

Visualizing news: Approaches to communicating journalistic narratives

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Resumo

A competitividade do mercado noticioso levou os jornalistas e editores a procurar formas inovadoras de captar a atenção do público e promover o envolvimento pessoal no meio do constante bombardeamento de informação. Este facto levou a uma maior utilização de infografias e visualizações na apresentação de narrativas noticiosas.

Para contribuir para a compreensão de como comunicar melhor as notícias, optámos por estudar a representação visual das narrativas jornalísticas. O objetivo foi desenvolver uma interface que explore a visualização na representação de narrativas noticiosas e nos permita tirar conclusões a partir da sua avaliação. Para realizar este estudo, investigámos os elementos essenciais da narrativa e os princípios do design visual e da ilustração na literatura para orientar o desenvolvimento do nosso trabalho e identificámos métricas para avaliar as ferramentas de visualização.

Na iteração inicial, propusemos 15 wireframes como sugestões de ferramentas de visualização, que avalíamos num grupo focal com participantes de várias áreas, seleccionando as duas ferramentas favoritas para serem estudadas mais aprofundadamente. Após a discussão, na mesma sessão, esboçamos uma nova ferramenta utilizando uma abordagem de co-criação que visava combinar as vantagens das abordagens anteriores misturando características e funcionalidades das ferramentas analisadas, seleccionando essa ferramenta para ser avaliada posteriormente.

Posteriormente, foi desenvolvido um mockup interativo como protótipo para as duas ferramentas seleccionadas e a co-criada, que foi avaliada em dois grupos de discussão com participantes de diferentes áreas em cada um. A ferramenta co-criada obteve os melhores resultados na avaliação do questionário, utilizando as métricas identificadas como critérios, e na discussão.

O nosso estudo confirma que os acontecimentos (ou ocorrências), os participantes, o tempo e o espaço são cruciais para representar uma narrativa a partir de notícias numa ferramenta de visualização. Através de grupos focais, identificámos os acontecimentos como o elemento mais significativo de uma narrativa. Quanto aos outros elementos, concluímos que a hierarquia pode variar consoante o tipo de notícia. Também observámos a importância dos princípios de design

visual - simplicidade, acessibilidade, contraste, layout sem deslocação, gráficos simples, ícones neutros e interatividade - uma vez que os participantes dos nossos grupos focais mencionaram fortemente a necessidade de estas características existirem numa visualização de narrativas eficaz. Por último, o nosso estudo demonstra que as ilustrações simplificam a compreensão e dão o tom à narrativa, adaptando-se eficazmente a vários tipos de notícias e audiências. No entanto, devido aos diferentes níveis de literacia visual, é essencial associar as ilustrações ao texto para garantir a clareza e o reconhecimento universal.

Apesar de termos validado o potencial das visualizações para melhorar a comunicação das narrativas jornalísticas, o nosso trabalho prepara o terreno para que a investigação futura se concentre na seleção de um público-alvo específico para desenvolver os progressos alcançados.

Palavras-chave: Visualização de notícias, Visualização de narrativas, Infografia

Abstract

The competitiveness of the news market has led journalists and editors to seek innovative ways to capture audience attention and foster personal engagement amidst the constant bombardment of information. This led to an increased use of visual media infographics and visualizations in presenting news narratives.

To contribute to the understanding of how to communicate news better, we chose to study the visual representation of journalistic narratives. The goal was to develop an interface that explores visualization in transmitting news narratives and allows us to draw conclusions from its evaluation. To conduct this study, we investigated the essential elements of narrative and visual design principles and illustration in the literature to guide the development of our work and identified metrics for evaluating visualization tools.

In the initial iteration, we proposed 15 wireframes as suggestions for visualization tools, which we evaluated in a focus group with participants from various areas, selecting the two most favored tools to be further studied. After the discussion, in the same session, we designed a new tool using a co-creation approach that aimed to combine the advantages of previous approaches by blending characteristics and functionalities from the analyzed tools, selecting that tool to be further evaluated.

Subsequently, as a prototype an interactive mockup for the two selected tools and the co-created tool was developed and evaluated in two focus groups with participants from different areas on each. The co-created tool achieved the best results overall in the questionnaire evaluation, using the metrics identified as criteria, and in the discussion.

Our study confirms that events (or occurrences), participants, time, and space are crucial for representing a narrative from news in a visualization tool. Through focus groups, we identified events as the most significant element of a narrative. As for the other elements, we concluded that the hierarchy can vary depending on the type of news item. We also support the importance of these visual design principles—simplicity, accessibility, contrast, layout without scrolling, simple graphics, neutral icons, and interactivity—as our focus group participants strongly mention the need for these characteristics to exist in an effective narrative visualization. Lastly, our study demonstrates that illustrations simplify understanding and set the tone for the narrative, adapting

effectively to various news types and audiences. However, due to varying levels of visual literacy, it is essential to pair illustrations with text to ensure clarity and universal recognition.

Although we have validated the potential of visualizations to enhance the communication of journalistic narratives, our work sets the stage for future research to focus on selecting a specific target audience to build on the progress achieved.

Keywords: News Visualization, Narrative Visualization, Infographics

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1. Introduction

The world of journalism has undergone significant changes in the last decades. These changes have been driven by the rise of digital technologies and the internet, which have transformed the production and circulation of news and how they are consumed (Mitchelstein & Boczkowski, 2009). This has led to a reconfiguration of journalism, with new skills and practices becoming essential (Mitchelstein & Boczkowski, 2009; Moura et al., 2023) .

With this, the congregation of different media formats in various platforms has also played a vital role in this transformation, leading to new narrative formats and increased collaboration between traditional journalists and new journalist storytellers (Tavares & Mascarenhas, 2013).

The new media and social media introduce a competitive nature of the news market, characterized by 24/7 access to free online news, causing journalists and editors to need to explore innovative ways to captivate audience attention and forge personal engagement (Van Krieken, 2018; Chen et al., 2016).

The sheer volume of content available across numerous platforms poses a filtering challenge for readers seeking specific information. Consequently, the constant exposure to overwhelming amounts of information that they struggle to digest can lead to frustration and disengagement among readers, causing them to lose motivation to stay informed (Fernandes, 2023).

Weber et al. (2018) also acknowledge these changes in journalists and the way journalism is being conducted, highlighting a shift in the approach to journalistic practices. Digital technologies, big and open data, and the datafication of many aspects of life are permeating newsrooms and have led to new forms in journalism (Muliawanti, 2018; Weber et al., 2018). Smit et al. (2013) and Ambadas, (2024) add that the use of infographics and visualization thrived in journalism because of the disclosure of big data, which made journalists focus more on visualization to present news attractively, visually, and quickly. Online journalists have notably been increasing the integration of visualizations into their narratives, allowing the visual representation to take the place of writing and focusing on showing instead of telling (Segel & Heer, 2010). These narrative visualizations are transmitted through various visual representations, for example illustrated narrative visualizations, which appear in data visualization in the form of

infographics (Byrne et al., 2016), anthropography's (Boy et al., 2017), and data comics (Bach et al., 2016).

Given the extensive changes driven by new technologies, the internet, social media, open data, and the sheer volume of information available, how news is delivered must evolve to captivate the modern reader (Greussing & Boomgaarden, 2019). One significant trend addressing this challenge involves using visual elements to enhance news presentation and engage audiences more effectively in the digital age (Ambadas, 2024; Greussing & Boomgaarden, 2019). In this thesis, we explore this solution further, delving into an approach to how to communicate journalistic narratives using visualization.

1.1 Motivation

In today's rapidly evolving landscape, marked by immediacy and relentless technological progress, the media grapples with profound transformations. As highlighted by Nascimento (2020), this era presents unique challenges to the fundamental principles of journalism, characterized by the swift and often superficial consumption of both information and misinformation.

In a world inundated with information, effective, accessible, and engaging communication is crucial. The reader perspective becomes increasingly important due to the overwhelming amount of information available. Readers are faced with the challenge of navigating through a deluge of news and media content, often leading to difficulty in discerning the credibility and relevance of the content, information overload, and cognitive fatigue. This can impact the way readers consume and engage with news stories, as well as their ability to comprehend complex narratives (Filipa Da Costa, 2021).

Fernandes, (2023) recognize the difficulties brought about by the abundance of available content and the multitude of platforms through which it can be accessed, which present challenges for the average reader. Readers are faced with the task of sifting through a vast array of news articles to identify the most relevant ones. This involves selecting the articles most pertinent to their interests or needs, which can vary depending on the reader's level of knowledge and specific preferences. Additionally, even once a news article is selected, understanding its content can be challenging, mainly if it is lengthy or complex. Extracting the critical information from dense text can be a daunting task.

Existing strategies attempt to mitigate the cognitive load on readers by offering specialized coverage for high-impact news stories and summarizing relevant information through visualizations and video essays. However, this manual approach is limited and often reserved for influential stories, neglecting smaller local articles or those with limited (Filipa Da Costa, 2021).

Our proposition involves exploring journalistic narratives through semi or fully automated means, applicable to news stories irrespective of their perceived impact or origin, focusing on

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areas such as visualization through design, focusing on principles used in data and information visualization, illustration fundamentals and storytelling. The potential use of an application to navigate news stories using representations beyond pure text introduces novel ways for readers to engage with the news.

1.2 Goals

The objective of this research is to develop an interface that explores visualization in transmitting news narratives and allows us to draw conclusions from its evaluation. We propose exploring fundamentals of storytelling and visualization techniques, as well as delving into design principles in data visualization, information visualization and illustration areas like infographics so we can communicate news in a more engaging, accessible and effective way using visual elements to enhance news presentation. The aim is to identify principles that will guide us in understanding how to construct visualizations of narratives rooted in news. Additionally, we emphasize incorporating storytelling principles to better understand the most pertinent elements that constitute a compelling story.

The goals we have outlined for this dissertation are to contribute to increasing readers' interest in news, minimizing the challenges associated with selecting and interpreting news articles, and reducing the cognitive burden on readers, by exploring new ways to represent news narratives.

1.3 Research questions

In this section after we explored the problem and aligned our motivations and goals, we constructed questions to focus our work.

We believe that integrating elements from storytelling and design principles used in data visualization, data stories and illustrated elements can help us create guidelines for a news visualization. Andrews (2019) speaks in his “Book Info we trust”, that though the areas we will study, such as data visualization, infographics, have different names, definitions, and characteristics, they have the same goal, to improve how people see the world. That’s why we look for different areas and techniques to improve how news are represented.

To focus our study, we were motivated by these research questions:

RQ1 - What are the most important elements in the representation of a narrative?

RQ2 - Which principles of visual design are most relevant to improving the communication of narratives?

RQ3 - What practices and aspects of illustration can help improve the visualization of narratives?

RQ1: What are the most important elements in the representation of a narrative?

The first research question (RQ1) aims to identify the essential elements of a narrative structure and assess their importance. These considerations are crucial for designing an effective visualization tool that accurately represents narratives derived from news content. A comprehensive literature review on narrative and storytelling in journalism is vital to understanding these elements.

In our literature review, we recognize that establishing a clear understanding of the fundamental concepts of narrative, story, and storytelling as used in the news is essential, as these terms are integral to our work. Additionally, we explored how a narrative can be organized, acknowledging that different structures can lead to diverse solutions. We also identified the core elements that contribute to forming any news narrative.

With these insights, we began developing our visualization wireframes as possible solutions to represent journalistic narratives, considering these elements and evaluating their importance across different organizational frameworks. To do this evaluation, we conducted a focus group session. During this session, we encouraged discussions and visualized the elements identified from the literature in various ways. These elements were organized differently and emphasized distinct aspects in each solution presented. Through the sample of solutions and the rich discussions where participants shared their perspectives and expertise, we measured the hierarchical importance of these elements to understand how they contribute to constructing visualizations for news-based narratives.

RQ2: Which principles of visual design are most relevant to improving the communication of narratives?

The second research question (RQ2) delves into the design perspective of creating accessible and engaging news visualizations. This involves understanding the principles that guide effective visual design, data visualization, and narrative visualization.

To better comprehend the subject matter of this question, we first defined what we mean by visualization. This foundational step was crucial for clarifying the terminology and ensuring a solid understanding of our focus areas.

Next, we collected a range of principles from information design, visual design and data visualization¹. These principles serve as a framework guiding our approach to creating news visualizations that are not only visually appealing but also effectively convey information and engage the audience. In the latter stages of our work, we applied these principles to evaluate our visualization solutions.

¹ [We define the term later in this text.](#)

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We then focused on identifying and emphasizing the most critical principles that significantly enhance the communication of narratives through visual means. During our focus group sessions, participants emphasized the importance of certain principles over others, enriching our process. Their feedback showed a collective preference for specific principles, which we identified as crucial for creating effective news visualizations.

RQ3: What practices and aspects of illustration can help improve the visualization of narratives?

The third research question (RQ3) investigates the practices and aspects of illustration that can enhance the visualization of narratives in news. This involves understanding the field of illustration and its role in various types of visualizations to determine which aspects are most effective in improving the communication of news stories.

To address this question, we began by defining key concepts such as illustration and infographics. This foundational understanding is crucial for framing our exploration of how illustrations can be used effectively in visualizations.

Next, we examined guidelines and practices that inform how to communicate narratives with illustrations in our solutions effectively.

Finally, we analyzed how illustration can specifically improve the visualization of news. Through this investigation, we aimed to conclude how using illustrative techniques can enrich the presentation of news content, making it more engaging and accessible for the audience to understand. This analysis was conducted with the insights gathered from feedback during our focus group sessions, where participants discussed the impact of various illustrative elements on the appeal and clarity of news visualizations.

The research questions proposed in this section provide a framework for the study. By answering these questions, it will be possible to develop a deeper understanding of how to integrate elements of storytelling, design principles and illustration to represent news effectively.

Based on the research questions we aim to: Develop a new way to represent news stories with visualization.

1.4 Research methodology

This study aims to develop a new form to represent news stories using visualization techniques. To achieve this goal, a multi-faceted approach was adopted, starting with a literature review to identify essential elements of narrative, design, and illustration.

We searched Google Scholar for the keywords in Table 1. We selected the initial theses, papers and books based on the year they were published, avoiding books before 2010 and prioritizing papers and theses after 2015 and the number of citations. After this first search step,

we started the snowballing search (Badampudi et al., 2015), complementing our search with papers cited by previously reviewed studies we collected. We did this after the first selective search because Badampudi et al. (2015) identified that a snowballing search is more reliable than a database search when creating a suitable start set. In the snowballing search, we focus on the quality and perspective of what we read mentioned in other papers, and that would create interest

Table 1: Research Study

in checking their work added to our library and, if interested, also focus on the works cited there.

Databases	Google scholar- Articles and books
Search Keys	(‘Visualization’ OR ‘News Visualization’ OR ‘Information Visualization’ OR ‘Data Visualization’ OR ‘Infographics’ OR ‘Infographics in news’ OR ‘Infographics in Journalism’ OR ‘information visualization in journalism’ OR ‘Journalism visualization’ OR ‘Journalism illustration’ OR ‘Illustrated news’ OR ‘data journalism’ OR ‘narrative in journalism’ OR ‘storytelling in journalism’ OR ‘news’ OR ‘storytelling in news’ OR ‘narrative in news’ OR ‘Visual representation’ OR ‘Representation of information’ OR ‘data visualization design’ OR ‘data visualization storytelling’ OR ‘data storytelling’ OR ‘Data stories’ OR ‘data’ OR ‘illustration’ Or ‘news’ Or journalism’ OR ‘illustration of data’ OR design of news’ OR ‘Narrative visualization’ OR ‘Storyline’ OR ‘Visual news’ OR ‘Visual Storytelling’ OR ‘Visual Story’ OR ‘Visual journalism’ OR ‘Narrativity’ OR ‘Multimedia Storytelling’ OR ‘Media graphics’ OR ‘Interactive Narratives’ OR ‘Visual Narratives’ OR ‘News Infodesign’ OR ‘Data Art’ Or ‘Multimedia Journalism’)
Documents collected	357

We collected 415 documents and defined a ranking criterion to exclude some documents. We ranked 1 (not relevant) to 6 (relevant), and with that, we ended up with 357 documents after reading the summary of each one to understand if it would help build our work. After the exclusion part, we ranked each document by categories of the discipline they were published in about to group similar papers and understand where each paper would have a part in the study.

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We selected and read papers based on their relevance to the topics we needed to explore at each stage and prioritized those with the highest ranking.

After the findings in the literature review and the exploring of similar work, the subsequent step was to organize the fundamentals of narrative, design, and illustration and to evaluate with the fundamentals collected the similar tools we collected to understand which features we can rely on and which ones we need to create.

After we concluded understanding the problem and our possibilities based on the literature review, we started sketching ideas with the insights we learned with the literature review, using McCandless (2021) methodology. Then we discussed those ideas with a focus group and based on that generated a co-created solution. The best three solution were prototyped to be evaluated, having in account that these visualizations aimed for accessibility across a broad audience and the ability to represent any story, characteristics we evaluated if it was possible and how in the different stages of our research.

The visualization tools were evaluated through two focus groups, each comprising different professionals from the fields of linguistics and journalism. We collected qualitative data from their feedback and quantitative data from a questionnaire in which each participant rated criteria identified in our literature review. Based on this, we gathered insights to respond to the research questions and identified areas for improvement in future studies.

1.5 Structure

This document's structure is organized to guide the reader through the development and evaluation of a narrative visualization tool in the context of journalism.

We describe the literature review conducted in Chapters 2 and 3. In Chapter 2, we begin by examining the fundamental concepts of storytelling and narrative. This chapter distinguishes between storytelling and narrative and reviews literature that explores their roles in journalism. It sets the foundation by examining how stories are crafted and how narrative techniques are employed to engage audiences effectively in the news domain. Following this, Chapter 3 focuses on visualization. It introduces the essential concepts of visual representation, including illustration and infographics. The chapter examines current research on visualization applications, offering insights into integrating visual elements into our tool.

Chapter 4 explores how previous work has tackled the topic of news visualizations by analyzing other tools and introduces our proposed solution to the visualization of journalistic content from a narrative-driven perspective.

In Chapter 5, we introduce our proposed solutions by building 15 wireframes, explaining how we built them and describing each one and its organization. In Chapter 6, we evaluate the proposed solutions and filter them to find the best ones, as well as co-creating a tool that would

be considered one of the final solutions. In Chapter 7, we create interactive mockups as prototypes in Figma of the co-created tool and the two best wireframes from the focus groups.

In Chapter 8, we conducted two evaluations with focus groups of different experts who tested and reviewed the three interactive mockups. Chapter 9 discusses the results of these evaluations, the conclusions we draw to answer each research question and recognize our work limitations. Finally, Chapter 10 provides an overview of the work described in this document and explores potential paths for future work.

2. Storytelling and narrative

2.1 Concepts

In this section, we provide comprehensive definitions of the concepts of story, storytelling, and narratives, illustrating their interconnections and distinctions. Subsequently, we delve into a review of literature and relevant works that have offered valuable insights for our research. Finally, we examine the significance of impact and explore methods for measuring it within narrative representation.

2.1.0 Story

According to Zhao and Elmqvist (2022), stories are defined as intricate sequences of events that unfold within specific places and involve diverse characters. These narratives, ranging from the mundane to the mythical, serve as the fundamental building blocks of human understanding and communication.

Jahn, as cited in Weber et al. (2018) work, offers a complementary definition, characterizing a story as "a sequence of events involving characters," with events encompassing both natural and non-natural happenings. This broader perspective acknowledges the diversity of stories, acknowledging that they can span the spectrum from the everyday to the extraordinary.

In the realm of journalism, the line between "story" and "news" often blurs. Ethnographic studies in news making, as noted by Mermoid (2018), reveal that journalists frequently use these terms interchangeably because both refer to happenings. Beyond mere narration, when journalists speak of storytelling, they encompass various text-linguistic practices such as describing, explaining, and arguing. This expanded definition recognizes the multifaceted nature of storytelling within the context of journalism (Weber et al., 2018).

2.1.1 Storytelling

Zhao and Elmqvist (2022) introduce Storytelling describing that in the timeless tapestry of human existence, storytelling has stood as the cornerstone of communication, record-keeping, and entertainment since the dawn of civilization. From the hunter returning from his latest foray, weaving tales of stalking prey, to the shaman enrapturing the tribe with narratives about the origins of gods, stars, and the moon, storytelling has persistently threaded its way through the fabric of our shared history (Zhao & Elmqvist, 2022). Weber (2020) adds that storytelling has been an integral part of human culture since ancient times. Throughout history, individuals have

engaged in storytelling as a fundamental means to communicate ideas, share experiences and knowledge, articulate desires and emotions, and preserve memories of the past.

Norambuena et al. (2021) delve into the world of visual analytics and analytical reasoning, defining storytelling as a metaphor employed in these domains. Their work, "Narrative Sensemaking: Strategies for Narrative Maps Construction," positions storytelling as a powerful tool for sensemaking in the visualization of complex data. This perspective underscores the adaptability of storytelling across different disciplines, emphasizing its role in making sense of intricate information.

In the book "Info We Trust," by Andrews (2019) storytelling is portrayed not just as a form of entertainment but as an essential aspect of the human experience. It is a mechanism for making sense of stimuli, assigning meaning to perceptions, and believed truths that prevent individuals from drowning in sensory overload. Storytelling, in this context, emerges as a vital conduit for transmitting knowledge across generations, bridging the gap between meaningful moments and the overarching narratives that span millennia (Andrews, 2019).

Duarte (2019) quotes in her work: "Tell me the facts, and I'll learn. Tell me the truth, and I'll believe. But tell me a story, and it will live in my heart forever," a native American proverb. This sentiment encapsulates the profound impact of storytelling on human cognition and emotion. As Duarte (2019) emphasizes, storytelling uniquely illuminates the brain, creating a connection that surpasses the effects of other forms of communication.

