general. There is a realization that infomata need to be programmed, but once it is done, subjects report that there is rarely a need for reprogramming, just minor adjustments (Table 2 and Table 3). “Not having to get out of bed to press a button” was the most celebrated example, emphasizing a relationship in which technology acts through and frees the body for other activities.

Table 2. Sense Cores for Infomata as Body Extensions

	Group	Structural Interpretation
1	Curious	The recognition of skills happens through exploration, search for alternatives and errors. There is a large demand for requests, which the infomaton does not always respond to accurately. Subjects consider that the technology does not always understand their requests, but they acknowledge that they did not seek information or manuals to understand capabilities/skills and limits. Subjects regard computers as allies in everyday life, which most consider to be “chaotic, insane, full of tasks”. Between studying and working, subjects report little time available for too many tasks. Also, in most testimonies subjects point out that “the – information system – does it for me”.
2	Analytical	Subjects seek information about digital systems before purchasing them, mostly through reviews on shopping websites and YouTube videos, comparing and analyzing features and how they can meet everyday needs. On average, subjects ask younger people for help with the initial configurations. Subjects seek assertive ways of communicating with infomata and report a higher level of satisfaction with the relationship with the machine. Subjects also report a busy daily life and the infomaton’s role as an ally. For this reason, infomata are programmed to carry out tasks alone, sending phone notifications when tasks are completed, scheduled, or unsuccessful. For this group, infomata resemble a double, like the myth of the mechanical maid (Erthal, Radfahrer, 2023). Most of the testimonials

		point out that “the – infomaton – does it for me, which is great because I could not do it without it”.
3	Experienced	Subjects are usually presented with all information needed, and are trained by people close to them to help with the first interactions. They do not dedicate time to explore infomata capabilities/skills, mostly acting by trial and error. Subjects believe to be the sole responsible for most unsuccessful routines, crediting a lack of skill and limitations in understanding the technology. Only one report assigned blame to the information system – even though it was an user error. Subjects usually give names to the infomata, talk to them, have fun with the possibilities (like using the robot vacuum cleaner to bring coffee) and attribute a proximity to the “human” to anthropomorphic characteristics. Most of the statements point to “the – computer – is a companion, there is life in it”.

Table 3. Testimonials for Infomata as Body Extensions

	Group	Literal testimonials
1	Curious	**DC2:** “*My air conditioning isn’t smart, so I bought an adapter and worked around it to make it smart. I can control it via an app or Alexa. So, it's very comforting when I don't have to get out of bed at night to turn the air conditioning on, or off, you know? I don't even need to open my eyes, I just talk to Alexa and everything is fine. There’s nothing worse than getting out of bed in the middle of the night, to turn on the lights, to turn on the fan or air conditioning*.”
2	Analytical	**DA4**: *“As it was just me and my daughter, I always counted on the help of everything that was intelligent. I started with a light in her room and now I have it throughout the house. Then, I bought the vacuum cleaner, which helped a lot, because he works all day. Since we have a cat, it saves a lot of time and work, because I can do other things. And it vacuums properly, comes back to recharge and restarts. When it's out of schedule, I activate it via Alexa and there it goes...Another great thing was the washing machine, which we put clothes in and program it to finish close to the moment we get home. I can’t live without them anymore”.*
3	Experienced	**DE1**: *“I named my washing machine Doris. There was a program on TV where the girl said ‘ready for a program with Doris?’ As the machine has so many programs she should call Doris. She sings a song when she finishes washing the clothes, and I understand that she is happy because she finished her work. She also says everything: if the door is not closed, if there are more clothes than it can hold, if there is a lot of soap, if she understands that it needs to be left drying longer... For me it was great because I don't even wash hand clothes anymore.”* **DE4**: *“I fought with Alexa for a week because she stopped responding to me. I thought she was angry with me and complained to my grandson. He told me I had to say ‘Alexa, such and such’. And I was saying 'such and such, Alexa'. After that everything went fine. And that's how I discovered that my grandson also talks to Alexa through the security camera. I understood that everything is connected and that I can just sit there and ask Alexa for things”.*