Van Krieken (2018) explores the incorporation of multimedia elements in news storytelling, exemplified by works like the New York Times' "Snow Fall," which has become a significant trend in contemporary journalism, contributing to heightened audience immersion. In the production of news stories, there exists a collaborative endeavor among media practitioners who engage in negotiations regarding narrative choices and configurations (Merminod, 2018).

In conclusion, the definitions and perspectives on storytelling presented in this chapter underscore its ubiquity and significance in human communication, understanding, and knowledge transmission. As we delve deeper into the intricate tapestry of storytelling, we will explore its various forms, functions, and its enduring role in shaping the human experience.

2.1.2 Narrative

Narratives are present in many forms of human expression and can be understood as a fundamental way of communication between people (Santana et al., 2023). The authors continue their definition of narrative by adding that narratives are composed of entities engaged in the story, the events they partake in, and the temporal data defining the sequence of narrated events. In essence, a narrative is perceived as a sequential and non-randomly connected series of events—an interconnected set of facts observed over time involving fundamental elements like organizations, individuals, locations, or time. In the survey Santana et al. (2023) explores definitions from more authors, since the topic have long been studied in the field of linguistics.

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Adam (1992) views narratives as a typical sequence that follows a thematic coherence, involving a chronological succession of events with characters. The events are interconnected by causality relations, forming a story structure that includes an initial situation, followed by a complication, reactions, resolution, and a final situation. According to Chatman (1980) and the structuralist theory, narratives can be conceptualized as having two components: (1) the story, which encompasses the content or sequence of events (actions, happenings), along with entities like characters and setting elements; and (2) the discourse, representing how the content is conveyed, whether through verbal language (oral and written), visual language (images), or other forms of representation (theatrical language), and so on.

Allan Bell (1991), as cited in Weber et al. (2018) work, provides a comprehensive definition of narrative. According to Bell, a narrative is essentially a sequence of events that are not only temporally structured but are also intricately linked through bonds of causality, whether strong or weak. This definition underscores the idea that narratives are not mere collections of events but rather organized, interconnected stories with inherent causal relationships

Norambuena et al. (2021) contribute to the understanding of narrative by introducing the concept of narrative sensemaking. This process is described as fundamental for comprehending sequential information. Expanding on the definition, Norambuena et al. (2021) present narratives as systems of stories, emphasizing that these stories consist of sequences of events tightly woven together in a coherent manner. Within this framework, events are identified as the fundamental units of narrative action, involving acts with characters, entities, or happenings, whether or not entities are causally involved.

The essence of narrative, as highlighted by both Allan Bell (1991), and Norambuena et al. (2021) lies in the coherence of sequences of events. Narratives are not random or disjointed; instead, they are purposefully structured and connected. This coherence extends beyond a linear arrangement, encompassing the dynamic relationships between events. The concept of narrative, thus, becomes a mechanism for weaving together stories into a meaningful and impactful form.

The genre of narrative journalism is now a global practice among journalists. The growing interest in this genre can be attributed to the fiercely competitive nature of the news market, characterized by 24/7 access to free online news. In response to this, journalists and editors find themselves compelled to explore innovative ways to captivate audience attention and forge personal engagement (Van Krieken, 2018).

2.1.3 Difference between storytelling and narrative

The distinction between narrative and storytelling is a complex one, Gubrium and Holstein (2008) suggest that, while they are often used interchangeably, they can be seen as separate entities. Sugiyama (1996) further explores this by highlighting the role of individual perspectives and interests in shaping narratives.

The distinction between narrative and story lies in the arrangement and presentation of events. The story refers to the actual sequence of events as they happen, while the narrative relates to the particular way in which these facts are arranged and conveyed to a reader or audience (Shaheen, 2019). The plot is the edited, ordered, packaged, and presented version of events, while narratives are based on cause-and-effect relationships applied to the sequence of events (Shaheen, 2019).

Norambuena et al. (2021) wrote, “Storytelling and narratives are common metaphors in visual analytics. In general, scholars have studied how arranging visualizations as story sequences helps in sensemaking. Other works focused on narrative visualization for news usually focus on augmenting data visualization techniques (e.g., charts) with contextual information (e.g., relevant articles associated with data points in the chart).”

Santana et al. (2023) adds that the terms "story" and "narrative" are sometimes used interchangeably, but they carry distinct meanings. A story comprises events interconnected by a narrator, while a narrative refers to how the story is expressed or understood. In essence, a change in the sequence of events results in a different narrative for the same story, indicating a fresh perspective provided by diverse observers.

2.2 Related works

Segel & Heer (2010) identified distinct genres of narrative visualization, emphasizing the balance between author-imposed narrative flow and reader-driven story discovery, suggesting design strategies for narrative visualization including approaches to journalistic storytelling media. They organize the design space in three main divisions of features: Genre, visual narrative tactics, and narrative structure tactics,

The genre categorizes each visualization into genres, representing different types of visual narratives. Concluding that narrative visualization can be mapped into 7 genres (Figure 1): Magazine-style, annotated chart, partitioned poster, flow chart, comic strip, slide show, and film/video/animation constitute different visual genres, and the key distinction among them, according to the authors, lies in the number of frames they incorporate. Frames, representing unique visual scenes arranged in time and/or space, vary in quantity for each genre, determining the ordering of visual elements within them. It's essential to note that these genres are not mutually exclusive; they can serve as components and be combined to craft more intricate and complex visual styles.

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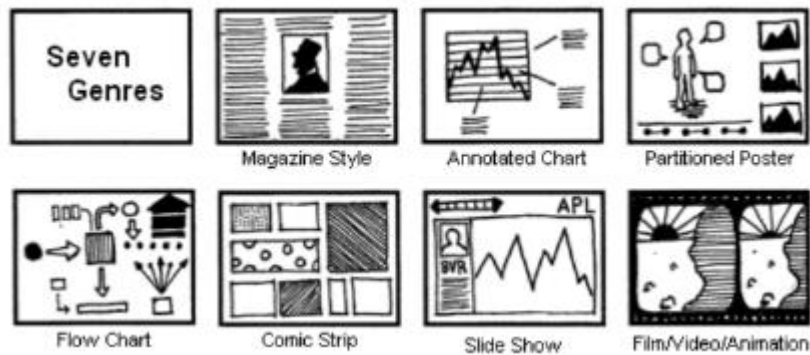


Figure 1: Genres of Narrative Visualization (Segel & Heer, 2010).

Visual Narrative Tactics is further divided into three sections:

- **Visual Structuring:** Involves mechanisms that convey the overall structure of the narrative, aiding the viewer in understanding their position within the visualization.
- **Highlighting:** Encompasses visual mechanisms that draw attention to specific elements through color, motion, framing, size, audio, etc.
- **Transition Guidance:** Includes techniques for moving within or between visual scenes without causing disorientation, such as continuity editing or animated transitions.

Narrative Structure tactics is also divided into three sections:

- **Ordering:** Deals with how the path through the visualization is arranged, whether linear, random access or user-directed.
- **Interactivity:** Encompasses ways users can manipulate the visualization, including filtering, selecting, searching, and navigating.
- **Messaging:** Addresses how the visualization communicates observations and commentary to the viewer, achieved through text fields, labels, captions, headlines, annotations, or more substantial descriptions like articles and summaries.

Segel & Heer (2010) also place narrative visualization along a spectrum of author-driven and reader-driven approaches. Whereas a pure author-driven approach has a strict path through the visualization, the reader-driven approach has no prescribed order for the images and messages and has a lot of interactivities. Now is very normal to find hybrid models of visualization, but to be more explanatory the author gives three structures to see how they work. The first structure (Martini Glass Structure) prioritizes the author-driven approach, the second structure (Interactive Slideshow) promotes a dialogue between the two approaches, while the third structure (Drill-Down Story) prioritizes the reader-driven approach.

Martini Glass Structure (Figure 2):

This structure initiates with an author-driven narrative, typically presenting questions, observations, or articles. The narrative follows a single path, resembling the stem of a martini glass. After the author's intended narrative is conveyed, the visualization opens up to a reader-driven stage. During this stage, users have the freedom to interactively explore the data.

Ideal for storytelling or efficient communication, where a structured narrative precedes interactive exploration.

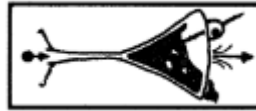


Figure 2: Martini Glass Structure (Segel & Heer, 2010).

Interactive Slideshow (Figure 3):

Following a traditional slideshow format, this structure allows for interaction within each slide. Users can explore specific points in the presentation before progressing to the next stage of the story. It strikes a balance between author-driven and reader-driven approaches by enabling interaction mid-narrative.

Well-suited for both complex datasets and narratives, providing step-by-step guidance through data dimensions and allowing users to control their pace of exploration.



Figure 3: Interactive Slideshow (Segel & Heer, 2010).

Drill-Down Story (Figure 4):

This structure introduces a general theme and enables users to choose specific instances or details within that theme. Users can drill down into particular aspects to reveal additional information and backstories. It emphasizes a more reader-driven approach, allowing users to dictate which stories they want to explore.

Particularly effective when users need to delve into specific details within a broader theme, giving them control over the exploration process.



Figure 4: Drill-Down Story (Segel & Heer, 2010).

Storytelling and narrative

Segel & Heer (2010) work provides a comprehensive framework for understanding and designing narrative visualizations, considering the interplay between genres, visual narrative tactics, and narrative structure tactics while allowing flexibility for a spectrum of author-driven and reader-driven approaches. Though his work considers visualization techniques as an instrument of the author, i.e., the journalist, we aim to propose an automatic visualization.

On the next work from Santana et al. (2023) we look to existing methods for extracting narratives from text, finding narrative components and their relationship before dealing with the structure of visualization. Their research addresses the increasing interest in using natural language processing techniques to extract, summarize, and generate new information from textual data. With the digital media ecosystem producing vast amounts of unstructured data, including news articles, web pages, blog posts, and tweets, there are challenges in automatically comprehending this content. A significant portion of this information is conveyed through natural language, often containing narratives that recount stories with multiple participants and events unfolding across different locations over a timeline.

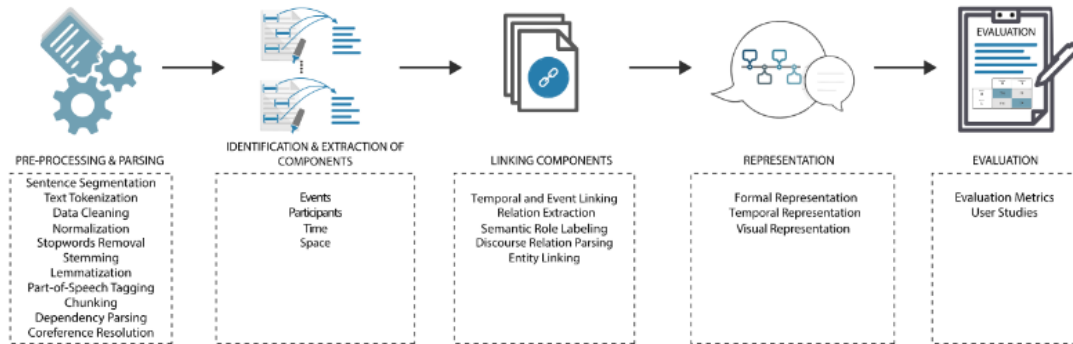


Figure 5: The narrative extraction pipeline (Santana et al., 2023).

Represented in the figure 5 is the narrative extraction pipeline of the work of Santana et al. (2023). In our work we are focusing on representing and evaluating a narrative visualization from news. So, this work is very similar to our idea though we are not doing every step but focusing on the visual part. In this research we will take the components of a narrative and the representation exploration.

In identifying and extracting narrative components, the focus is on critical elements for constructing a narrative. They define 4 elements:

Events: Events are crucial for narrative extraction, defined as significant occurrences at specific times and places with consequences. Event detection often relies on event triggers, such as verbs or phrasal verbs, to identify occurrences. They also show that there are 8 events types, and 33 subtypes as seen in the table 2.

Table 2: Event type and subtype (Segel & Heer, 2010).

Event Type	Event Subtype
Life	<i>Be-Born, Marry, Divorce, Injure, Die</i>
Movement	<i>Transport</i>
Contact	<i>Meet, Phone-write</i>
Conflict	<i>Attack, Demonstrate</i>
Business	<i>Merge-org, Declare-bankruptcy, Start-Org, End-org</i>
Transaction	<i>Transfer-money, Transfer-ownership</i>
Personnel	<i>Elect, Start-position, End-position, Nominate</i>
Justice	<i>Arrest-jail, Execute, Pardon, Release-parole, Fine, Convict, Charge-indict, Trial-hearing, Acquite, Sentence, Sue, Extradite, appeal</i>

Participants: Representing the "who" in the story are identified through Named Entity Recognition (NER). Entities, often persons or organizations, are categorized based on rule-based, unsupervised, feature-based, supervised, or deep-learning-based approaches. Beyond traditional entities, recent research explores broader character understanding, encompassing motivations and mental states.

Time: Since temporal references are essential for establishing the narrative timeline.

Space: Space is vital for understanding the spatial context of events. Challenges include disambiguating references and dealing with spatial relationships.

They also explained the importance of linking the information, "More than extracting separate elements from texts, establishing relations and detecting structures from them becomes essential to fully understand their meaning." They mentioned 5 tasks:

- Temporal Reasoning - This involves comprehending the temporal and causal relations between events and temporal references in a given text. This involves identifying temporal expressions and events, determining temporal relations between events, and constructing timelines to represent the chronological order of events.
- Entity Relation Extraction - Focuses on capturing semantic connections between named entities in a sentence. The task involves using various approaches, including rule-based, weakly supervised, distantly supervised, or unsupervised methods, and neural network models to extract relations. The ultimate aim is to represent relationships.
- Entity Linking - Entity linking aims to recognize, disambiguate, and link entities mentioned in a narrative to unique identifiers from knowledge bases.
- Semantic Role Labeling (SRL) - It is about assigning semantic roles to sentence constituents, answering questions about who did what to whom, and other semantic

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relationships. This task involves predicting predicates and arguments in a sentence, leading to a deeper understanding of the sentence's meaning at a semantic level.

- Discourse Relation Parsing - Involves uncovering relations between text units, such as clauses or sentences, to explain how discourse is organized. This complex task includes identifying explicit and implicit discourse relations, establishing relationships between different narrative parts, and labeling discourse connectives, arguments, and attribution spans.

These tasks collectively contribute to the information linking stage, enhancing understanding of narrative structures, temporal relationships, and semantic roles within textual data.

Santana et al. (2023) work gave us the elements that compose a narrative and also the type of links we need to have in consideration between them. This will help us to plan the visualization knowing what fundamentals we need to have in consideration in the narrative part.

The next contributions came from Van Krieken (2018) he explores narrative technique and how it translates to creating immersive stories from journalistic multimedia, possessing, unique characteristics.

Van Krieken (2018) introduces the incorporation of storytelling into journalism as a contemporary and widely discussed theme, evident in newsrooms' increasing adoption of narrative formats for content delivery. However, storytelling techniques in news reporting have been around for a while, dating back to the 18th and 19th centuries when journalists blended literary and journalistic elements in their writings. The professionalization of journalism in the early 20th century shifted towards objectivity, distancing from novel-like aspects. This transition replaced the narrative style with a neutral, objective structure—characterized by the non-chronological inverted pyramid, prioritizing the latest information over older details. The author identifies that the aim of journalistic storytelling is to immerse readers and excite them both intellectually and emotionally. The primary functional and communicative distinction between non-narrative news articles and news stories lies in their stylistic variations, representing the difference between providing information and engaging the audience. Analytical examinations of news stories in print journalism have identified several text-linguistic features believed to heighten the reader's immersive experience in the narrative. These features can be broadly categorized into three main narrative elements (Table 3): Scene reconstructions, event structures, and viewpoint techniques:

Scene reconstructions involve vivid and detailed depictions of the spatiotemporal environment in which newsworthy events occurred. Unlike straight news reports, which lack such descriptive details, scene reconstructions aim to transport readers to the story world, allowing them to visualize events unfolding.

Event structures in news stories deviates from the inverted pyramid structure of non-narrative news articles. News stories typically follow a chronological order, presenting events in the order

they occurred. This chronological ordering, as opposed to the non-chronological structure of news articles, enhances audience immersion by creating suspense.

Viewpoint techniques is prominent in news stories rather than in non-narrative news reports. These techniques include representing a news actor's speech, thoughts, desires, observations, and emotions. Different modes of representation, such as direct, indirect, and free indirect, capture the voice and perspective of news actors, adding liveliness to the narrative.

Table 3: Text-linguistic features of the three main narrative categories (Van Krieken, 2018).

Narrative Category	Text-Linguistic Features
(1) Scene reconstructions	• Location markers • Descriptive detail
(2) Event structure	• Temporal markers • Tense
(3) Viewpoint techniques	• Speech and thought - direct - indirect - free indirect • Implicit viewpoint markers - cognition - perception - emotion

These narrative techniques serve specific functions, with scene reconstructions facilitating reader imagination, chronological event structure contributing to suspense, and viewpoint techniques providing a subjective perspective. Incorporating direct quotations and implicit viewpoint markers further enhances the immersive experience in news stories.

Additionally, the evolution of multimedia storytelling in journalism has introduced new possibilities for creating immersive stories. Multimedia stories, utilizing multiple media formats, have the potential to immerse the audience through a distraction-free environment and interactive elements. The Van Krieken (2018) explores how the discussed narrative techniques are expressed in various media formats used in journalistic multimedia stories and the extent to which these formats complement each other in creating an immersive experience.

Van Krieken (2018) explained how narrative techniques, including scene reconstructions, event structure, and viewpoint techniques, are expressed in various media formats used in journalistic multimedia stories and to what extent these formats complement each other in creating an immersive experience (Table 4). They reconstruct the narrative techniques using this media:

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- Scene Reconstructions: Utilized in text, video, audio, and pictures to enhance audience imagination of the story's setting, guiding them through the narrative.
- Event Structure: Mainly expressed in text, occasionally reinforced by pictures, maintaining a dominant chronological order to heighten suspense.
- Viewpoint Techniques: Represented in text, video, and audio, providing access to the feelings, observations, thoughts, and speech of news actors. Speech reports serve both narrative-internal and narrative-external functions.

Table 4: Expression of narrative techniques in the media formats (Van Krieken, 2018).

Narrative Category	Text	Video	Audio	Picture	Graphic
(1) Scene reconstructions	✓	✓		✓	✓
(2) Event structure	✓			✓	
(3) Viewpoint techniques	✓	✓	✓		

This study provided narrative techniques for augmenting immersion of the reader and also suggest how each one could be worked in our visualization.

The next work contributed with the narrative constituents in data visualization. Weber (2020) enters more in the journalism that works with data, and mention that journalists when discussing storytelling, they include not just narrating but also describing, explaining, or arguing. This extends to data visualization, where "data storytelling" involves various forms like visualizations, infographics, and dashboards. These forms are visualizations that we are interested in exploring in our work for the amount of information they can transmit as well as still being engaging to the audience.

Weber (2020) mentions in his work the distinction between telling and showing in a narrative involves how events are presented. The concept of telling vs. showing relates to the degree of the narrating instance's presence. "Showing" is a way of saying that involves revealing as much as possible while making people forget that is the narrator telling. A narrative in the telling mode is more distant and mediated, saying less than the showing mode. In the table 5 you can see the key features of telling vs. showing narratives collected in his work:

Table 5: Telling vs. showing (Weber, 2020).

	Telling	Showing
Narrator and narrator's spatial position towards what is told	– presence of a narrator – mediated presentation – remote distance – only what is worth telling is presented in the narrative	– absence of a narrator – unmediated presentation – close distance, as if the events were revealed
Speed of unfolding the narrative	– fast speed, which means less detailed information – focus on summary	– slow speed, which means more detailed information – focus on scene
Dialogue	– absence of dialogues – epic	– presence of dialogues – scenic
Explicitness / implicitness	– explicitness of characters' traits, themes, meanings, or morals of the story	– implicitness of characters' traits, themes, meanings, or morals of the story
Partiality / impartiality	– partiality which includes commentary and subjective evaluation	– impartiality and objectivity
Reader's perception	– the reader gets the story told	– the reader witnesses the events of the story

Weber (2020) also collects the Narrative constituents describing each one in the table 6:

Table 6: Narrative constituents (Weber, 2020).

Spatial and temporal dimension	– The world is situated in time and undergoes a transformation caused by non-habitual physical events. – It is about individuated existents. – Temporal transformation excludes pure explanation, description, or argumentation.
Characters and events	– It is about characters that react emotionally to the events, which excludes weather reports and financial reports, for instance. – Some actions by the characters must be purposeful, which excludes mental events.
Sequentiality	– Sequence of events that are temporally structured and coherently related to each other, which excludes lists or a sequence of unconnected events. – The occurrence of the events must be a fact for the story world, which excludes hypotheses, instructions, or statements. – Completeness (eventfulness): the whole story is presented, which excludes fragmentary storytelling, e.g. breaking news or news about ongoing events.
Tellability	– Giving an answer to: What's the point? – Something meaningful that makes the story worth telling

Weber (2020) contributed to our study by identifying various techniques that that constitute narrativity in data visualization:

- The narrator's presence is conveyed through small text elements like titles, teasers, captions, and tooltips, as well as by design choices and stylistic features that emphasize specific data through color or size adjustments and even through aural interpretations.

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- Sequentially is illustrated through actions like scrolling, animation, and dynamic transitions such as zoom, dissolve, wipe, and fade.
- The temporal aspect is effectively showcased using various data visualization formats like timelines, time series graphs, flow maps, slideshows, data videos, and other charts illustrating changes over time.
- Tellability delves into the journalistic inquiry of what factors make a story compelling and worth narrating.

In the study of Weber (2020) work, we understand better how data journalism works with narrative and visualization and we concluded how to work with that with the techniques given, the narrative components and also the characteristics from understanding narratives that show vs tell.

In the next work, Piper (2021) provided the elements of a narrative (Figure 6). The author determinates that to constitute a story, various essential elements must be present, including a teller (A), a mode of telling (medium)(B), a recipient(C), a social situation(D), an agent (E), at least one action or event (F), a possible object (G), a location (H), a time-frame (I), and a motivation or cause (J).

A	Someone
B	tells
C	someone
D	somewhere
	that
E	someone
F	did something(s)
G	[to someone]
H	somewhere
I	at some time
J	for some reason.

Figure 6: Elements of Narrative (Piper, 2021).

These elements will also be a good consideration in the visualization for different angles and elements that constitute a narrative.

The last contributions for this chapter came from Figueiras (2014) that highlighted the benefits of incorporating storytelling into visualizations, suggesting strategies to incorporate narrative elements in existing visualizations.

The paper highlights several benefits of incorporating storytelling into visualizations: Storytelling in visualizations enhances relatability and empathy by presenting data not just as abstract information but as real stories about people. This contextualization enriches the user's understanding of specific data points. It also boosts user engagement, making visualizations more memorable and enjoyable. This engagement is crucial for creating immersive experiences where users feel connected to the information. Incorporating temporal references helps users navigate data over time, offering a sense of story flow and aiding in exploring trends and events' evolution. Figueiras also highlights the need to balance exploration with exposition. Storytelling should allow users to delve deeper into the data rather than dictating a fixed interpretation. This balance allows for both guided and autonomous exploration, fostering a deeper engagement with the data. Narrative elements guide users' attention and simplify interpreting complex information, making data more accessible and easier to understand. Visualizations enriched with storytelling are more memorable, ensuring users retain the information longer and more effectively.

The paper also suggests three strategies for incorporating storytelling into visualizations:

- Adding Context: This strategy involves providing additional information or context to enhance the understanding of data points.
- Empathy Through Short Stories: Introducing short stories or narratives related to the data points to create a sense of relatability and empathy.
- Temporal References for Narrative Flow: Incorporating temporal references, such as timelines, to provide a sense of story flow and aid navigation through the data over time.

With these contributions of Figueiras (2014), we understand how visualization and storytelling are connected and how they can work together to enhance the visualization experience. The strategies provided and the application examples offer valuable insights into how we can effortlessly improve visualizations and apply these principles to our work.

3. Visualization

3.1 Concepts

In this section, we will explore the fundamental concepts underpinning the use of visualization in journalistic narratives, including visualization, visual representation, illustration, and infographics. We will delve into essential visual principles and techniques that guide the creation and application of our journalistic narrative tool. Finally, we will gather methods and criteria to evaluate our future prototype with users.

3.1.0 Visualization

Visualization is a versatile interdisciplinary imaging technique that aims to make the invisible visible through experimental and computer-aided methods (Nakayama & Aoki, 2001). Spence (2014) describes visualization as the activity of forming a mental model of something. Mazza (2009) further delves into this concept, stating that visualization, according to the dictionary, is a cognitive activity rooted in internal mental constructions within the mind. It is not something physically printed or displayed on a computer screen. External visual representations, facilitated by computers through visualization tools, act as aids for individuals to construct an internal mental representation of the world (Mazza, 2009). Despite the role of computers in enhancing the visualization process, the definition remains independent of technology, emphasizing that visualization fundamentally occurs within the mind (Mazza, 2009). Some authors use the term "visualization" to encompass both the printed visual representation and the cognitive process of comprehending an image (Mazza, 2009).

Visualization research spans various fields, including data visualization, architectural visualization, scientific visualization, functional visualization, and artistic visualization (Seevinck, 2014). These different areas share a common goal: transforming information into visual representations. This information can range from numeric and geometric data to logical data, making it easier for the audience to understand (Seevinck, 2014).

Benoît (2019) introduces information visualization as a multidisciplinary practice encompassing data's aesthetic, communicative, technical, and social aspects. Information visualization involves using images to represent data instead of traditional printed tables, aiming to aid in comprehending complex information. This form of visualization has undergone significant changes, with its roots in scientific reasoning expanding into artistic practice (Viégas & Wattenberg, 2007). Manovich (2010) argues that crafting a comprehensive definition for information visualization that effectively distinguishes it from related fields like scientific

visualization and information design is challenging. However, the author provides the following distinctions:

- **Information Visualization:** This field concentrates on representing non-numeric data, such as text and networks of relations, in visual formats. Its main emphasis is translating discrete data into visual representations, often incorporating interactive interfaces for effective communication and problem-solving.
- **Scientific Visualization:** In contrast, scientific visualization predominantly deals with numerical data, typically derived from scientific simulations or measurements. Its primary purpose is to analyze and interpret intricate scientific phenomena through visual representations, such as fluid dynamics, molecular structures, or astronomical data.
- **Information Design:** Information design commences with structured data and aims to express this organization visually. It focuses on creating transparent and impactful visualizations of information, such as charts, diagrams, and maps, to facilitate comprehension and communication.

These distinctions underscore the varying data types, objectives, and methodologies employed within each field despite some overlapping techniques and tools utilized for visualization.

Santana et al. (2023) introduce narrative visualization addresses the interplay between narrative and visualization. This includes perspectives that range from the use of visualization elements to enrich traditional narratives, to the exploration of narrative techniques in visualization-rich artefacts.

3.1.1 Visual representation

Visual representation constitutes a pivotal element within the behavioral sciences, frequently employed to distill intricate research into easily interpretable formats (Stanczak, 2004). It encompasses diverse forms, such as pictorial representation, graphs and tables, maps, diagrams, networks, and icons (Lohse et al., 1990). These representations can be further classified based on the spatial information and cognitive processing effort they necessitate (Lohse et al., 1990).

Visual representation is an indispensable component of data visualization, information visualization, and infographics—subjects delved into here—enabling the translation of intricate data into easily comprehensible visual contexts (Atwood et al., 1999). This intricate process involves the amalgamation of data visualization methods, computer graphics, design, and imagination (Atwood et al., 1999). In essence, visual representation assumes a vital role in these domains, rendering data more accessible and comprehensible to a broader audience.

Visualization

3.1.2 Illustration and infographics

Illustrations are unique communication tools, carving their aesthetic and communicative niche distinct from other mediums (Soliman, 2019). When well designed, are a powerful aid to understanding non-quantitative information (Kirsh, 2002).

Soliman (2019) wrote that this artistic field has evolved over time, adapting to shifting political and social conditions and technological advancements alongside the development of various creative styles. The symbiotic relationship between drawings and texts weaves together imagination, creativity, and skill to visually articulate specific information, narrate stories, and construct new worlds. The resulting drawings boast visual and functional qualities and contribute to a visual heritage mirroring our culture (Soliman, 2019).

Illustrations integrate into information design, effectively conveying details and shaping audience perception (Soliman, 2019). They offer viewers a detailed portrayal of topics that might be challenging to grasp solely through text (Soliman, 2019). Kirsh (2002) delves into this, providing examples of situations where illustration is beneficial: In geometry, illustrations aid students in comprehending Euclidean problems and reasoning constructively towards a solution. In physics, they assist students in grasping principles that might be challenging to comprehend based solely on discursive accounts. In narrative fields like children's stories, fairy tales, or biographies, illustrations typically enhance the reading (or listening) experience and facilitate comprehension. The illustrations utilized in information design possess distinct visual and aesthetic properties, setting them apart from other design elements.

In contemporary times, illustrations emerge as pivotal communication, especially in elucidating complex ideas to express in words alone. This significance is particularly evident in news cartoons, often called "Infographics" or "Information Graphics," prevalent in print media like newspapers, magazines, and books (Soliman, 2019).

Defining illustration reveals like discussed by Soliman (2019) a diversity of perspectives. Some view drawings as a form of visual communication or a tool to solve communication problems, providing social and press commentary or explanation. Others perceive drawings as an applied art in a commercial context or a prevailing form of human narrative art. Some argue that all contemporary arts are inherently illustrative and descriptive. What makes drawings captivating is their ability to fulfill the communication imperative, blending imagination, creativity, skill, visual narration, and creating new worlds and perspectives. Drawings serve varied purposes across different media and artistic styles, from storytelling to clarifying concepts or ideas (Soliman, 2019).

Infographics, as a form of information design, have a long history of simplifying complex topics into easily understandable visual formats (Balkac & Ergun, 2018). The origins of what we now consider Infographics trace back to ancient cave paintings, sharing the purpose of simplifying complex topics into easily understandable visual formats (Dick, 2020). The term Infographics officially emerged in the 1970s as a branch of graphic design, gaining prominence with the advent

of personal computers and graphic design software in the early 1980s, playing a crucial role in conveying information, and using the illustrations within them to clarifying complex data (Soliman, 2019). William Playfair pioneered modern infographics through his innovative use of charts and graphs, including time-series charts and bar charts (Figueiras, 2014).

Siricharoen and Siricharoen (2015) viewed the infographic as a means to augment human capabilities beyond the constraints of the brain. They defined infographics as data visualization and affirmed that the primary purpose of infographics is to summarize information quickly. Siricharoen and Siricharoen (2015) also noted that the human mind can recognize visual information more successfully in a world with little time and too much information to learn, making infographics the perfect area to explore in our work.

To better define Infographics, Soliman (2019) explains that is a fusion of information and graphic design, visually represent information for immediate comprehension. They leverage minimal text, serving as a potent tool for presenting data, explaining concepts, simplifying presentations, detailing relationships, illustrating trends, and providing fundamental insights. The visual appeal of images and graphics in infographics facilitates understanding abstract ideas.

In summary, illustrations, especially within infographics, represent a dynamic and integral aspect of communication. They appeal to both literal and visual elements of the brain, serving as a powerful tool to convey complex information seamlessly and engagingly, and this is why we want to use this discipline in the Visualizations of the Narratives.

3.2 Related works

Andrews (2019) explores principles of information design. Andrews (2019) explained narrative art, focusing on the power of storytelling through imagery in his work. It emphasizes how a single image can convey the setting, characters, conflict, and outcomes, eliciting strong emotions. Exploring with this the impact of freeze-framed still images, particularly in advertisements and narrative art, and allowing narrative to be told by photographs, paintings, and magazine illustrations that engage us intellectually and stir our emotions.

“Getting the reader’s attention is not the same as informing them.” (Andrews, 2019) The author focused on the importance of design and how to get the attention and to inform the “busy reader” are different tasks that demand different treatments. He leaves sketches of grids (Figure 7) that we can take inspiration in the building of our visualization:

Visualization

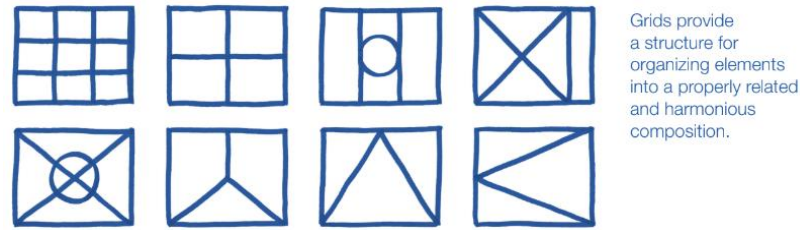


Figure 7: Grids (Andrews, 2019).

Andrews (2019) outlines several design principles crucial for creating compelling visuals:

- **Focus:** A clear focal point directs viewers to the main area of interest. (Figure 8)
- **Diagonal Lines:** These break up the standard rectangular layout, guiding the viewer's eye. (Figure 8)
- **Spatial Depth:** Overlapping objects and varying sizes and colors create a sense of depth. (Figure 8)
- **Narrative Essence:** A single frame can capture setting, characters, conflict, and resolution. (Figure 8)

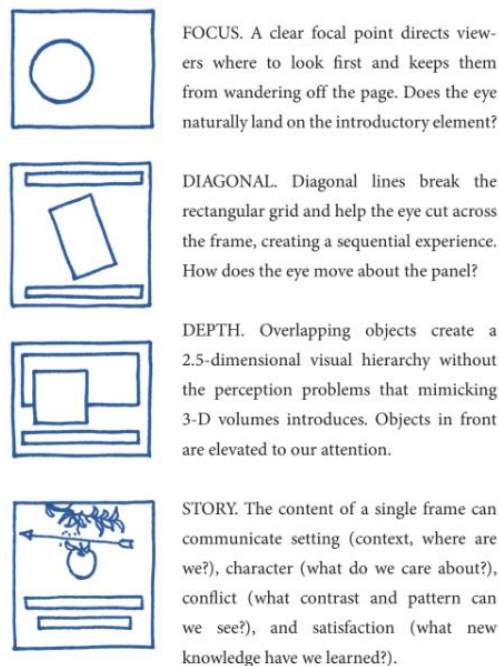


Figure 8: Design guidelines (Andrews, 2019).

Andrews (2019) introduces in his work the term "chunk," a unit of information stored in short-term memory. This concept, initially observed in grouped color categories on a hometown map, was introduced by psychologist George Miller in 1956. While our ability to hold chunks has been refined to around three or four, complex storytelling involves packaging ideas into chunks

that can be navigated and broken into sub-elements. Cognitive psychologist Steven Pinker warns against overwhelming readers with too many visual elements, suggesting using gestalt effects like enclosure and grouping. Colin Ware's research emphasizes enhancing visual search by associating smaller and larger objects, creating a multiscale design that organizes information into visual hierarchies aligned with conceptual meaning. (Andrews, 2019) In the next figure 9 you can find styles given by the author to how organize the “chunk”.



Figure 9: Organization styles (Andrews, 2019).

The work also talks about visual pop-out. Visual pop-out is a phenomenon where a distinct item conspicuously stands out. In contrast to grouping, pop-out is a pre-attentive effect, automatically capturing attention before conscious focus. Employing pop-out and gestalt grouping techniques allows for prioritizing content based on importance. This strategic approach creates a sequential appreciation for the reader, initially attracting and retaining their attention as they visually explore individual chunks of information. In the figure 10 you can see types of visual pop-out represented in the author work:

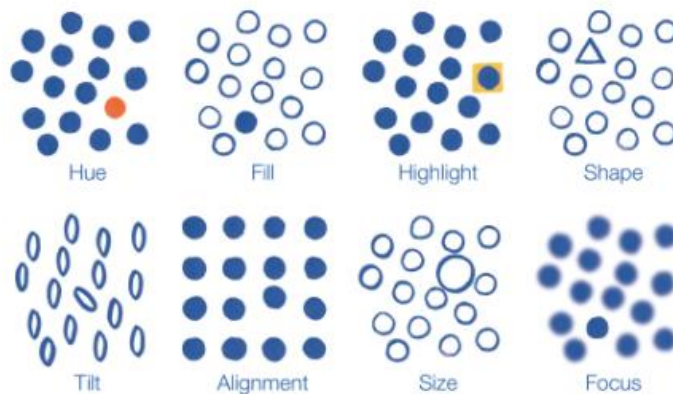


Figure 10 Types of visual pop-out (Andrews, 2019).

Next, the author's contributions are relevant to our research with Design principles for a trustworthy content. These principles collectively contribute to establishing trust between the creator and the audience. The principles are:

- Positive First Impression: Trustworthy design makes a positive first impression. Visual appeal is crucial or at least, not off-putting, signaling care in creation.

Visualization

- **Correctness and Accuracy:** Trustworthy design is correct and accurate. Errors and bugs undermine trust and credibility.
- **Accessibility:** Trustworthy design engages the audience's capabilities. Complexity is acceptable, but clutter creates chaos.
- **Directness:** Trustworthy design is direct, avoiding unnecessary complexity. Familiar protocols are employed where expected.
- **Transparency:** Trustworthy design is transparent about data sources. Qualifications, editorial decisions, and anticipated criticism are communicated.
- **Vulnerability:** Trustworthy design is vulnerable, with the creator standing by their work. The inclusion of contact information and engagement in feedback build trust.
- **Trust in the Audience:** The trustworthy design recognizes the intelligence of the audience. The audience is not talked down to, and the design helps them understand new concepts.

With Andrews' work, we collected design principles, understood the emphasis on the power of freeze-framed images in storytelling, explored design elements like grids, delved into the term "chunk," learned how to organize it, examined various types of visual pop-outs, and gathered principles for trustworthy content design. Collecting design strategies to help us build the visualization.

In their book "The Visual Imperative: Creating a Visual Culture of Data Discovery" Ryan et al. (2016) delve into the core principles of effective data visualization, emphasizing the importance of understanding cognitive elements. They provide a comprehensive checklist to guide the visual design of data, focusing on several key areas:

- **Color** is a powerful tool in data visualization, crucial for influencing perception and conveying information. Effective use of color enhances understanding and highlights patterns. Important considerations include ensuring sufficient contrast between elements for clarity, choosing appropriate color scales for different data types (sequential, diverging, categorical), designing with accessibility in mind, particularly for color blindness, and maintaining consistent color usage throughout the visualization.
- **Typography** significantly contributes to data visualizations' readability and visual appeal. Key aspects to consider are selecting readable fonts (serif or sans-serif based on the context), optimizing font sizes for titles, labels, and annotations, and establishing a clear hierarchy with varied font sizes to differentiate elements.
- **Layout and Composition** are the arrangement of elements on the visualization canvas, and significantly impacts user comprehension. Using whitespace helps

reduce clutter and improve clarity, aligning elements creates a cohesive and organized appearance, and guiding the viewer's eye with a logical flow of information ensures that the narrative is easily followed.

- Choosing the correct type of chart or graph is crucial for accurately representing data. Considerations include matching the chart type to the data and the story being told, simplifying charts to emphasize key information and reduce cognitive load, and providing explicit annotations to explain data points or trends.
- Visual elements beyond charts and graphs, such as images and icons, can significantly enhance storytelling. It's important to ensure these elements are relevant to the narrative and add value. Maintaining a consistent visual style for images and icons is also essential.
- Interactive elements can engage users and allow them to explore the data more deeply. These elements should be user-friendly, enhance the overall experience, and provide guidance or instructions for practical use to ensure that interactivity is intuitive and beneficial.

Ryan et al. (2016) Reminded us, that these considerations serve as a starting point, and effective visualization requires an iterative design, feedback, and refinement process. They also explore deeper aspects of color theory relevant to data visualization design. Exploring specific aspects of color theory that impact the design process. Ryan et al. (2016) explores the basic color theory which includes primary, secondary, and tertiary colors that form the color wheel. The color wheel is a tool for making purposeful color combinations based on desired effects such as contrast or blending. Complementary colors, opposite each other on the color wheel, provide the highest contrast level, enhancing visibility. On the other hand, analogous colors, neighboring each other on the wheel, create harmonious blends with minimal contrast. Color education also introduces the idea that colors evoke feelings, moods, and cultural associations. For instance, red may symbolize danger, green may convey a sense of "go" or positivity, and purple may be associated with royalty.

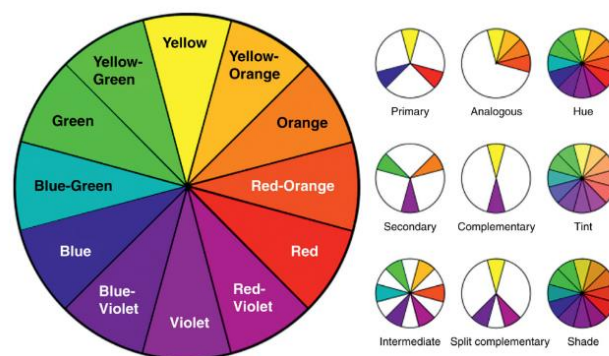


Figure 11: A Gray Scale Modified Traditional Color Wheel (Ryan et al., 2016).

Visualization

Ryan et al. (2016) explores two key considerations when designing: color blindness and color culture. Color blindness affects approximately 8% of men and 0.5% of women, leading to a different perception of colors. There are three main types: red–green (most common), blue–green, and total color blindness. Design implications arise from challenges in achieving consistent visual experiences for those with color vision deficiencies. Strategies to mitigate color blindness issues include:

- Use shapes or symbols in addition to color.
- Be cautious with similar-intensity colors, especially in maps, and use labels or cues to distinguish areas.
- Familiarize with color combinations that can compensate for color blindness.
- When in doubt, use grayscale, as even those with total color blindness can distinguish shades of black and white.

Ryan et al. (2016) highlights the complex nature of color perception, which extends beyond mere visual differences to include cultural and gender influences. Different cultures associate colors with varying meanings; for instance, white symbolizes purity in Western weddings but signifies mourning in China. Gender differences also impact color perception, as evidenced by a 2010 survey where men and women named colors differently. This underscores the importance of understanding cultural and gender nuances in color perception, especially in our interconnected world. Recognizing these subtleties is crucial for creating visualizations that resonate universally.

In discussing infographics, Ryan et al. (2016) argue that while infographics and data visualizations share common design principles, they serve as complementary tools along a continuum. Both aim to convey information effectively, though infographics often blend narrative and design to make data more accessible. This perspective suggests that the principles for creating effective visualizations can also enhance infographics.

The last contribution to our research given by Ryan et al. (2016) is a list of commonly accessible and familiar chart types, offering a starting point for users new to visual data work.

Sample Set:

- Bar Chart: Ideal for comparing numerical data across categories, with enhancements like multiple bars or color overlays to show comparisons.
- Line Chart: Best for displaying trends over time, connecting data points to highlight changes.
- Pie/Donut Chart: Useful for showing proportions within a whole but should be used sparingly to avoid misinterpretation.

- Scatter Plot: Excellent for exploring relationships between two variables, highlighting patterns and outliers.
- Bubble Chart: A variation of the scatter plot that adds a third dimension through bubble size, useful for comparing multiple data aspects.
- Histogram: Focuses on data distribution across categories, similar to a bar chart but specifically for frequency analysis.
- Tree Map: Displays hierarchical data using nested rectangles, ideal for showing part-to-whole relationships and large datasets.
- Heat Map: Uses color gradients to represent data in a matrix, helping to visualize complex relationships and individual values.