2.2.2. B) Adaptability to Infomata

This theme axis indicates the analysis of the statements on how the adaptation to infomata occurred and how the automation of their existence developed. The statements are very close to the core meanings of Axis A – some are even repetitive, reflecting the research demand: “think about the relationship with information systems”, as something that is not usually done. The analysis shows that there is no resistance to the novelty of infomata (Table 4 and Table 5). It also reveals how they are assimilated as part of life and subsequently automated. People barely remember their presence. This phenomenon is part of the idea of a perpetual – gradual – transformation of the modalities of

perception, in which the human being incorporates patterns of adaptability for the relationship with technology in continuous modeling between bodies and objects.

Table 4. Sense Cores for Infomata Adaptability

	Group	Structural Interpretation
1	Curious	Subjects in general do not know how long the information systems were present in their lives, even when recently started operating. Subjects show little understanding of computer programming rarely shared devices with their families, mostly assigning responsibility for configuration and adjustments to third parties. Subjects rarely remember infomata at home, or that the machines work without the need for direct commands. They consider information systems to be discreet and silent, carrying out their tasks without the need for intervention. A common statement would be "The – information system – is automatically coupled to everyday life".
2	Analytical	Subjects seek to explore most connection possibilities among home computers and smart devices, usually with careful programming to automate the infomata on their own, without any need for adjustment or intervention. They declare spending a lot of time to completely automate the system, considering the dynamics of their routines, the demands of the house and the other people with whom they share computer systems. Subjects usually configure other users information systems, considering this detailed planning. They devote much attention to checking whether the computers are operating as desired and whether they carry out tasks correctly. Subjects can observe the information while carrying out tasks. They have had experiences in which they forgot about information (such as travel) and paid more attention to them. A common statement would be "The – information system – is automatically coupled to everyday life under surveillance"
3	Experienced	The relationship with information systems is basic. Subjects learn trivial relationships that are repeated from time to time, but these commands are also frequently forgotten. Subjects usually rely on other people to operate the computers. Automation comes as a surprise, a playful element. It is fun to see infomata working alone and silently. Subjects usually talk to the informants and congratulate them or thank them for their action. A common notion would be: "my friend – computer – is part of my daily life".

Table 5. Testimonials for Adaptability to Infomata

	Group	Literal testimonials
1	Curious	**DC3:** "*I never knew the refrigerator made shopping lists. When my parents went away, my mom set the fridge to text me. It was very funny. I was curious to know how and downloaded the app. For 40 days, I, alone, communicated with her via Alexa: the refrigerator and me sending her a grocery shopping list. I ended up getting used to it and today I don't even talk to Alexa anymore. The refrigerator already knows what I want*".
2	Analytical	**DA1**: "*I have two young children and three dogs. During the pandemic we didn't have time for anything. What saved us was the integration of the lamps, the robot vacuum cleaner and Alexa. The lights would come on when it was time to wake up, then go off an hour later. They turned on at six in the afternoon and reduced the intensity until bedtime. The house is very big, with a huge yard... The robot (vacuum cleaner) was always somewhere... I only noticed it when it felt like it needed to recharge and the base was close to my desk in the office. Only then did I remember it and check the filter. As for the lamps, I always had to monitor them using the app, because as the house is big, some of them didn't respond to the Wi-Fi connection. I was so tired that sometimes my wife would just say 'Alexa, turn off all the lights'. It was difficult, but today we got used to it".*
3	Experienced	**DE3**: *"I'm very warm, living here on the beach it's sunny and hot most of the time. My son made an Alexa call to the fan so it could turn on by itself. I do not know how!! (laughs). But it's like this: every time the temperature*

		reaches 26 degrees the fan turns on by itself. And it only turns off if the temperature drops. When I look at it, it's working and I just think it's over 26 degrees". **DE4**: *"Every single day I get scared. At eight she tells me what the weather will be like today and if it's going to rain and tells me who's birthday is – people I don't even know – and who the saint of the day is. I always get scared and go close to her to listen. She is always very cute".*

2.2.3. C) Sensory stimuli perception

This axis dwells upon the analysis of statements about how natural sensory stimuli are perceived and qualified from an automated relationship with the information. Respondents perceive their presence or adjust their senses to perceive the sensory stimuli they emit, usually sounds or text messages (Table 6 and Table 7). This phenomenon constitutes a generalized dullness regarding perceptions and sensory stimuli (Erthal, 2018). These perceptions emerge into consciousness usually only upon request. In ordinary everyday life, regardless of the environment, people do not pay attention to their senses, unless it is an unusual situation such as an extremely strong odor, for example.