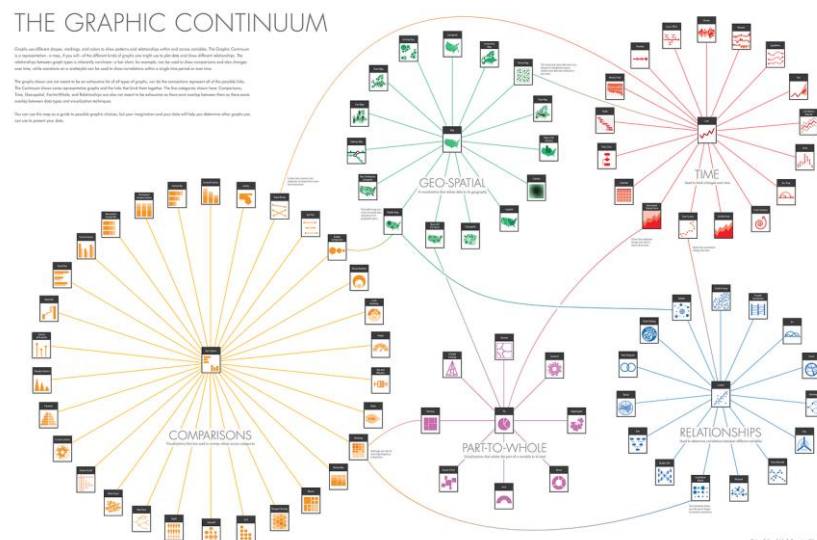


Figure 12: The Graphic Continuum, Conceived by Jonathan Schwabish and Severino
(Ryan et al., 2016).

The Graphic Continuum, conceived by Jonathan Schwabish and Severino Ribeca and presented by Ryan et al. (2016) work (Figure 12), categorizes these chart types into five main uses: comparison, geospatial analysis, time series, part-to-whole relationships, and exploring correlations. This continuum aids in selecting the most appropriate chart type for the data being represented, ensuring clear and practical information communication.

Zhao and Elmqvist, (2022) proposed three novel storytelling mechanisms that dynamically incorporate visual representation. In one of the chapters of his research, he delves into visual forms of communication, encompassing icons, illustrations, schematics, photographs, and full-

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motion video. It emphasizes the importance of considering the visual literacy of everyday users when presenting insights from data. The concept of "casual visualization" is introduced, stressing the need to cater to users with varying visualization skills. This is an essential aspect and something we should evaluate in our visualization, namely, if it is accessible regarding the visual literacy of the users.

The following work from Benoît, (2019) explores design principles that enhance the visual presentation of information.

Graphic design plays a crucial role in information visualization, influencing the viewer's sense and affective response to the image and shaping the interpretation of the message. For information visualization specialists, the visual aspects of the design must align with visual norms that facilitate interpretation. Coherence is essential, where visual, textual, interactive, and data elements contribute harmoniously to convey the same message to the viewer. (Benoît, 2019)

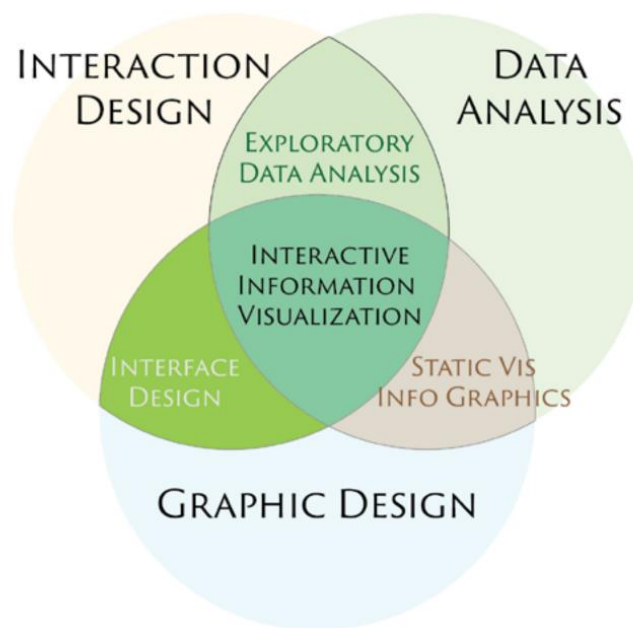


Figure 13: Venn diagram of main work function areas in information visualization
(Benoît, 2019).

The author delves into the fundamentals of graphic design, emphasizing the importance of typography, color theory, and composition in bridging the gap between visualization aesthetics and data:

- Composition: The graphic design industry has adopted principles from German modernism, particularly around the 1930s. These principles, popularized by Müller-Brockmann's "Grid Systems in Graphic Design," have become standard for graphic

production. The movement transitioned from highly symmetrical, floral-oriented designs to more prominent main elements, a smaller color palette, and repetitive visual themes. teaching design composition for posters and websites, the author introduces the "rule of thirds." This rule limits the design to three colors, typefaces, and display areas. It simplifies design composition, and its influence is visible in easy computer-aided design templates and personalized design rule applications. Trends in information visualization favor composite designs with three major functional areas: a graphic, a user control panel for interaction, and a graphic display area. The main area is dedicated to visualization, incorporating realistic images, recognizable maps, icons, drawings, and visual primitives. The composition parallels syntax, forming the basis for "visual storytelling. (Benoît, 2019)"

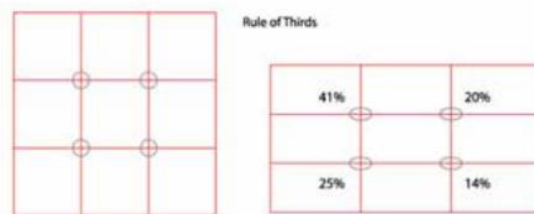


Figure 14: The rule of thirds (Benoît, 2019).

- Visual elements: While exploring the visual elements shaping data narrative, Benoît (2019) uncovered vital principles contributing to the overall harmony and impact of information visualization.
 - Unity/Harmony - In achieving unity and harmony, the sensible spacing of elements naturally guides the viewer's eye across the visualization. Repeating similar visual elements creates a cohesive look, reinforcing the overall visual language. Extending lines or patterns smoothly directs the viewer's attention through the data, while consistent repetition of design elements helps to solidify the visual message. Additionally, introducing a rhythmic flow with strategic interruptions can emphasize key data points, adding to the visual appeal and clarity.

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- Equilibrium - The concept of equilibrium brings balance and symmetry to our visual design. Symmetry involves placing elements evenly on both sides of an axis, fostering a sense of stability and clarity. Conversely, asymmetry introduces variety in shapes and sizes while maintaining overall visual harmony, making designs more dynamic and engaging. Circular arrangements enhance visual appeal by focusing on central points and fostering a cohesive aesthetic (Figure 15).

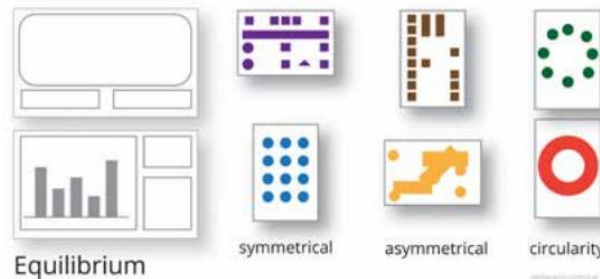


Figure 15: Assembling design areas based on principles of symmetry/asymmetry (Benoît, 2019).

- Hierarchy - Hierarchy plays a pivotal role in organizing visual elements to convey information effectively. Adopting a tree structure allows for hierarchical organization akin to branches stemming from roots, illustrating dependencies and connections within data. Implementing a parent-child relationship further clarifies relationships between elements, emphasizing importance and order. Size variations among elements within the same category establish a clear hierarchy, directing viewer focus based on relative significance. Benoît illustrates these principles through visual examples in Figure 16.

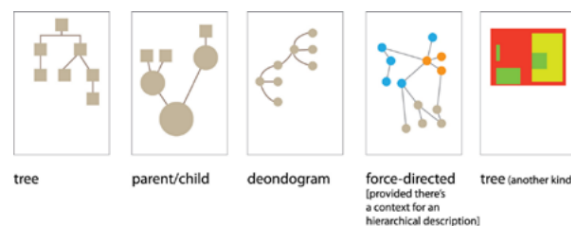


Figure 16: Various trees and equilibrium designs (Benoît, 2019).

- Scale/Proportion - Considering scale and proportion adds depth to visual storytelling. Varying the size of elements communicates their relative significance, guiding the viewer's interpretation effectively. Using ratios to link elements fosters visual harmony, creating a cohesive composition that enhances overall readability. Strategic divisions within the visualization create focal points, guiding the viewer's attention through complex data landscapes.

- Dominance/Accenting - Highlighting elements through dominance and accenting is crucial for emphasizing essential information. Employing different shapes or colors draws attention to specific data points or trends, enhancing clarity and guiding interpretation. Variation in size among elements further directs the viewer's focus, ensuring essential details stand out prominently.
- Similarity/Contrast - Incorporating elements of similarity and contrast enhances visual appeal. Establishing clear distinctions between lightness and shadow enhances foreground-background separation, facilitating better comprehension of data relationships. Introducing diversity in lines and shapes adds texture and visual interest, enhancing contrast and emphasizing critical data insights.
- Typography: Modern font files encapsulate the entire typographic history, offering many possibilities from traditional to contemporary representations. The choice of fonts is subtle yet impactful, contributing to both design aesthetics and legibility. The rule of thirds extends to fonts prevailing with distinct roles:
 - Heading Font: Commands attention, often bold, setting the tone.
 - Body Text Font: Ensures readability and complements the heading font.
 - Details Font: Adds nuance, often a serif font for variety.
- Color: Color is not merely an aesthetic choice but a crucial element that sets the tone influences legibility and impacts cognition. Successful visualization designers recognize the significance of color in interpretation and user guidance. Lighter hues, aids users in discerning strengths and relationships between graphic elements and underlying data. The retina's sensitivity to color changes as we age, impacting our interpretation of specific colors. This aging factor raises considerations about the suitability of color choices in screen designs, messages, and signage. Color theory provides several standards to describe a "color space," including primary/secondary/tertiary colors and complementary/analogous schemes.
 - Primary colors: red, green, blue.
 - Secondary: green, orange, purple.
 - Tertiary: yellow-orange, red-orange, red-purple, blue-purple, blue-green, yellow-green.
 - Adding white creates a "tint"; adding black, the "shade"; gray creates the "tone."

When selecting a color palette, both affective and aesthetic factors and data characteristics contribute to the decision. Various color palettes, such as monochromatic, complementary, analogous, and high-contrast versions, cater to different data types and visualizations.

Visualization

Benoît (2019) research underscores the critical role of aesthetics in effectively presenting data through information visualization principles. Exploring graphic design fundamentals yields valuable insights into creating compelling visual narratives.

Airaldi et al. (2022) reported the best practices for designing narrative visualizations, and evaluation criteria and methods to assess them.

The study identified 38 best practices for evaluating visualizations, categorized into five groups:

- **Cognitive:** These practices focus on reducing cognitive load associated with chart comprehension, aiding in a better understanding visual information.
- **Data:** Best practices in this category concern aspects related to the data sources behind visual representations, including transparency, reliability, and accuracy.
- **Perceptual:** These practices are based on the principles of graphical perception, aimed at enhancing the user's ability to interpret information by strategically mapping visual variables and using color effectively.
- **Presentation:** This category involves choices regarding how data is mapped to the visual domain, considering aesthetics, style, layout, and clarity of the design.
- **Usability:** Practices in this category focus on the functionality and understandability of charts, including features like accessibility, consistency, and interactivity, which enable users to perform tasks effectively.

It is possible for certain practices to be classified under multiple categories because of the close relationship between cognition and perception.

Airaldi et al. (2022) created a table where she would put each practice, next to the category they belong to, the context and the reference. The next table is a simpler version of their table:

Table 7: Best practices implementations Airaldi et al. (2022)

Category	Best Practice
Cognitive	Simplify complex ideas
Cognitive	Provide contextual information
Cognitive	Use metonymy to map visual signs to implicit meanings
Cognitive	Limit the number of series or categories displayed
Cognitive Data	Select the appropriate visualization considering the types of data to represent and the advantages and disadvantages of each technique
Cognitive Data	Present uncertainty information alongside point estimates to enable informed judgments and decisions
Cognitive Data	Use a common baseline to make comparison between series easier

Category	Best Practice
Cognitive Data Perceptual	Map information and data dimensions to the most salient visual features
Cognitive Data Perceptual	Avoid obscuring information
Cognitive Perceptual	Grids and labels should be usefully visible; effective in providing information without being obtrusive
Cognitive	Provide redundancy to improve comprehension and memorability of the information
Cognitive Perceptual Presentation	Focus the important data points of a visualization to draw the user's attention to the relevant areas
Cognitive Perceptual Presentation	Declutter visualizations by removing unnecessary elements such as grid lines, marks, legends, and colors
Cognitive Perceptual Presentation	Maximize the data-ink ratio by limiting the amount of "ink" that is not used to present data
Cognitive Presentation	Use text, labels and annotations for effective information consumption and decision making
Cognitive Presentation Usability	Avoid adding embellishments, non-essential imagery, and chart junk to not distract readers from data
Cognitive Usability	Choose the visualization technique that better supports the expected tasks
Cognitive Usability	Guide the user in the consumption of the story
Cognitive Usability	Tailor designs to the needs of their audience, taking into account individual user characteristics
Data	Provide credits of the provenance of the data and details of the design to ensure transparency and credibility
Data	Avoid omitting information
Perceptual Cognitive	Use visual imagery and embellishments to help to fix a chart in a viewer's memory
Perceptual	Use color effectively, preserving important differences in the data
Perceptual	Group similar marks and visual features to facilitate tasks
Perceptual	Incorporate tangible or situated feelings to evoke senses and create experiences
Perceptual Presentation	Avoid using 3D effects
Perceptual Presentation	Manage design parameters with care
Perceptual Presentation Usability	Use comfortable font sizes to improve legibility
Usability	Make information accessible to impaired users
Presentation	Communicate a narrative in a clear way

Visualization

Category	Best Practice
Presentation	Layout the elements of the charts and the whole story so that it is easier to understand the data
Presentation	Define the sequence of events and possible story paths
Presentation	Maintain consistency throughout the story
Presentation	Define what role the visualization plays in the story
Usability	Include interaction techniques to allow the user to explore the data
Usability	Provide feedback to show to readers that their input affects the story and to improve the performance of specific encodings
Usability	Allow the user control over the story components
Usability	Avoid lengthy tutorials and explicit description of every design manipulation

Airaldi et al. (2022) also has identified 47 evaluation criteria and organized them into two levels: 5 main criteria and 42 sub-criteria. The main criteria are as follows:

- **Comprehension:** The visualization should facilitate understanding underlying information and generate insights.
- **Engagement:** A combination of factors that keep the user engaged with the data.
- **Information:** Relates to the quality and credibility of the underlying data.
- **Memorability:** Deals with information retention and the visualization's relevant aspects. A memorable visualization "sticks" in the viewer's mind.
- **Usability:** The degree to which the visualization helps users achieve goals with minimal effort, including the functionality and comprehensibility of the graphics.

These main criteria are further branch out into specific sub-criteria such as visual clutter (diminishing communication ability with unnecessary elements), familiarity (frequency of encountering certain features), and confidence (trust in understanding the dataset). Additionally, felt involvement (users feeling drawn into and enjoying the task), ease of use (perceived usability), simplicity (displaying only relevant information), cognitive load (mental effort required), and aesthetics (visual appeal) are considered to provide a holistic assessment of the visualization's effectiveness. These examples represent just a subset of the extensive sub-criteria, ensuring a comprehensive evaluation that covers various aspects contributing to narrative visualizations' overall impact and utility.

The study also provides various evaluation methods:

- **Empirical Studies:** Participants perform tasks while researchers measure completion time, error rates, and accuracy.
- **Complexity Analysis:** Analyzes design complexity, considering visual integration and interpretability.

- **Heuristics:** Develop a comprehensive checklist for evaluation, combining usability principles with visualization-specific heuristics.
- **Affective Response Studies:** Identifies emotional responses to infographics and derives design heuristics.
- **Usability Questionnaire and Fuzzy Logic:** Evaluates participant responses across communication, information, and technology criteria.
- **Visual Intelligence Density (VID):** Measures the helpful information obtained through interaction with a visualization.
- **Visualization Literacy Assessment:** Assesses non-expert users' understanding of visualizations.

The study notes that effective visualizations simplify information extraction, but unified standards for evaluating effectiveness are lacking. While memorability, comprehension, and engagement are primary criteria, aesthetics significantly impact user engagement and information retention.

Airaldi et al. (2022) conclude that evaluation criteria are subjective and context-dependent, emphasizing the importance of aligning visualization goals with these criteria. This study provides valuable guidelines and evaluation methods for designing compelling narrative visualizations, which we will apply to our work.

The next work by Soliman (2019), explores the aesthetic and communicative values of illustrations used in infographic. Soliman (2019) posits that the utilization of Infographic graphics arises when the exclusive reliance on words fails to articulate intricate information in an accessible or captivating manner. The amalgamation of illustrations, facts, and text gives rise to infographics, serving as a visually compelling storytelling medium. Data visualization techniques may be employed to fulfill the infographic's objectives. (Soliman, 2019)

Soliman (2019) also outlines reasons for choosing illustrations over other graphic elements, emphasizing their ability to express abstract ideas, handle ambitious themes, aid storytelling, clarify complex data, and fulfill specific stylistic needs. Illustrations offer creative freedom, cost efficiency, and a unique ability to establish a distinctive brand image.

Additionally, Soliman (2019) identifies key characteristics of effective infographics, such as visual reduction, data organization, registration ability, revelatory and meaningful exploration, simplification, and data transformation into engaging visuals. Infographics enhance cognitive abilities, information retention, and versatility across disciplines, aiding quick visual scanning and social media effectiveness. They facilitate multilingual communication and ease of publishing, making them powerful tools for broad audience engagement.

Visualization

With this research we better understood guidelines to construct and understand when we need to construct infographics for our visualization.

The next work explores infographics as well. Siricharoen and Siricharoen (2015) listed the fundamentals of infographics and how they should be evaluated.

In the research they consider infographics are data visualization that presents complex information quickly and clear. Infographics are composed of 3 major parts:

1. Visual elements: Colors, graphics, signs, icons, maps, etc.
2. Content elements: Facts, statistics, texts, references, time frames, etc.
3. Knowledge: Conclusion to express the stories or messages.

Siricharoen and Siricharoen (2015) identify key questions to validate infographics, focusing on information, aesthetics, overall assessment, and chart types. Questions about the information examine its usefulness, included data, audience comprehension, and storytelling. Questions about aesthetics assess color to use, object display, and potential misrepresentations. Overall assessment questions consider legibility, author credibility, and functionality. Questions about chart types address the effectiveness and readability of visual elements.

Their work also emphasizes 5 attributes of great infographics, they are contrast, hierarchy, accuracy, relevance and truth. And lastly annotate the characteristics of an effective infographic:

- Utility: Easily comprehensible, Clear purpose, Reliable data (with cited sources), Informative—viewers gain knowledge.
- Legibility: Readability is effortless, the Color scheme doesn't impede reading, Graphs/diagrams are appropriately labeled, and Font choice, size, and color contribute to legibility.
- Design: Graphics align with purpose and audience, High-quality and non-distracting graphics, Consistency maintained, Effective use of space (no unnecessary clutter), Appropriate contrast and color usage.
- Aesthetics: Easy to follow, Overall design enhances understanding, Well-structured hierarchy/organization of data.

From Siricharoen and Siricharoen (2015) framework, we gain valuable criteria and a structured approach for evaluating the infographics we create.

Garreton et al. (2023) explore how visual artifacts, specifically data visualizations and illustrations, influence readers' attitudes in long-form journalistic storytelling. Their research investigates the persuasive, emotional, and memorable dimensions of these visual elements, comparing their effects on reader attitudes towards a specific topic, such as the Chilean water crisis. The study involved creating three versions of an article with different visual elements—

illustrations only (A), visualizations only (B), and a combination of both (AB). Participants were assessed across three phases, revealing that while visualizations can significantly impact attitudes and evoke emotions, they do not notably affect information retention compared to illustrations alone. The findings suggest that integrating visualization techniques into storytelling enhances memorability, persuasion, and emotional engagement, with illustrations supporting aesthetic appeal in this context (Garreton et al., 2023).

4. Tools for narrative visualization

We analyzed works that wanted to give a solution to the same problem to see different approaches and innovate based on the work that is already done.

Costa and Nunes (2023) developed NewsLines, a prototype that visualizes news content as a storyline, allowing users to interact with the visualization. Costa and Nunes (2023) solution involve the implementation of a visualization tool for news stories, focusing on highlighting narrative elements. The tool was developed based on existing visualization tools like D3 Narrative Layout and Comic Book Narrative Charts. Interaction possibilities include dragging events, entities, and titles, hovering for tooltips, focusing on events, and selecting entities and events. The data is structured in JSON format, and the tool allows users to explore and analyze news stories through a narrative-driven lens. A user test with journalists and a survey targeting the academic community were conducted to assess the effectiveness of the prototype. The results indicate that the tool offers more interaction opportunities than existing tools. Still, improvements in usability and accessibility are needed.

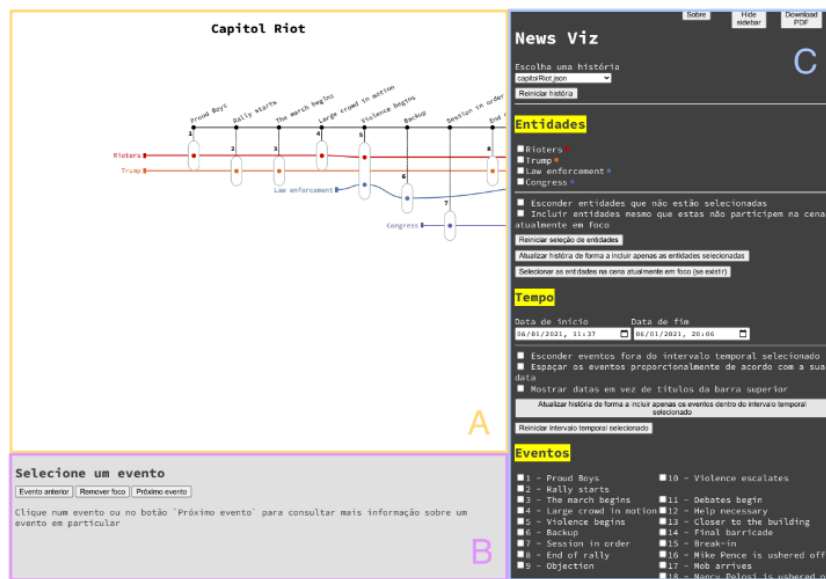


Figure 17: NewsLine interface. Element A depicts the visualization, element B the event information module and element C the sidebar (Costa & Nunes, 2023)

Before reaching the final result, Costa and Nunes (2023) identified various visualization tools and approaches for analyzing and understanding topical trends in extensive document collections, mainly focusing on news articles. Those Tools are:

- ThemeRiver Visualization (Havre et al., 2002) uses a river metaphor to depict themes as color-coded currents flowing over time.
- Contexter (Grobelnik & Mladenic, 2004) extracts entities and context graphs from news collections.
- Narratives (Ebert et al., 2008) visualizes keyword evolution using line graphs.
- TIARA (Liu et al., 2009) employs Latent Dirichlet Allocation for visual analytics.
- EventRiver (Luo et al., 2012) represents events with bubbles in a river, emphasizing temporal relevance.
- (Dunham et al., 2010) developed a method to visualize news streams by organizing articles into evolving threads, prioritizing key details, and deleting outdated or less relevant threads. Threads were color-coded and aligned vertically by topic. CloudLines (Krstajić et al., 2011) distorts timelines to highlight recent event data.
- ParallelTopics (Miksch et al., 2011) uses probabilistic modeling for topical distributions.
- TextFlow (Cui et al., 2011a) mines topics and visualizes topic evolution.
- LeadLine (Ward et al., 2012) identifies significant events in news and social media.
- HierarchicalTopics (Dou et al., 2013) explores topic relationships hierarchically.
- Metro Lines (Association for Computing Machinery. Special Interest Group on Management of Data & Association for Computing Machinery. Special Interest Group on Knowledge Discovery & Data Mining, 2013) uses zoomable maps to summarize document connections.
- Story Tracker (Krstajić et al., 2013) analyzes temporal news story evolution.
- Storylines Model (Vossen et al., 2015) encodes storylines from news streams using NLP.
- Thematic Timelines (Tannier & Vernier, 2016) create thematic timelines from keywords.
- StoryTeller (Van Meersbergen et al., 2017) visualizes multi-dimensional textual data.
- NewsLens (Laban & Hearst, 2017) clusters news stories using bag-of-words representation.

Tools for narrative visualization

Table 8 by Costa & Nunes (2023) presents the visualization techniques provided by the papers they review and that we listed below:

Table 8: Input and domain of the papers reviewed by Costa and Nunes (2023).

	Line graph	Scatterplot	Node-link	Parallel coordinates	Tree	Timeline	Pixel-based/Area	Tag cloud	River	Map	Metro map	Storyline
ThemeRiver [27]									✓			
Contexter [26]			✓									
Narratives [21]	✓					✓						
TIARA [42]			✓						✓			
EventRiver [44]							✓					
Krstajić et al. [33]							✓					
CloudLines [34]							✓					
ParallelTopics [15]		✓		✓				✓	✓			
TextFlow [13]							✓	✓	✓			
LeadLine [16]							✓	✓	✓	✓		
HierarchicalTopics [17]					✓			✓	✓			
Metro lines [51]											✓	
Story Tracker [35]				✓					✓			
Vossen et al. [60]		✓					✓					
Tannier and Vernier [57]						✓	✓					
Storyteller [59]						✓						✓
newsLens [37]						✓	✓					

The analysis of the reviewed papers leads the authors to several key conclusions. Firstly, the importance of time in comprehending the evolution of a text corpus, especially in the context of news, is highlighted. It's recognized that understanding when specific topics were more or less relevant is vital, emphasizing the crucial role of time-related information.

The river metaphor is a favored technique in data visualization, alongside timelines, pixel-based methods, and tag clouds. Each technique serves different purposes: timelines highlight temporal changes, pixel-based methods offer detailed analysis, and tag clouds summarize document collections. The choice of visualization depends on balancing simplicity with completeness, ranging from basic line graphs to complex river metaphors.

Interaction plays a vital role, as crucial as visual representation, with categories like selecting, exploring, reconfiguring, and filtering. The selection of these interactions depends on whether the visualization is author-driven or user-driven, underlining the importance of customized, interactive features to enhance effectiveness.

Addone et al. (2020) created Novellete, a platform that incorporates visual storytelling. The authors observe that existing storytelling tools are often tailored to specific target audiences, needing more versatility across different contexts and heterogeneous audiences. Novelette aims to provide a single, unified workflow for creating stories that can be used across diverse contexts. This workflow is intended to support users in all story creation, refinement, publication, and group management activities. Novelette is designed to be a fully-fledged digital environment, assisting end-users in various story creation aspects. This includes features for refining and publishing

stories and managing groups of workers. The authors plan to establish a community around the platform to encourage collaborative design and address real user needs.

When studying, the authors found tools that are characterized. The table synthesizes features of various tools in the context of education (Edu.), media, and journalism (Journ.). It classifies tools based on whether they are Tool creators (Tc) or provide Management support (Mng). Features such as storytelling support, language support, license type, and year of release are included.

Table 9: Reviewed tools by Addone et al. (2020). Edu. * = Education, Journ. * = Journalism, Tool VS Environment = Tool creator (Tc) or Management support (Mng), Storytelling support = Full, partial or basic.

Table I: Features synthesis of reviewed tools. Edu.*= Education, Journ.*= Journalism, Tool VS Environment= Tool creator (Tc) or Management support (Mng), Storytelling support= Full (●), Partial (◐) or Basic (◑).

	Year	Edu.*	Media	Journ.*	Tool VS Environment	Storytelling Support*	Language Support	Licence Type
SPOD [7]	2017	-	✓	✓	-	◑	5 EU lan.	Free & Open Source
Socrata [8]	2018	-	✓	✓	-	◑	5 EU lan.	Commercial
Opendatasoft [9]	2019	-	✓	✓	-	◑	8 EU lan,ar	Commercial
StoryWeb [10]	2020	✓	-	-	Tc	◐	en	-
Communics [11]	2020	✓	-	-	Tc	◐	en	-
iStory [12]	2020	-	✓	✓	Tc	◐	en	-
Gravity [13]	2020	-	-	✓	Tc	◐	en	-
Tableau-Stories [14]	2020	-	✓	✓	Tc	◐	6 EU lan., ja-jp, ko-kr, zh-tw	Commercial
UTellStory [15]	2020	✓	✓	✓	Mng	●	en	Free
StoryJumper [16]	2020	✓	✓	✓	Mng	●	en	Free (Paid book)
Wakelet [17]	2020	✓	✓	✓	Mng	●	en	Free
Novelette	2020	✓	✓	✓	Mng	●	en,it	Free & Open Source

The tools that checked for journalism are also useful for our research to evaluate. The ones listed are: SPOD, Socrata, Opendatasoft, iStory, Gravity, Tableau-Stories, UTellStory, StoryJumper, Wakelet and lastly Addone et al. (2020) tool, Novelette.

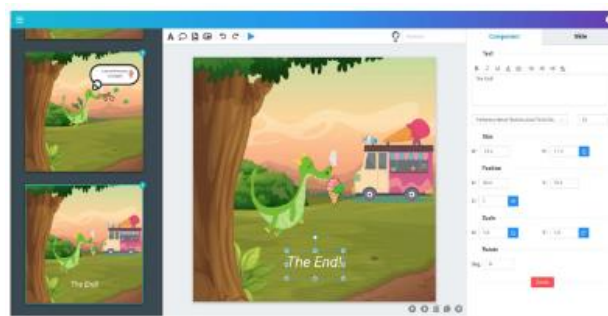


Figure 18: Novelette interface (Addone et al., 2020).

The Novelette creator interface consists of a scene overview, a visual story editor, and a panel with details related to the focused element in the scene. The interface includes features for saving stories, changing settings, accessing suggestions, and handling writer's block with a

Tools for narrative visualization

suggestion mechanism. Suggestions are generated based on analogies, synonyms, and rhymes using external services like BabelNet, WordAssociations, and RhymeBrain.

Novelette supports teachers and students. Teachers can manage groups, create accounts, and provide templates and images. Students can continue stories from these templates and upload their own pictures. The platform's intuitive design accommodates students of all levels, allowing them to create, render, and visualize stories effectively.

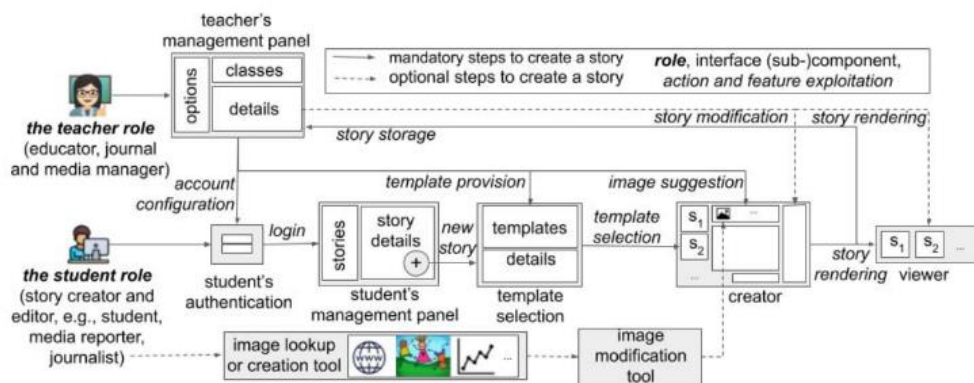


Figure 19 The Novelette general-purpose and domain-agnostic workflow (Addone et al., 2020).

Novelette was used in journalism: It presented a data story on COVID-19 using a detailed dataset released by a regional agency.

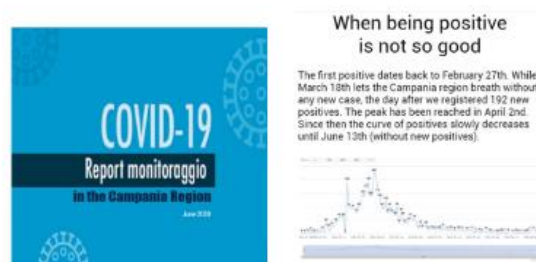


Figure 20 : Journalism use case: data story on COVID 19 using Novelette (Addone et al., 2020).

Addone et al. (2020) contributed to our work with a large collection of tools and a new review of visual storytelling that we could evaluate and take ideas from.

The next paper by Bimbo et al. (2010) proposes an application to improve users' attention when reading news articles by providing audio-visual presentations with context-based image illustrations. The system uses information processing techniques to generate multimedia stories, combining text and images. The automated story illustration involves selecting the best

illustration for each sentence and improving the story sequence. The application includes features such as text-to-speech, automated illustration methods, and user feedback for illustration selection. (Bimbo et al., 2010)

The assisted news reading application comprises different components, allowing users to select news categories, sections, headlines, and illustration methods. Data, including news articles from BBC and images from Flickr, is processed and stored in an SQLite database. The automated story illustration methods involve techniques like cosine similarity, memory-based functions, and the incorporation of WordNet to enhance the relationship between images and sentences. (Bimbo et al., 2010)

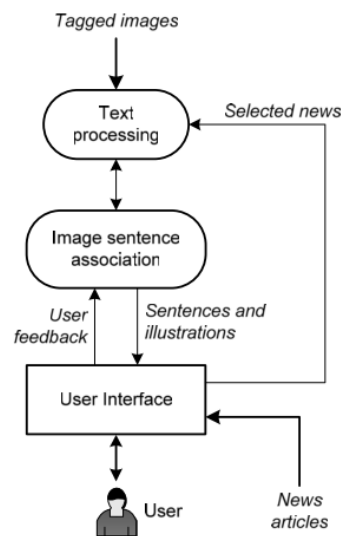


Figure 21: Application architecture (Bimbo et al., 2010).

A user study involving 18 subjects assesses the effectiveness of the application. Results indicate that users generally prefer news with illustrations, with a significant portion also expressing a preference for news with sound. Users found the illustrations valuable and enjoyable, although some illustrations needed to be more adequate based on the tone of the news (Bimbo et al., 2010).

In conclusion, the article demonstrates the potential of the proposed application to assist users in reading news by providing multimedia content with automated illustrations. The user study results suggest positive user perceptions, emphasizing the importance of contextually appropriate images in enhancing the reading experience (Bimbo et al., 2010).

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Figure 22: Examples of the full screen news reading mode (Bimbo et al., 2010).

5. Wireframes development

In this chapter, we are going to delve into the creation of 15 different wireframes of visualization tools and their organization, building upon the insights from our prior literature review and a methodology by McCandless (2021).

5.1 Insights from literature: Guiding tool structure

Understanding the existing landscape was paramount to inform our approach in this phase. We began by reviewing the tools gathered in Chapter 4 and Ryan et al. (2016) graph continuum, which provided insights into different structures and functionalities. This process facilitated a more profound comprehension of each tool and visualization style and familiarized us with various organizational patterns, thus streamlining the tool creation process.

Building on Segel's & Heer's (2010) work, we recognized that our sketches should embody a hybrid style, drawing inspiration from flowcharts, annotated charts, and partitioned posters. Drawing from Santana et al. (2023) insights, we identified four critical narrative elements: events, participants, time, and space, which served as foundational considerations for our tool development process. Furthermore, Krieken's (2018) enumerating characteristics to enhance text immersion underscored the importance of further refining this aspect in our advanced prototype iterations. Lastly, (Weber, 2020) delineation of four essential narrative characteristics—spatial and temporal dimensionality, characters and events, sequence, and tellability—served as guiding principles that we adhered to throughout our tool development journey.

5.2 Wireframe development process

A wireframe, as defined by Yudhanto et al. (2022), is a low-fidelity outline of a digital experience such as apps or websites. Its primary purpose is to establish a page's basic structure and highlight the product's intended functions (Segara, 2019). Wireframes help designers identify the essential content to include in their products by providing a visual representation of the layout and functionality, helping them also to catch potential problems early in the design process and save time and costs (Kazangirler et al., 2023).

Given the constraints of our time, we determined that creating wireframes for visualization of narrative tools was the most practical approach. To optimize efficiency and resource allocation, we opted to sketch our ideas on paper during creative sessions. Sketching is a key method for

Wireframes development

generating and discussing ideas (L. Jones et al., 2021). In human-computer interaction, sketching is crucial for imagining new technologies and conveying dynamic, interactive components of designs (L. Jones et al., 2021).

This process was guided by the design sprint methodology described by Knapp et al. (2016) in their book "Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days.". The methodology is a structured five-day process for solving critical problems and testing new ideas through rapid prototyping and user feedback. For our creative session, we focused on the activities of the second day, described in the "Tuesday" chapter of the book, which involve "Remix and Improve" and "Sketch".

During the "Remix and Improve" phase, we compiled a list of the most compelling features from existing visualization tools, focusing on shape, interactivity, chart customization and integration of multiple narrative elements. Resources such as the McCandless (2021) book with a vast gallery of visualizations, online searches in platforms such as Google and Pinterest, and our literature review helped us find visualizations to identify these features. We evaluated the usability and design of various interfaces, emphasizing elements that enhanced navigation and data interpretation. Additionally, we assessed the technical performance of these tools, particularly their response times and capacity to handle narrative elements. This thorough evaluation enabled us to blend the best existing features with our enhancements, resulting in a unique and innovative solution tailored to our needs.

Also, in our state of the art, Santana et al. (2023) identified the elements of a narrative: events, participants, time, and location. We considered this in our designs, ensuring that we always use and organize these elements, prioritizing them differently in each case. Weber (2020) also enumerates the elements of a narrative that we considered in each tool. These elements are spatial and temporal dimensions, characters and events, sequence, and tellability. However, we focused little on tellability initially because we did not work with news narratives in the first phase. These elements were the four components we knew we needed to compose our ideas with.

With refined ideas from the "Remix and Improve" phase, we moved on to the "sketching phase". The four-step sketch (Figure 23) started with twenty minutes to "boot up" by taking notes on the goals, opportunities, and inspiration. Then, for another twenty minutes, we wrote down rough ideas. Next, we explored alternative ideas with a rapid sketching exercise called Crazy 8s.

Finally, drawing our solution sketch took thirty minutes or more—a single well-formed concept with all the details worked out. This is the methodology according to McCandless (2021) in this phase; however, we knew we did not want just one solution, but more so we could filter the best options with users, so we adapted the process so we could get that result.

Here is a detailed breakdown of our process during this phase:

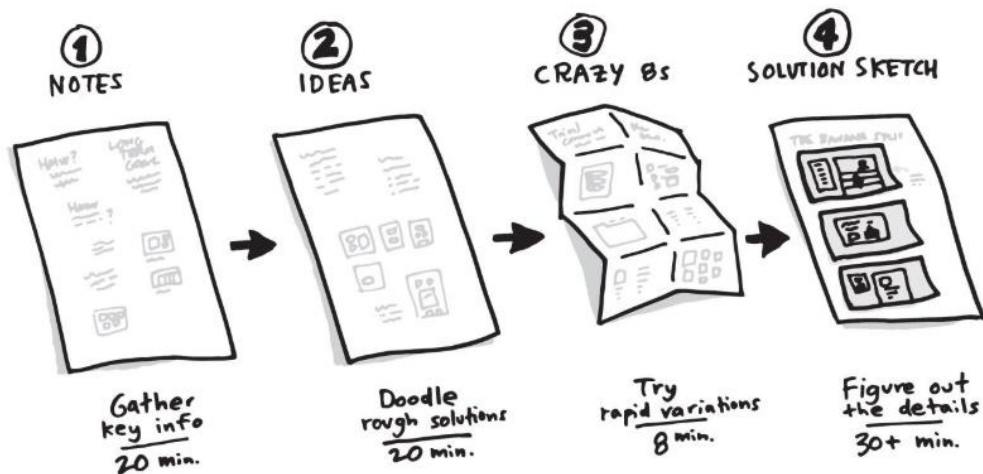


Figure 23 The four-step sketch (McCandless, 2021).

To kickstart the sketch phase, we analyze the information collected. This involved a 20-minute session of taking comprehensive notes by revisiting key resources. These notes served as a personal refresher and foundation for the next steps.

With our notes, we started generating rough ideas. This phase lasted another 20 minutes and was all about exploring possibilities. We filled the sheet with Simple visual representations of concepts and Basic drawings to represent user interactions or layouts. Afterwards, we reviewed the sheet and circled the ideas that stood out as the most promising.

Next up was Crazy 8s, a rapid-fire sketching exercise designed to push beyond initial ideas and explore various alternatives. We started with a standard letter-size sheet, folding it in half three times to create eight panels. With a timer set for 60 seconds per panel, we began sketching. For each of the eight mini-sketches, we focused on variations of our top ideas from the previous step, which generated more ideas from the ones inspiring them.

Finally, it was time to assemble everything into a detailed solution sketch. Though the process took 30 minutes to create a three-panel storyboard depicting how a user would interact with our product or service, because we didn't want just one solution, we used this phase to simulate correctly the ideas we believe could be successful, bring an interesting feature, or tell a narrative in a new way. In this phase, the sketches should stand on their own without needing additional explanation. While the sketches were not artistically elaborate, they were detailed enough to illustrate the core idea effectively. By the end, we had 15 sketches (Figure 24), each narrating the concept in its own distinctive style.

Wireframes development

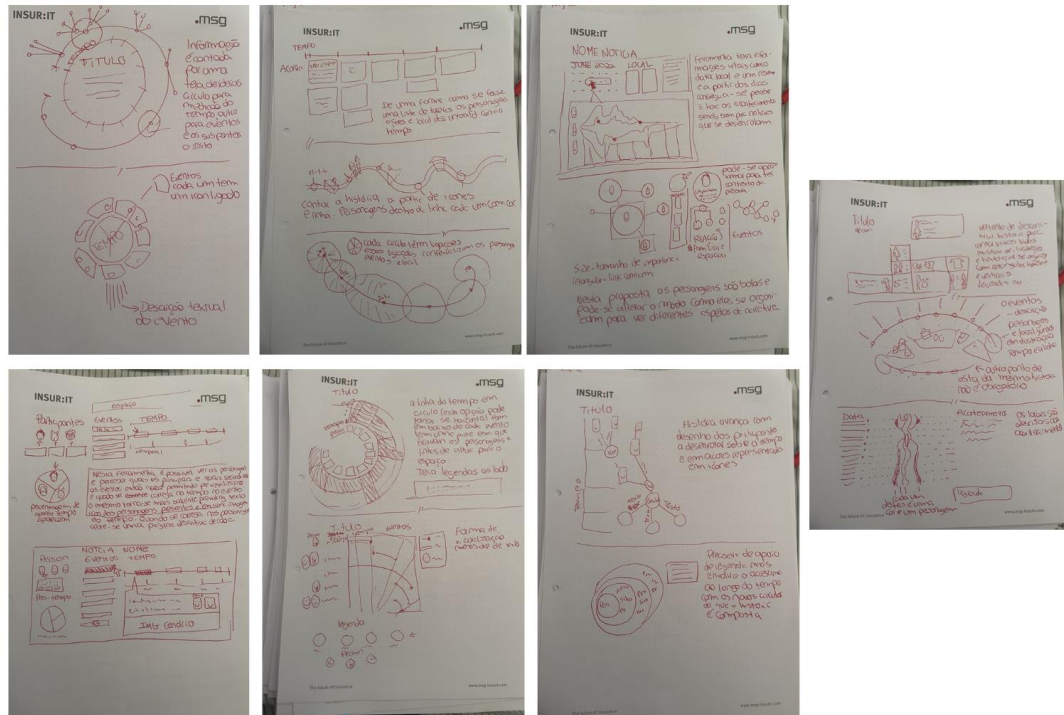


Figure 24 Final sketches of the creative session.