Table 6. Sense Core for the Perception of Sensory Stimuli

	Group	Structural Interpretation
1	Curious	Subjects have little knowledge about their sensory landscape and their own ways of feeling. They are usually surprised by the discoveries they make about the senses based on the research questions. They tend not to establish synesthetic connections. A general idea would be "I never thought about it, but I get pleasure when I pay attention to my senses."
2	Analytical	They have little knowledge about their sensory landscape and their own ways of feeling. They are surprised by the discoveries they make about the senses based on the research questions. Respondents who are parents showed more synesthetic connections based on the experiences and demands of children. A general idea would be "I never thought about it, but I feel pleasure when I pay attention to my senses."
3	Experienced	The difference for the "curious" group would be the amount of sensory experiences accumulated throughout life. Unconsciousness and surprise would be practically the same. A general idea would be "I don't think about it, but I feel pleasure when I pay attention to my senses."

Table 7. Testimonials for Perception of Sensory Stimuli

	Group	Literal testimonials
1	Curious	**DC5:** "*I pay zero attention to these things, but I started paying attention after I started reporting. To do the experiment, I turned off the lights, to see how natural light would determine my pace. I realized that I don't need as much light on in the morning and I feel less rushed at night when the house is darker. It was bizarre*". **DC1:** "*I noticed that the vacuum cleaner makes a little noise, in fact it makes several different noises for each action. I also noticed sounds that I hadn't noticed, from the streets, from the car. I became more open to these perceptions. It's a different kind of attention. I traveled over the weekend and noticed that the city had a different smell".*
2	Analytical	**DA3**: "*In a chaotic day-to-day life, I really value these experiences, I know they are present all the time, but we don't notice because our heads are always full of things".* **DA4**: "*I grew up in a place and for me the sensory experience is very important. Listen to the birds or the sound of the bustling metropolis, smell*

		the rain or the smell of a subway car full of people wet with rain, taste a fruit at the market or pick it from the tree, watch the sun rise or the sun set in somewhere very open – like on the beach, touching the beach sand or the earth with your feet... it's always a moment of great pleasure and awareness of the act, even appreciation".
3	Experienced	**DE3**: *"Living on the beach, it's great to observe nature, its smells and colors. I also remember many moments when we stopped to admire the sky, the moon, the gardens, the squares. Everything was different and we don't think about it much. It was pleasant. But the body ages and we can't stand the heat, we can't sunbathe, we can't be calm...".*

2.2.4. D) Artificial pleasures

This thematic axis reflects the analysis of statements about how artificial stimuli capable of creating emotional states are recognized. In comparison to natural sensory stimuli, what would be the forms of artificialization of the environment used to promote pleasure? The implications would be the sensory economy, in which technologies are created that simulate sensory stimuli. The analysis repeats the unconsciousness about the senses and a more accurate observation after the beginning of the research (Table 8 and Table 9).

Table 8. Sense Cores for Artificial Pleasures

	Group	Structural Interpretation
1	Curious	Because they know little about the sensory landscape and their own ways of feeling, they also do not express elaborate analyzes of artificial stimuli, showing surprise at the discoveries based on the research questioning. There is confusion about natural and artificial, which is corrected in the testimonials. A general idea would be "I never thought about it, but I recognize that I create these environments to get more pleasure".
2	Analytical	The difference between them and the "curious" is that they establish contrasts between natural and artificial experiences. Unconsciousness, surprise, and the general idea can be considered the same.
3	Experienced	Despite having little knowledge about their sensory landscape and their own ways of feeling, they demonstrate more sensitivity to artificializations and compare based on the contrast with past experiences. "I notice the increase in artificial stimuli in contrast to natural ones".