Before converting these sketches into digital wireframes, we wanted to anchor our design in a familiar narrative. Since the tools we are using represent a new way of telling stories, choosing a well-known tale ensures that users can navigate the tool with ease, leveraging their prior knowledge of the storyline as a guide. We decided to use the Red Riding Hood (Brothers Grimm., 1812) story in our digital wireframes to help them be clearer to users. However, we needed a concise summary to create the wireframe with the least detail possible and for that we relied on ChatGPT AI, through the OpenAI website², using the prompt in appendix 10, from which we obtained the following:

"Little Red Riding Hood, is sent to take food in a basket to her sick grandmother. On the way, in the middle of the woods, she encounters a wolf who deceives her, and when she arrives at her grandmother's house, she devours her grandmother and tries to swallow her as well. A hunter intervenes, saves them, and kills the wolf, and the Red Riding Hood and her grandmother are reunited."

² <https://chatgpt.com/>

The wireframes were built in Photoshop using this narrative, and the sketches' structure. We avoided adding embellishments, non-essential imagery, and chart junk to not distract readers from data like suggested by Airaldi et al. (2022). To also avoid bias and be inclusive we opted for the wireframes to be in gray scale (Ryan et al., 2016).

5.3 Wireframes organization

After we developed the digital wireframes of the visualization tools that we created, we organize them into six groups and order them based on that. These groups were created with similar purposes and focus that each tool had:

Group 1 Dashboard style (Wireframes 1,2,3) (Figure 25): In this group, the visualization tools contain more than one panel, with various interactive pieces of information in each block. They are largely based on a geometric construction with subsections within.

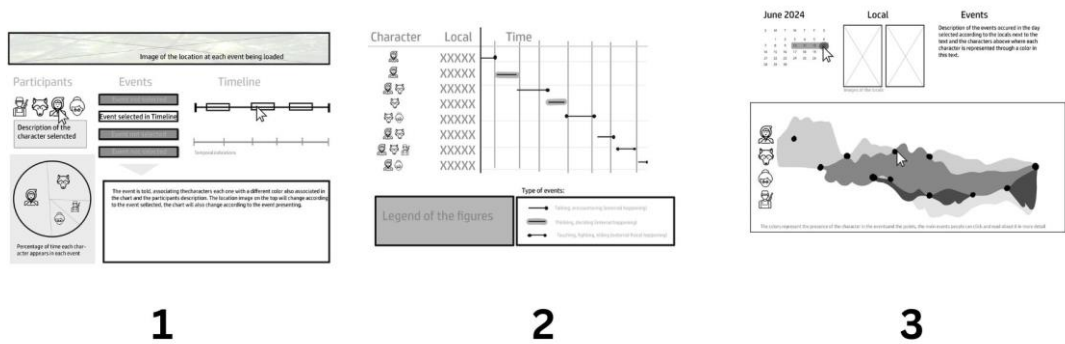


Figure 25 Group 1 Dashboard style tools.

Group 2 Event focus (Wireframes 4,5,6) (Figure 26): In these tools, events take center stage, acting as the main characters that drive the narrative. All other elements in the visualization derive from these pivotal events.

Wireframes development

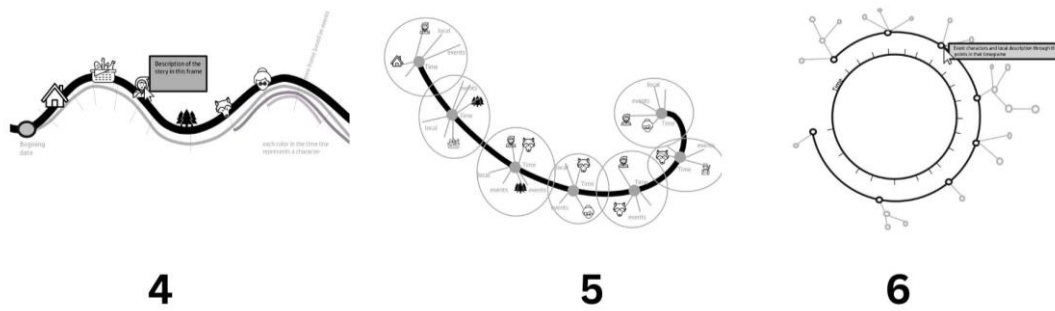


Figure 26 Group 2 Event focus tools.

Group 3 Participants link (Wireframes 7,8) (Figure 27): The narrative in these tools is constructed through the intricate web of connections established between participants, locations, or objects over time. This unique approach to narrative visualization offers a dynamic and interactive experience.

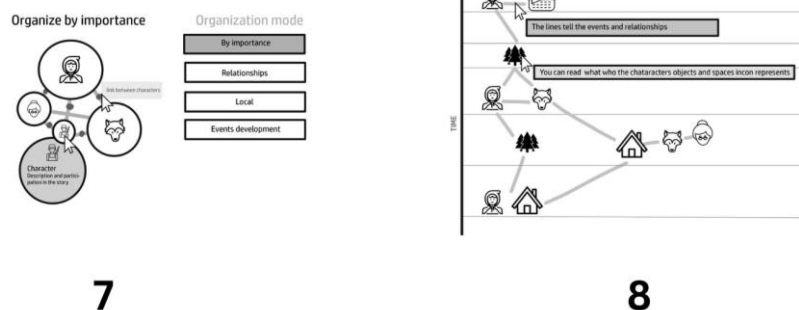


Figure 27 Group 3 Participants link tools.

Group 4 Mixed focuses (Wireframes 9,10,11) (Figure 28): The interactive elements focus on more than one element.

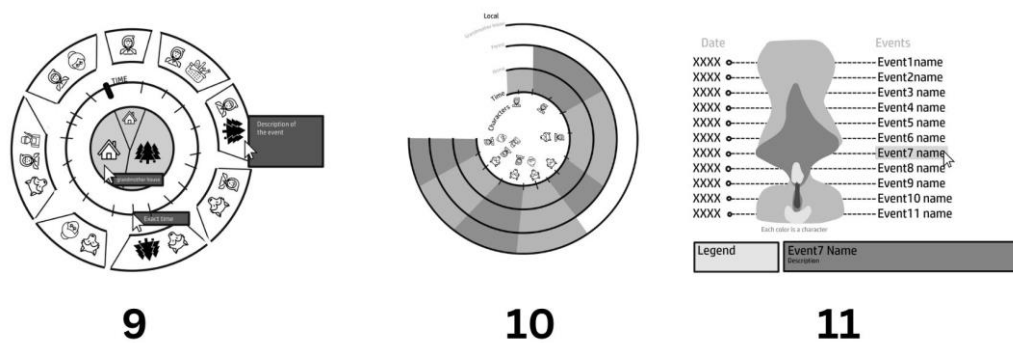


Figure 28 Group 4 Mixed focuses tools

Group 5 Perspective (Wireframes 12,13) (Figure 29): These two tools allow users to view more than one perspective on a story.

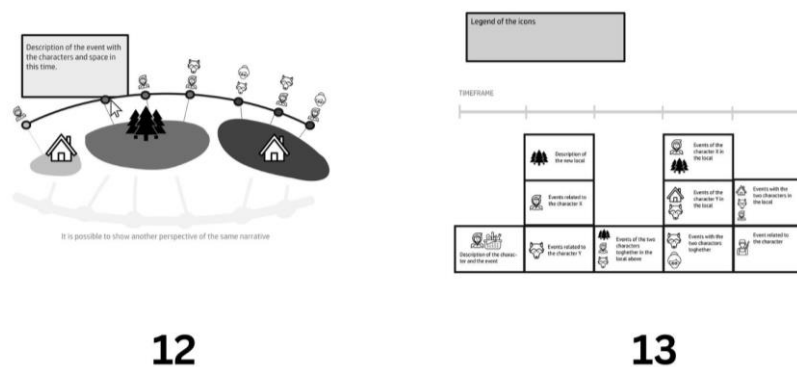


Figure 29 Group 5 Perspective tools

Group 6 Construct mechanic (Wireframes 14,15) (Figure 30): The logic here is the construction of a narrative, so it works with the concept of feeling like you are adding or even removing elements, managing to convey the same narrative in a very simple or complex way depending on the intention.

Wireframes development

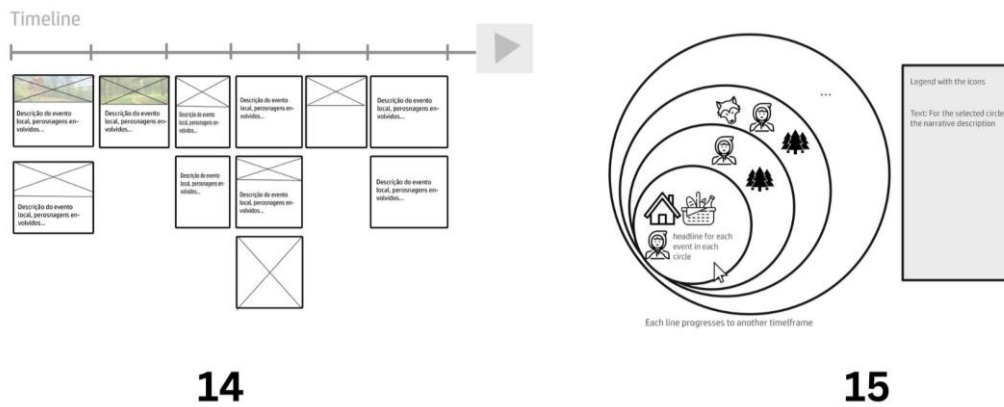
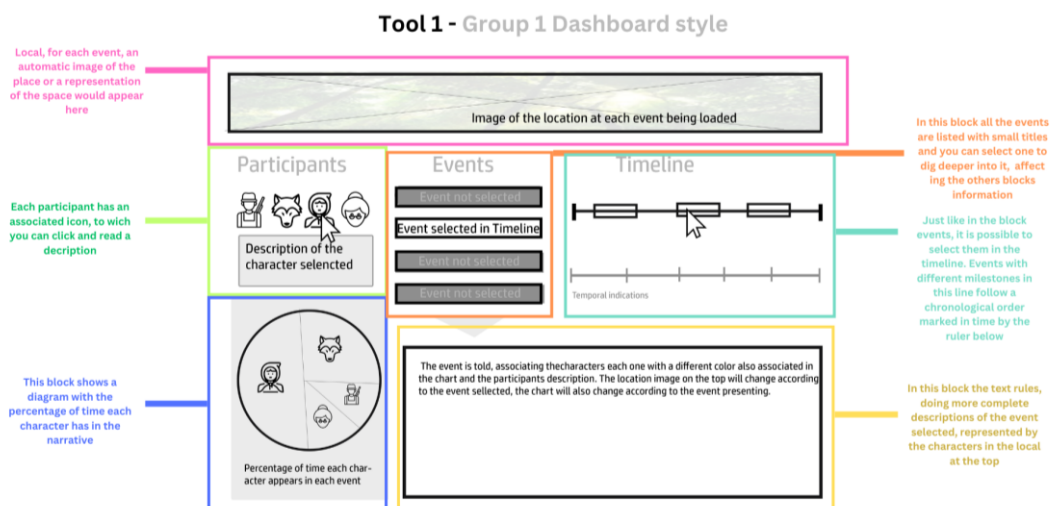


Figure 30 Group 6 Construct mechanic tools.

5.4 Wireframes explanations

This chapter explains individually each of the 15 visualization tools designed to represent narratives from news in the creative session in 5.2. Each tool belongs to one of five conceptual groups discussed in 5.3—Dashboard Style, Event Focus, Participants Link, Mixed Focuses, and Perspective—each focusing on different storytelling and elements. The inspiration for these tools is drawn primarily from "The Graphic Continuum" (Ryan et al., 2016) and various works and methodologies related to data visualization.



The visualization is composed by 6 Blocks: Local, participants, time of appearance of each participant, events, timeline and text description. Following a Dashboard Style with lots of interactive blocks with different information contributing to tell one narrative.

Figure 31 Wireframe of the tool 1.

Tool 1: The first tool (Figure 31) is from the first group, Dashboard style, because it has different panels, with different information each all combined in the same visualization tool.

During our creative session, we drew significant inspiration from the timeline style in the "Time" group of "The Graphic Continuum" (Ryan et al., 2016) and its application in Costa & Nunes (2023) works developing this tool. Costa & Nunes (2023) visualization offered a lucid structure for depicting chronological data, which we found particularly influential. Additionally, for the visualization of time percentages within the "Part-to-Whole" group of "The Graphic Continuum" we employed the pie chart style (Ryan et al., 2016) to represent these proportions effectively.

The experience is non-linear, random access in Segel & Heer (2010) study, because each user can start in a different place to explore the narrative. It has 6 different information blocks, that can be detected in the Figure 31 and analyses in the legend on the Figure 46 and Appendix 3. The user can check the events on the tab events or in the timeline, where time indicators are given for each event. Before pressing anything, the tool starts with a resume in the description part, and the percentage of time each participant is in the story overall. When an event is selected the textual description appears bellow and the participant percentage changes to the percentage inside the event selected, and on the top a generated image shows the local of the action. These three elements are the ones that change according to a new event. The characters can be consulted next to the events, and the timeline is fixed and not interactive.

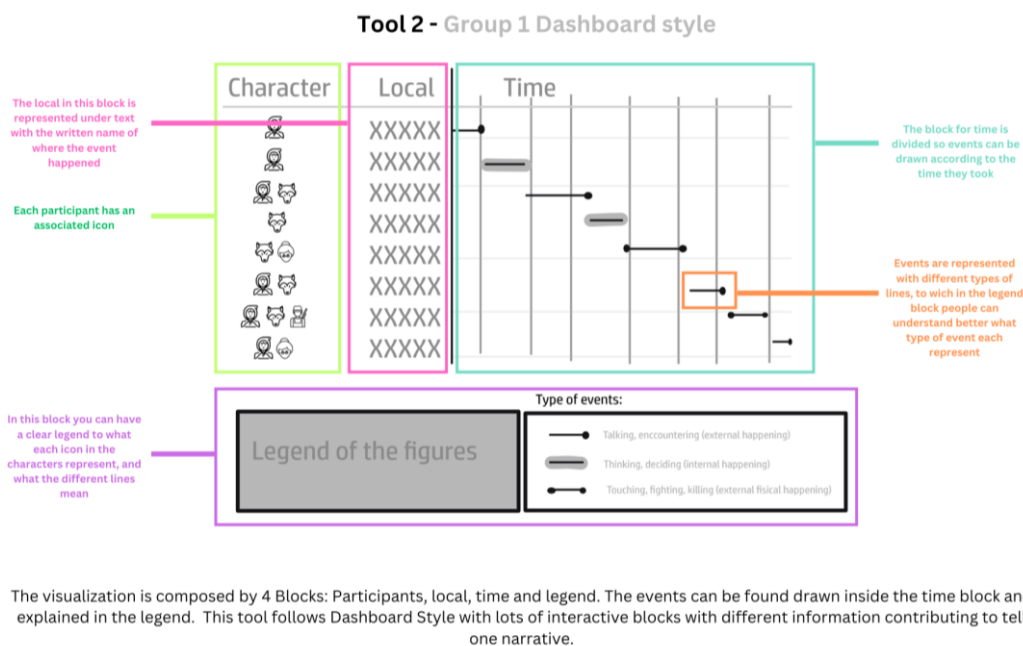


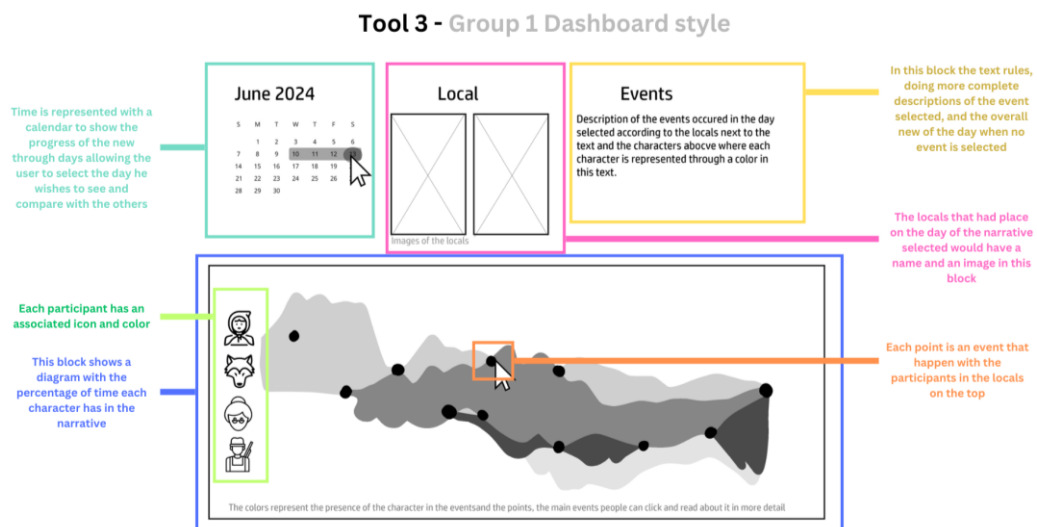
Figure 32 Wireframe of the tool 2.

Tool 2: The second tool (Figure 32) is from the first group, Dashboard style, because it has different panels, with different information each all combined in the same visualization tool.

Wireframes development

The Gantt chart style of "The Graphic Continuum" (Ryan et al., 2016) inspired visually this tool. This wireframe adopted the aesthetic and functional aspects of Gantt charts to represent time-based events.

The experience is non-linear, random access in Segel & Heer (2010) study, because each user can start in a different place to explore the narrative. There are 4 blocks in this tool, organized in a table, the first row lets people check the characters in each event, the second the local, and the third the events and where they stay in the timeline. On the second column you can check a space for a legend of the items, and also an explanation for different types of events that would be represented differently in the time line, and classify based on different aspects.



The visualization is composed by 4 Blocks: Time, local, text description, and appearance of each participant with the events. Following a Dashboard Style with lots of interactive blocks with different information contributing to tell one narrative, better suited for long narratives that happen over time to compare data and study the evolution of the happening.

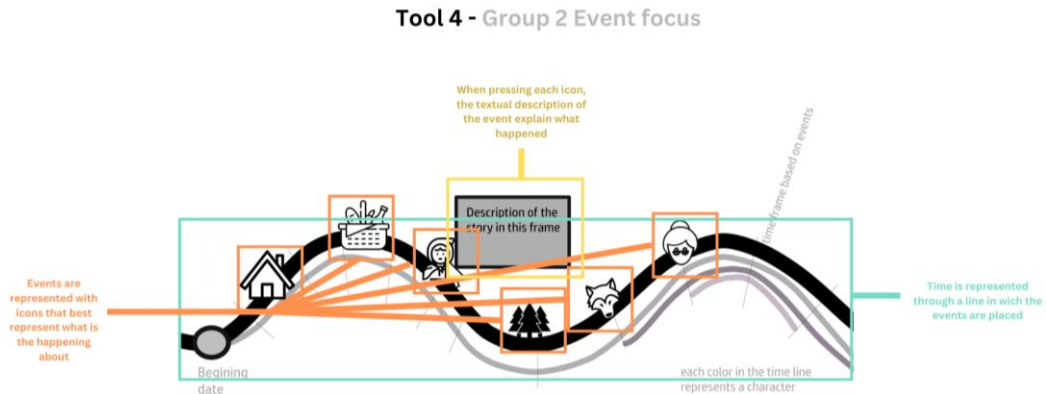
Figure 33 Wireframe of the tool 3.

Tool 3: The third tool (Figure 33) is from the first group, Dashboard style, because it has different panels with different information, each combined in the same visualization tool.

Within the "Time" category, we also explored stream visualizations on "The Graphic Continuum" (Ryan et al., 2016). Tools like ThemeRiver (Havre et al., 2002) and TextFlow (Cui et al., 2011) guided how to represent stream visualizations in a tool. These insights inspired the creation of wireframe 3.

The experience is non-linear, random access in Segel & Heer (2010) study, because each user can start in a different place to explore the narrative. The elements are organized in 4 blocks. This tool was made to be fitted to news that occurs over a long period of time, so in that way, the time is represented by a calendar. It is possible to select the day the user wishes to see and to analyses the events that happened each day, followed by generated images of the locals where it happened, the events of that day and a textual description in the first column. The second column has a

graphic that shows all the characters involved in that day, the percentage of time and when they were active in the narrative, and in which events they were present. The events are represented with dots that can be clicked so that the text can appear on the top explaining that event.



The visualization is composed by a line representing time where the events, represented by icons occur. This Visualization focus a lot on the events since is the only button you can press to read more about it, interacting with the timeline to see more events forward.

Figure 34 Wireframe of the tool 4.

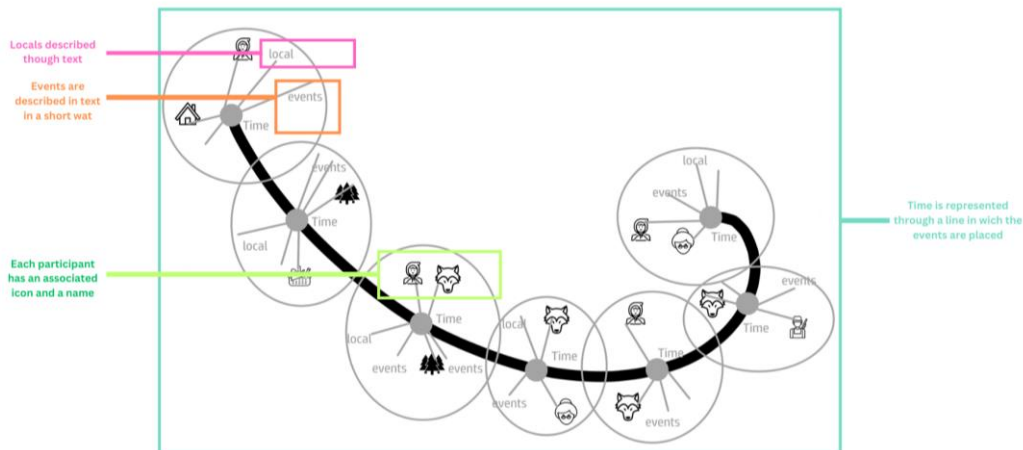
Tool 4: The fourth tool (Figure 34) is from the second group, Event focus, because the only interactive element in the story is the event, focusing the attention on that element.

Just like in tool 1, during our creative session, we drew significant inspiration from the timeline style in the "Time" group of "The Graphic Continuum" (Ryan et al., 2016) and its application in Costa & Nunes (2023) works developing this tool.

The experience is linear (Segel & Heer, 2010) because users follow a path. The narratives disenroll in a line where a resentful icon of each event represents each event, and when pressed, the text appears explaining what happened. There was also the idea that besides the main line, each character could have an associated color and be represented in thinner lines so people could understand the presence of each character in the story and each event.

Wireframes development

Tool 5 - Group 2 Event focus



The visualization is composed by a line representing time where the events, represented by circles. Each circle has branches to elements that compose the event in terms of participants, local and actions and the description of the event itself. This Visualization focus a lot on the events since they mark the timeline and is the only button you can press to read more about it, interacting with the timeline to see more events forward.

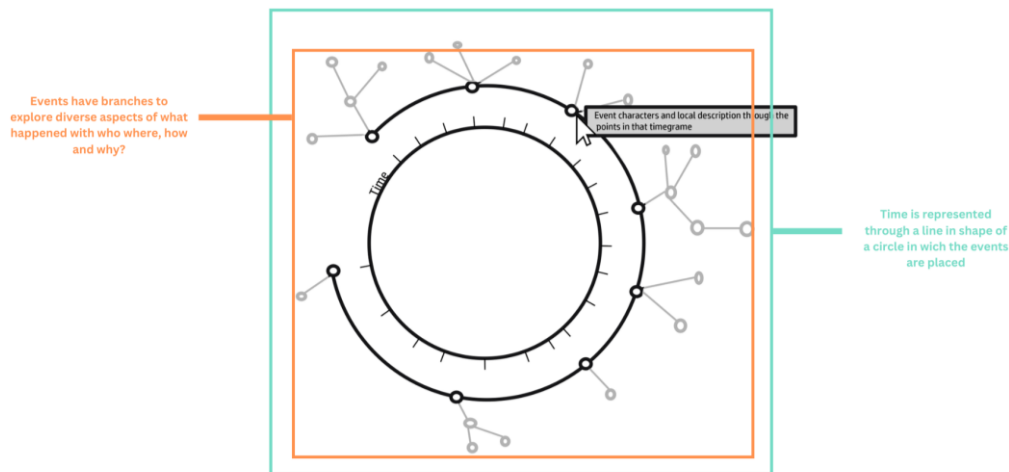
Figure 35 Wireframe of the tool 5.

Tool 5: The fifth tool (Figure 35) is from the second group, Event Focus, because the only interactive element in the story is the event, focusing attention on that element.

During our creative session, we drew significant inspiration from the timeline style in the "Time" group of "The Graphic Continuum" (Ryan et al., 2016) and drew this tool like a variant from tool 4, that would allow a different approach on the information, maintaining a similar style.

The experience is linear (Segel & Heer, 2010) because users follow a path. The narratives unfold in a line where dots in the timeline represent events. Each dot is connected with information about that event, including texts and icons. Everything is connected in a web that separates events.

Tool 6 - Group 2 Event focus



The visualization is composed by 2 elements the timeline and the events that are explored with all the branches in form of text. This Visualization focus a lot on the events since they mark the timeline and is the only button you can interact.

Figure 36 Wireframe of the tool 6.

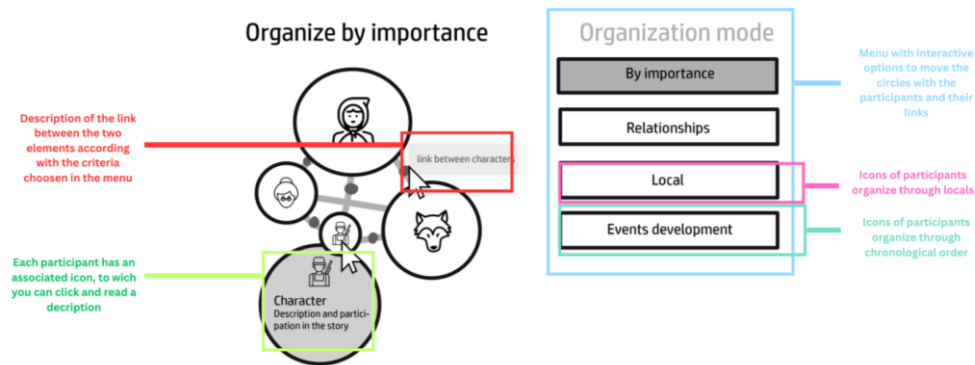
Tool 6: The sixth tool (Figure 36) is also from the second group, Event Focus, because the only interactive element in the story is the event, focusing on that element.

For Wireframe 6, we were inspired by the Sunburst visual style inside the Part-to-whole group on "The Graphic Continuum"(Ryan et al., 2016).

A mixed path, user-directed in Segel & Heer (2010) work because the user starts with a path but then it became free to explore as he wants. The narratives unfold in a line where dots in the timeline represent events, similar to the fifth tool. The difference between the sixth and the fifth tool is that the sixth works only with text, and the connections of the events also have connections themselves, forming a more extensive web and being more descriptive. Users can filter the level of detail in the information by sticking to the first levels of information or exploring further by reading the additional strings.

Wireframes development

Tool 7 - Group 3 Participants link



The visualization is composed by two blocks: the interactive circles countaining the characters and their links with each other, and a menu where you can choose the mode that will organise and rewrite the elements and link descriptions. The focus in this visualization is the links because is through there that the narrative will be described.

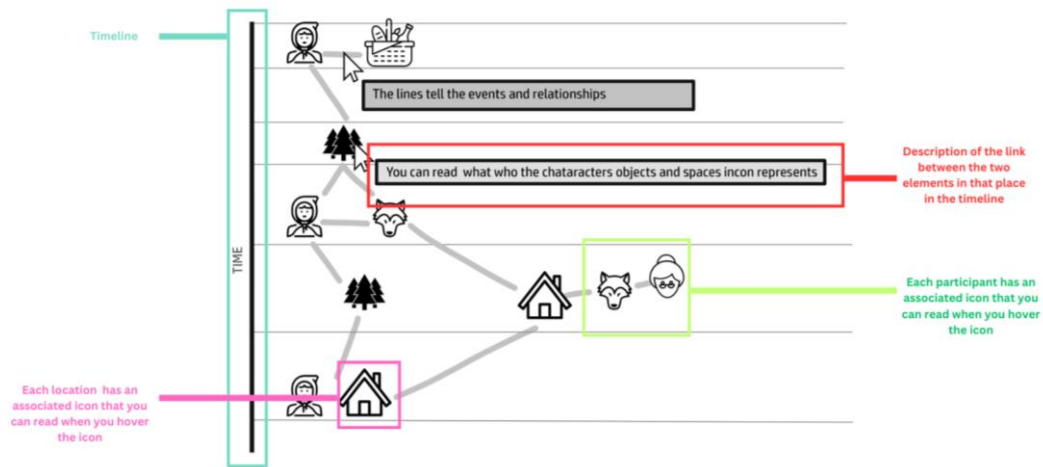
Figure 37 Wireframe of the tool 7.

Tool 7: The seventh tool (Figure 37) is from the third group, Participants Link, because the story develops through characters' connections with other characters, objects, or locations.

Wireframe 7 was developed referencing Network visualization principles from group relationship on "The Graphic Continuum" (Ryan et al., 2016), effectively showing connections within elements. This style highlights the intricate web of relationships between data points, providing a clear view of how individual elements are interconnected.

The experience is non-linear, random access in Segel & Heer (2010) study, as each user can start in a different place to explore the narrative. In this tool, the right menu provides new ways to organize the circle containing the participants. The suggested criteria for organization are "importance, relationships, local, and events development." The size and position of each circle depend on the selected criteria. Besides the circles changing size and position, the information also varies with each criterion, so users must explore the tool thoroughly to gain a complete view of the narrative.

Tool 8 - Group 3 Participants link



The visualization is composed by a table that puts the icons representing participants, objects and locals according to the timeline of the happening. The focus in this visualization is the links because is through there that the narrative will be described.

Figure 38 Wireframe of the tool 8.

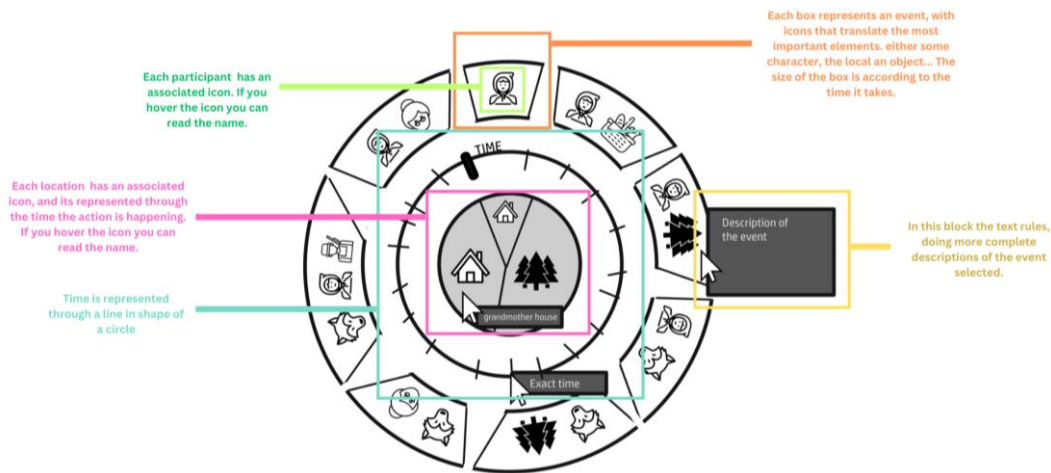
Tool 8: The eighth tool (Figure 38) is from the third group, Participants Link, because the story develops through characters' connections with other characters, objects, or locations.

We utilized the parallel coordinates style from the group relationship in "The Graphic Continuum" (Ryan et al., 2016) for Wireframe 8. This visualization technique maps multiple variables across parallel axes, allowing for the visualization of complex interrelationships and correlations within multi-dimensional datasets.

The experience is linear (Segel & Heer, 2010) because users follow a path. The timeline moves up and down, with characters, objects, and locations represented through icons connected by lines where the text explains the happenings.

Wireframes development

Tool 9 - Group 4 Mixed focuses



The visualization is composed by 3 circles: Local, timeline and events. They are all connected through the shape of the circle where everything fits according to the narrative. This visualization has a mix focus on the events, local and the characters adding interactivity in all without making any of them seem more important to the eye.

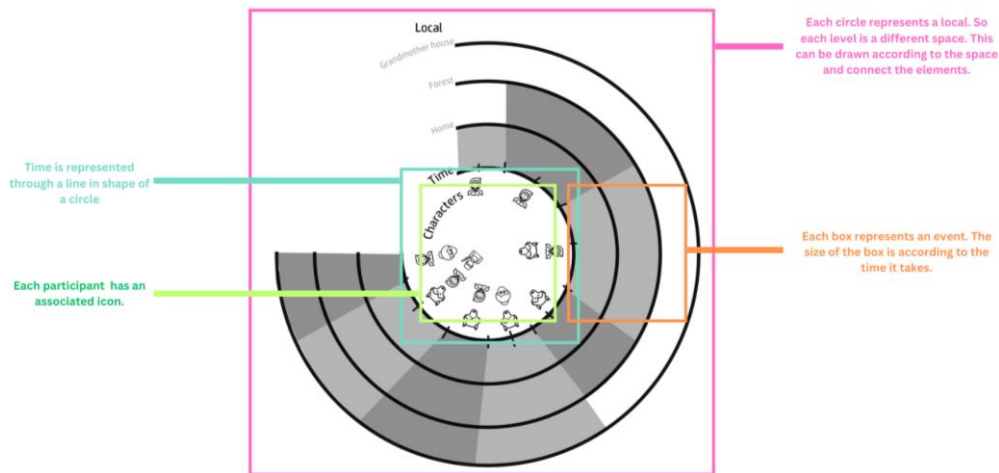
Figure 39 Wireframe of the tool 9.

Tool 9: The ninth tool (Figure 39) is from the fourth group, Mixed Focuses, a group that selected more than one focus or an aspect that would not usually be chosen as the focus. This group was more experimental, aiming to test and experiment with new functionalities rather than creating a balanced tool.

For Wireframe 9, we used the Donut style, an adaptation of pie charts in the "Part-to-Whole" group on "The Graphic Continuum"(Ryan et al., 2016).

The experience of this tool is linear (Segel & Heer, 2010) because users follow a path. The ninth tool balances events, time, and location equally, displaying them together to facilitate viewing all elements simultaneously. All items are interactive, allowing users to advance the story by selecting any.

Tool 10 - Group 4 Mixed focuses



The visualization is composed by 3 elements, participants, local and events. Both compose a visualization together being the three the focus with this mixed focused visualization.

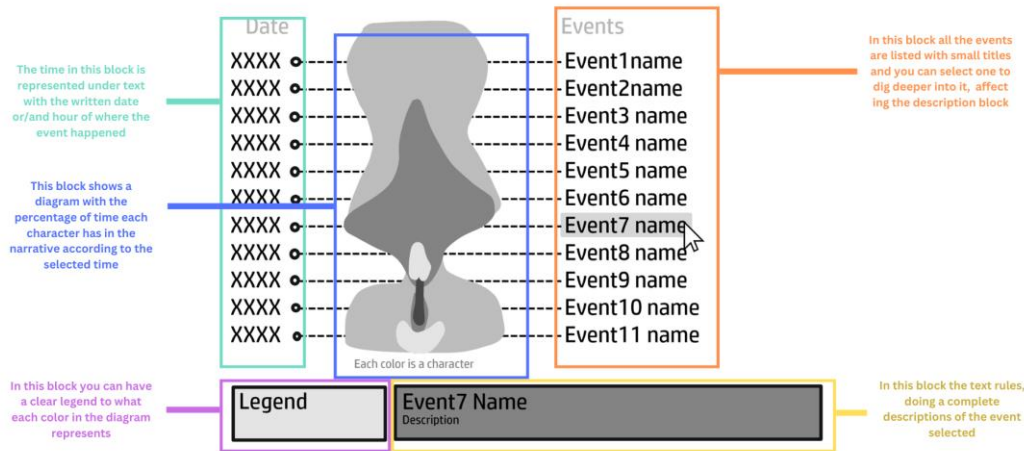
Figure 40 Wireframe of the tool 10.

Tool 10: The tenth tool (Figure 40) is from the fourth group, Mixed Focuses, a group that selected more than one focus or an aspect that would not usually be chosen as the focus. This group was more experimental, aiming to test and experiment with new functionalities.

Wireframe 10 was developed using the Nightingale chart on the "Part-to-Whole" group on "The Graphic Continuum" (Ryan et al., 2016). We also took inspiration from the depiction of this style in "Beautiful Visualizations: Yeyy Africa" (McCandless, 2021). The experience of this tool is linear (Segel & Heer, 2010) because users follow a path. This tool focuses heavily on locations and events. Events are the interactive part where the narrative can be read, but the events are elevated to the level of where they happened, giving locations significant visual importance. Ideally, the location levels could have illustrations covering the whole circle, visually guiding the user to where the events happened.

Wireframes development

Tool 11 - Group 4 Mixed focuses



The visualization is composed by 5 Blocks: Time, time of appearance of each participant, and a legend that explains who are the characters, events, timeline and text description. The focus is mixed, since we concentrated on the events and the characters.

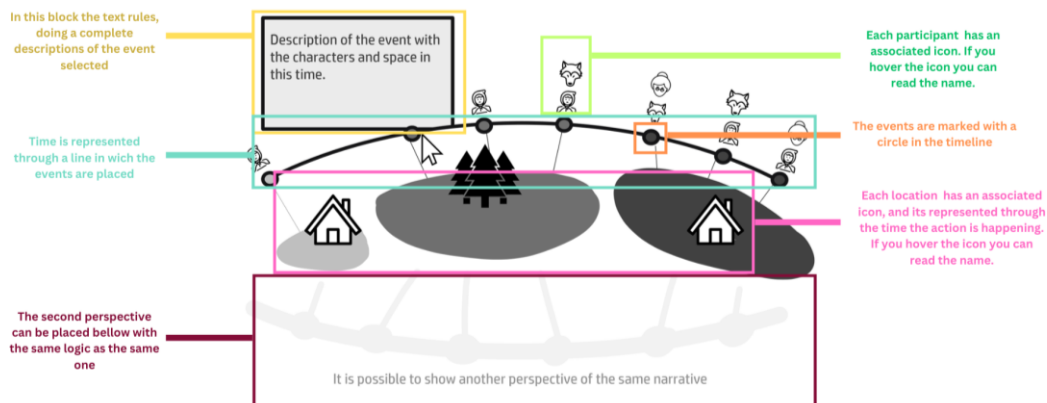
Figure 41 Wireframe of the tool 11.

Tool 11: The eleventh tool (Figure 41) is from the fourth group, Mixed Focuses, a group that selected more than one focus or an aspect that would not usually be chosen as the focus. This group was more experimental, aiming to test and experiment with new functionalities.

Within the "Time" category, we also explored stream visualizations on "The Graphic Continuum" (Ryan et al., 2016). Tools like ThemeRiver (Havre et al., 2002) and TextFlow (Cui et al., 2011) guided how to represent stream visualizations in a tool. These insights inspired the creation of wireframe 3.

The experience of this tool is linear (Segel & Heer, 2010) because users follow a path. In this tool, the visual focus is on the characters and the time they spend in the story. A color represents each character, explained in the legend, with their appearance based on the time they are present in the story and the duration of their presence in each event. On the sides, it is possible to see when each event occurs and the event's name, which, when selected, generates a descriptive text explaining what happened.

Tool 12 - Group 5 Perspective



The visualization is composed by a line where the events are marked and associated to characters represented by icons and a location. It is possible to represent other side of the story since the focus of this visualization is the multiple perspectives.

Figure 42 Wireframe of the tool 12.

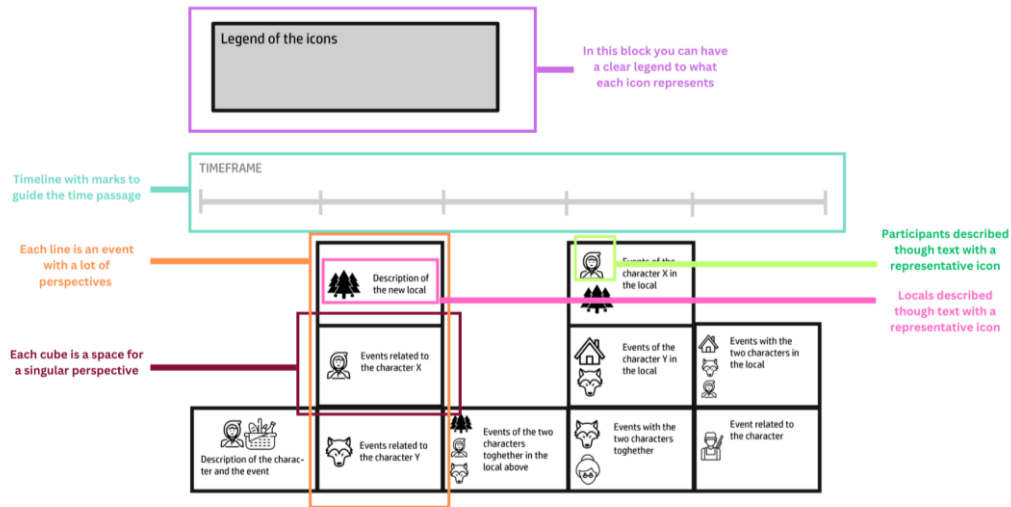
Tool 12: The twelfth tool (Figure 42) is from the fifth group, Perspective, because it tells the narrative from more than one participant's Perspective.

During our creative session, we drew significant inspiration from the timeline style in the "Time" group of "The Graphic Continuum" (Ryan et al., 2016).

The experience is non-linear, random access in Segel & Heer (2010) study, as each user can start in a different place to explore the narrative. Users can start with any perspective and either read one Perspective at a time or alternate between them. This tool is designed for two perspectives to compare the same events from different characters' viewpoints. Events are represented on the timeline with a dot, and by pressing it, people can read what happened, with a line connecting to the location where they occurred.

Wireframes development

Tool 13 - Group 5 Perspective



The visualization is composed by 2 Blocks: one for the legend and clarification of the icons and one where the narrative is born, with a timeline to help mark moments, and lines that represent events with different perspectives each one in one rectangle. This visualization leaves space for a lot of perspectives, since it was the focus of its creation to be able to do that.