Table 9. Testimonials for Artificial Pleasures

	Group	Literal testimonials
1	Curious	**DC2:** "*There's one thing that I can only sleep with the air on. Even if it's winter, I need the noise, that constant frequency, that calms me to sleep*". **DC4:** "*I catch waves every morning and when it rains I get really discouraged, so I program the bedroom light to look like the sun rising on the beach and ask Alexa to play a surf playlist".* **DC5:** "*Headphones are essential for me. I know it's risky to create this bubble of the world, but I can't live without music all the time, even if it's just a headphone. My behavior adapts to the music".* **DC1:** "*I learned that there are smells that can help us concentrate, for example. I bought an electric diffuser and two essential oils: one for focus and one for relaxation. It's been great. Not to mention that it isolates other odors".*
2	Analytical	**DA2**: "*One day I started to realize that everything had sound: when I turned on the TV, when I turned on the computer, when I turned on the stove, when the machine finished washing, when I maneuvered the car. Before, there was nothing like that. And now we know what is happening through this sonic 'feedback system'. I started customizing the sounds on*

		my phone to recognize my interactions and differentiate myself from other devices". **DA5:** "*I am very visual and for me, the most interesting thing is to create this environment that refers to different emotional states. At home I have an armchair for reading, for example, and the lamp has a special setting to read comfortably. The lights in the room are yellow, always dimly lit, so as not to reveal too much of the environment. To watch television, I create a bluish-purple environment: zero interfere with the screen brightness".*
3	Experienced	**DE2**: *"Home appliances are the best examples. At home, the refrigerator sends a message to my daughter telling her what's missing. The washing machine sends a message to my secretary letting me know that the cycle is over. The stove turns off by itself, I add the rice and it turns off after 15 minutes with the rice ready. I don't pay attention to the noise of the washing machine because it barely makes any noise. The sound of the stove is annoying, it sounds like a fan, but I don't need to watch the pan. The lights are incredible, they turn on and off by themselves. I think they could come up with a way to heat or cool the floor too.".*

3. Inferences

The reports provided by the respondents show that infomata are potential vehicles of communication. As such, they can alienate, collect data, and transit that data through the Internet of Things (IoT). The research examined a specific and ubiquitous contemporary cultural context: the domestic environment inhabited by infomata that establish dynamics in the daily life of the house and in family relationships.

There is a modulation between habits, values, and the impact of technology on daily life, which can make media essential in daily routines. In the investigation, we identified the way in which these practices are incorporated and transmitted by the "habit" that makes them natural, common, and even necessary. The culture of a time is learned through participation, and the phenomenon explored in this research demonstrates that the way of appropriation of the culture of virtualization and technological "home" transformation is a product of interactions with objects, things, systems, and people connected in a network. A set of relationships, negotiations and dialogues that give new meanings to the field of communication.

Sensory perceptions can be modeled and lead to emotional states by providing soundscapes, visuals, and tactiles. It is possible to artificialize an environment, creating spheres dissonant from natural conditions, which is a process of alienation of the senses by technology. The body also needs to learn the codes of interaction with the infomata by programming and reprogramming the devices. An advanced process of mechanization proposed by McLuhan (2003) in which sensory experiences are artificialized by technology.

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[i] Considered electronic, digital objects and household appliances connected in a network and configured as media and not just devices with the function of serving the domestic environment.

[ii] Infomata is the attribution used by Han (2022) for technological objects – or things – that are previously programmed and frequently updated and that relate to people and other objects connected in a network. He cites cars and their ability both to dialogue about their own operating and mechanical conditions, and to recognize the conditions (or lack thereof) of the driver according to his driving performance.

[iii] According to Pereira (2006), "Sensorialities should be understood as the cognitive and synesthetic aptitudes that a body can achieve when it comes into contact with a certain expression of culture" and "Affectivity should be thought of as this force that drives the body in the transformation of its sensorialities and materialities, as a strategy to better act in the face of certain messages/stimuli/context".