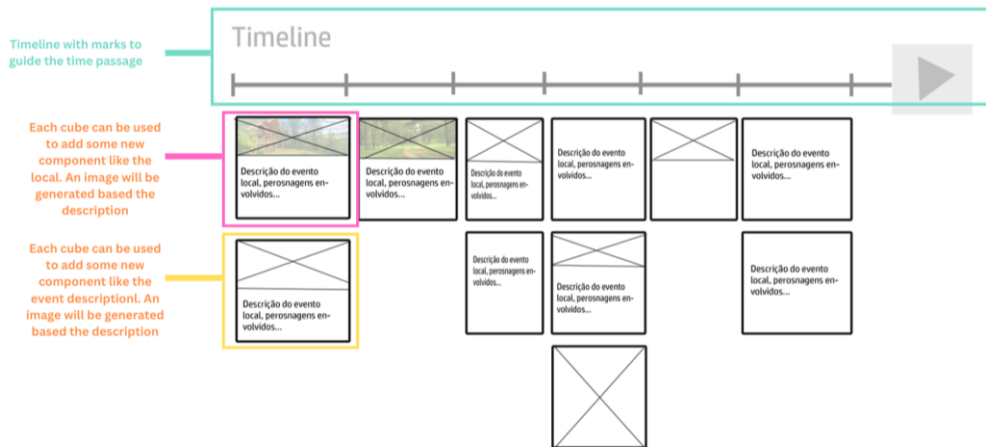
Figure 43 Wireframe of the tool 13.

Tool 13: The thirteenth tool (Figure 43) is also from the fifth group, Perspective, because it tells the narrative from more than one participant's Perspective.

Wireframes 13 was inspired by column charts, a style that arranges data in vertical columns, from "comparing categories" groups and timeframes, from "time" group on "The Graphic Continuum." (Ryan et al., 2016)—mixing both visualization aesthetics.

The experience is non-linear, random access in Segel & Heer (2010) study, as each user can start in a different place to explore the narrative. Users can start with any perspective and either read one Perspective at a time or alternate between them. This tool is designed for more than two perspectives. Different perspectives are separated into blocks, with locations and objects having their blocks to describe them. Additionally, it can create blocks with multiple characters for dialogues, combining them in the same block.

Tool 14 - Group 6 Construct mechanic



The visualization is composed by a timeline that guide the happenings, and blocks that can be add and can represent everything for the new that happen in that moment. It can be a description of the local, the characters, their link, the event/action that happen. The idea is that you can take and add and its about constructing the narrative with the level of detail that the user wishes. The blocks can have generated images, or choosen images or just have the text.

Figure 44 Wireframe of the tool 14.

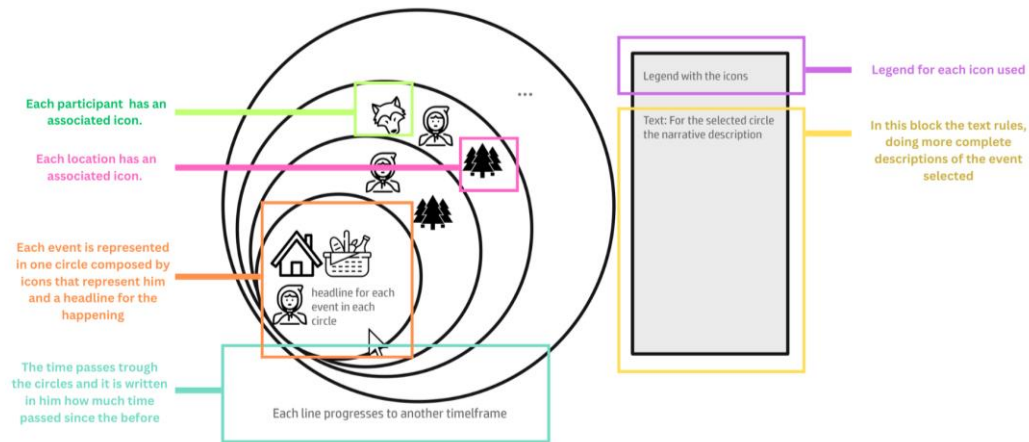
Tool 14: The fourteenth tool (Figure 44) is from the sixth group, Construct Mechanic, because different levels of information can be added or removed.

Wireframes 13 was inspired by column charts, a style that arranges data in vertical columns, from "comparing categories" groups and timeframes, from "time" group on "The Graphic Continuum." (Ryan et al., 2016)—mixing both visualization aesthetics.

The experience is non-linear, random access in Segel & Heer (2010) study, as each user can start in a different place to explore the narrative. This tool features a timeline with different times marked, and below it, various squares can be added with text, images, audio, video, social media posts, and illustrations. This tool can provide a very detailed or straightforward approach, depending on how the creator constructs the narrative and the desired level of detail.

Wireframes development

Tool 15 - Group 6 Construct mechanic



The visualization is composed by 2 Blocks: The interactive one with circles inside circles that tell the narrative through chronological order, and a part that is made for better understanding the interactive one with a legend to the icons and a detailed description of each event. This visualization focuses on the construction of the narrative with the circles and iconos, the user can decide how much circles want and iconos, so the level of detail its in his hands.

Figure 45 Wireframe of the tool 15.

Tool 15: The fifteenth tool (Figure 45) is from the sixth group, Construct Mechanic, because different levels of information can be added or removed.

We used the Nested Bubbles style from the "comparing categories" group on "The Graphic Continuum" (Ryan et al., 2016), which uses nested circular elements, for Wireframe 15.

The experience is non-linear, random access in Segel & Heer (2010) study, as each user can start in a different place to explore the narrative. A circle can be created for each event, containing text to explain it and icons to illustrate it. As events progress, the circle will adjust to make the selected circle more extensive and easier to read. Circles can be added or removed depending on the desired level of detail in the narrative.

6. Wireframes evaluation

After creating 15 approaches for a visualization tool to tell news narratives, it was time to test them. This step was crucial for identifying the best features, representations, and tools to refine the work by focusing on the most compelling aspects. We decided to test them with a focus group. The objective of the focus group was to explore and discuss participants' preferences, opinions, and experiences with these news visualization tools. The goal was to gain valuable insights into users' preferences for different visualization tools, understand which elements are most important for comprehending and navigating news, and identify potential areas for improvement or future development.

6.1 Focus group methodology

To achieve our objective, we gathered diverse participants connected to visualization through different fields to gain various perspectives. We conducted semi-structured discussions (Appendix 2) on various aspects of news visualization tools. The group consisted of 6 young adults aged between 24 and 28, with priority given to their professional areas, including journalism, education, psychology, user experience design, data analysis, and international relations.

Before the focus group, we also requested our participants to do some pre-work. We prepared a booklet (Appendix 3) that explained the topic and introduced the visualization tools in a way they could understand, but always leaving space for creativity so they could bring their insights. Besides asking them to read the booklet, we also requested that they write what they liked and disliked most about each of the 15 tools. This way, when the focus group occurred, everyone was already familiar with the tools and had an idea of what they liked and disliked. In this booklet we explained each of the visualizations with a legend explaining what each color represents and how we were expecting it to work like you can see in Figure 45 and 46.

A confidentiality agreement (Appendix 1) was also in place to maintain the participants' privacy, because of this the participants were identified as “participant 1, participant2 ... participant6”.

To facilitate the discussion, each tool was printed on A4 sheets, numbered for reference, and we provided writing materials so that participants could write and draw new ideas on them. The discussions were recorded, transcribed, and analyzed to identify patterns and insights in collecting qualitative data.

Wireframes evaluation

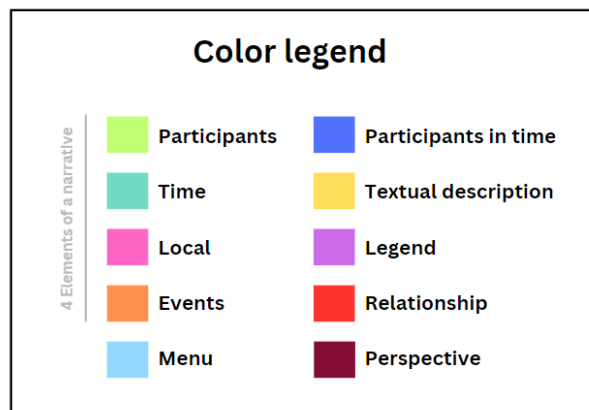
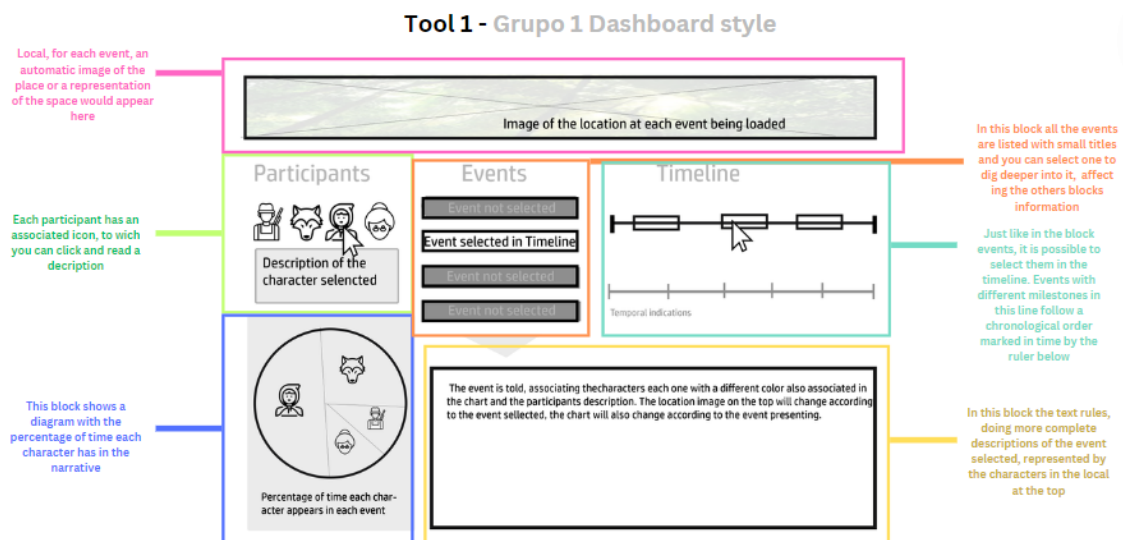


Figure 45 Color legend of the wireframes.



The visualization is composed by 6 Blocks: Local, participants, time of appearance of each participant, events, timeline and text description. Following a Dashboard Style with lots of interactive blocks with different information contributing to tell one narrative.

Figure 46 Legend of wireframe of the tool 1.

6.2 Focus group result analysis

The focus group took place on March 29, 2024, at 5:00 p.m. and lasted for 1 hour and 40 minutes. Due to the diverse perspectives present, it generated extensive debate on all questions, with no moment of unanimous agreement. This emphasized the value of qualitative data. Therefore, the following insights were derived from this group, considering the questions we brought:

Question 1: Was it possible to understand all the tools and how the story of Little Red Riding Hood was represented in them?

Due to its narrative complexity, not all tools were considered suitable for representing the story of Little Red Riding Hood. Some tools were discarded because they needed to provide more detailed information, while others were deemed more appropriate for more straightforward narratives. The participant's main conclusions to this question were:

- There were better ways to explain the story than tool (3), considering this tool not appropriated for this specific story.
- Tool 6: This tool was poorly received due to the lack of images, which made it difficult to grasp the narrative, especially for those who needed a visual representation to follow the story.
- Tool 11: Difficulty was encountered in understanding the graph presented in this tool, leading to its exclusion as a viable option for representing the story of Little Red Riding Hood.
- Tool 7: Deemed inadequate for representing the story of Little Red Riding Hood due to the lack of details and complexity in the narrative. This tool did not provide sufficient information to understand the story entirely, lacked a timeline and concluded that it could lead to incorrect reading and interpretation.

Question 2: Which tools do you prefer and why? Taking into account your personal opinion.

Preferences varied among participants, but some tools, such as Tool 12, were widely regarded as favorites due to their ability to represent narratives in a more visual and interactive manner. Other preferred tools included Tool 1, 3, 4, 14, and 15. Tool 12 was the top choice overall, being selected by all participants except one who ranked it as their third choice.

Question 3: Which tools did you like least on a personal level? And why?

Some tools, such as Tool 6 and Tool 11, were less appreciated due to a lack of clarity in representing the narratives. The absence of graphics and an excessive emphasis on text were cited as reasons for preferring other tools.

Question 4: Which of the shown groups did you find the most important? Within that group, which tool was considered the best and why?

There is no absolute consensus on the ideal order, as it depends on the news context, target audience, and individual participants' preferences. However, there was a consensus that the "Event Focus" group should be prioritized as the first to be presented, as it offers a linear overview of events, allowing users to understand the story as a whole. Following this, opinions diverged between the "Dashboard Style" group and the "Perspective" group, with some participants preferring the simplified data analysis of the former and others valuing the different perspectives

Wireframes evaluation

offered by the latter. The "Construct Mechanics" group was generally considered less critical due to its complexity and potential for confusing.

Question 5: Ordering by importance the elements of a narrative: events, characters, space, time.

Most participants agreed that events are the most crucial element in a narrative, followed by characters. Space and time were considered less important compared to events and characters. However, there is the conclusion that the order is controversial unless there is a specific new point from which they can conclude.

Question 6: Considering these two narratives provided, indicate which tools cannot visualize both narratives and why you chose those.

In examining narrative visualization tools applied to news stories, two recent articles from the JN website were selected for analysis. The first, published on March 19, 2024, at 19:21, details a case of domestic violence in Loures involving a 68-year-old man (Alves, 2024). The narrative written by Alves (2024) includes incidents of physical and verbal assault against his partner, threats directed at her brother-in-law, and subsequent police intervention leading to the aggressor's arrest. The victim's account of ongoing abuse and the involvement of family members in the confrontation underscores the complexity of the events.

Analysis of the narrative using various visualization tools revealed Tool 10's inadequacy due to its lack of detail and limited ability to represent the story's complexities, while Tool 11 lacked a clear timeline. Tools 1 and 8 were considered partially suitable because although they may provide information about events, characters, and chronology, participants expressed doubts about the effectiveness of these tools in conveying the story in a way that is easy to understand or appealing to the audience. Participants also mentioned that an adaptation of Tool 8 could be effective if adjusted to provide more details about the events and characters involved. Conversely, Tools 12 and 13 emerged as the most suitable for their intuitive ability to depict multiple events and characters.

The second article, published on the same day at 10:31, investigates Manuel Serrão and Júlio Magalhães for suspected fraud in obtaining EU subsidies through fraudulent invoices totaling €40 million since 2015 (Panda, 2024). The investigation implicates several companies and associations directed by the suspects, with charges including subsidy fraud, tax evasion, money laundering, and abuse of power. The Compete 2020 program's management entity confirmed the investigations, emphasizing transparency in fund management (Panda, 2024).

In conclusion, Tools 1, 3, 8, and 12 were identified as most suitable for visualizing the fraud investigation due to their ability to clearly represent events, characters, and interactions between implicated entities. Tools 7 and 4, though mentioned, did not meet the suitability criteria.

Overall, Tools 12, 1, and 8 were found effective for both narratives, demonstrating their versatility in journalistic storytelling through visualization.

Question 7: Do you believe that each visualization style fits better with different types of news?

Participants agreed that different visualization styles are more suitable for different types of news. Simpler narratives may benefit from tools with more apparent visual representations, while complex investigations may require more detailed and interactive tools. However, there was no definitive consensus on which visualization style would be the most suitable for each type of news, as this may depend on various factors, including the story's complexity and the target audience's preferences.

Suggestions were made that combining tools, such as Tool 1 and Tool 12, could provide a more comprehensive approach to storytelling. Tool 8 was suggested for news involving complex interactions between different entities, such as in corruption cases.

Question 8: Upon these visual aids, comment and rank the elements you consider most important in tools for visualizing a narrative: Text, Graphics, Icons, and Generated Images.

The order of importance of visual elements for visualizing a narrative, as discussed, is: 1) Icons, 2) Text, 3) Graphics, and 4) Generated Images. Participants highlighted the importance icons to identify characters and events. Participants recognized that illustrations reduce cognitive burden, providing them with a broad understanding of the narrative through illustrated icons. The text was considered essential but secondary compared to visual elements, followed by graphics that provide a clear visual representation of the narrative. Generated images were seen as less crucial by all.

With this focus group, the more relevant insights were:

- The combination of tools for effective news storytelling: Participants reached a consensus on the effectiveness of combining Tools 1 and 12 to narrate a wide range of news stories, suggesting the potential inclusion of Tool 8 to illustrate entity interactions.
- The visual element significance: Icons and text emerged as pivotal elements for information conveyance, closely trailed by graphics. While generated images were considered less critical, their contextual value remained acknowledged.
- The graphics interpretation challenges: The potential difficulty in interpreting graphics, particularly among individuals less acquainted with this visual format, was highlighted. This underscores the need to ensure accessibility and clarity in graphic representation.
- The synergy between visual and textual elements: Participants underscored the effectiveness of blending descriptive text with visual aids like icons and graphics to craft comprehensive and informative news narratives.

6.3 Co-creation session

After the discussion, we identified the potential of integrating three tools to create an optimal solution. To achieve this, we conducted a brief co-creation session to ideate and design the perfect tool, leveraging co-creation as an engaging method for design ideation and creative problem-solving (P. Jones & Kijima, 2018). This approach enabled us to combine elements we believed would address the suitability challenge for all types of news. As Vargas et al. (2022) argue, engaging the community is crucial for effectively designing, implementing, and assessing resulting initiatives. Recognizing the value of contributions from all six perspectives, we incorporated this co-creation session at the end of the focus group. According to Silva (2023) and O'Hare et al. (2018), co-creation involves a collaborative creative process where designers and non-designers work together to develop a project—in our case, a visualization tool capable of narrating any news story from a new. During the session, we used printed sheets to sketch and annotate (Appendix 4), indicating which assets to retain, which to add, and how to integrate them. Participants drew over the existing designs to remove unnecessary functions and describe how the new tool should operate. Once this process was completed, a comprehensive sketch (Appendix 5) of the tool was created to ensure consensus and clarity among all participants.

In discussing the development of our narrative visualization new tool, it was decided that the tool should be a mixed path, user-directed in Segel & Heer (2010) work. Participants emphasized the importance of understanding the story holistically before delving into details, so this would start in a linear way and then have the option to let the user explore more in a non-linear way. As Participant 1 noted, *"I agree that should be the first approach, and maybe the first time we see the news, and then, I do not know, have something to explore more about that news. In case we want to know more."* Participant 2 added, *"I think you need to understand the story as a whole first before you can analyze it. Because if you only analyze it point by point, you might end up analyzing without a guiding thread. Then, you need to be able to interpret the news to conceive it as a whole. It would help if you had an overall understanding of a news story first and then have a not linear path to explore more."*

Regarding the focus of the tool, it was decided to prioritize event-focused displays due to their clarity in presenting narrative timelines. Participant 5 remarked, *"If we look at it for the first time, I would say it is the event."* participant 2 supported this, stating, *"The event focus should be the first because it tells the story in a cleaner timeline, and it is telling the story that I think the general target audience wants to see initially to know more about it in detail."*

The decision to include the dashboard and perspectives style in the tool was met with some considerations. Participant 2 expressed concern about the dashboard style, noting, *"I think the last in my importance order would be the dashboard style appearance because not everyone wants to see it from a more analytical perspective."* Participant 4 highlighted potential conflicts with alternative perspectives, stating, *"Perspectives can generate conflict or not because they are, as I said, perspectives, so they may or may not have scientific involvement..."* However, it was agreed

that these features could provide valuable insights after establishing the narrative through events. Participant 3 explained, *"I think the event has to be the main focus because the other two, the dashboard and the perspective, bring a perspective to the story. One brings quantitative data, and the other brings qualitative data."*

The functions we decided to kept were the same structure as tool 12 but with icons in the timeline to better tell the event visually before the person reads it, and the locals with a smaller size. As for the dashboard part of the tool, it was decided that the characters' part would be kept as in tool 1, but with the integration of connection between characters, a functionality present in tool 8. To better show the locals, not with generated images since that gave the aspect of fake news as stated in the focus group, a section with a map would be integrated. We also agreed to add a media part to become more accessible, like tool 14, so the tool could have audio, video and be connected to social media.

In terms of design principles, the participants identified a need for simplicity and accessibility. Participant 1 emphasized, *"The news has to be presented in a simpler, clearer, and more definitive way because there is not much time to waste with the news."* Visual elements such as icons were highlighted as necessary for clarity. Participant 4 identified a preoccupation in terms of the graphs, *"I think there is a large portion of the population, even in school, for whom interpreting graphs is a headache."* Making us conclude that we shouldn't use complex graphs.

Following the discussion, we annotate and sketch integrating the insights above (Appendices 4 and 5). We develop the digital wireframe for our new co-created tool in Adobe Photoshop. This wireframe has two interconnected parts that we needed to develop (Figures 46 and 47):

The first part, shown in Figure 46, draws inspiration from Tool 12 (Figure 42), incorporating modifications such as adding timeline icons for better visual storytelling. The second part, depicted in Figure 47, adopts a dashboard style from Tool 1 (Figure 31), adapted to be more user-friendly and less overwhelming.

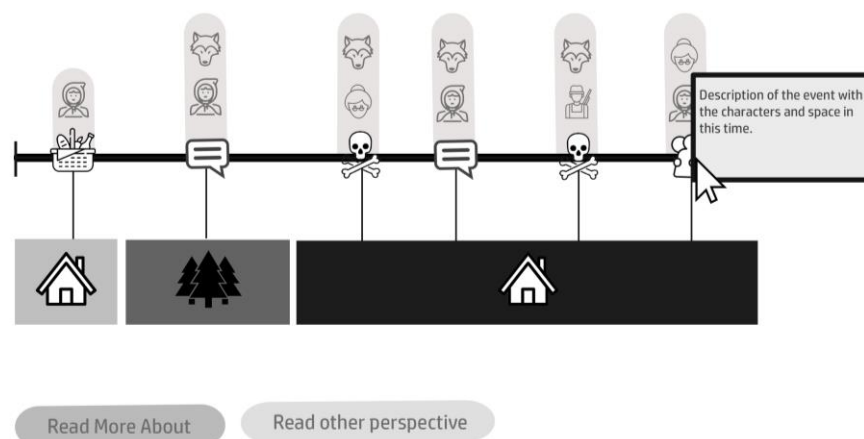


Figure 46 Co-created tool wireframe first part.

Wireframes evaluation

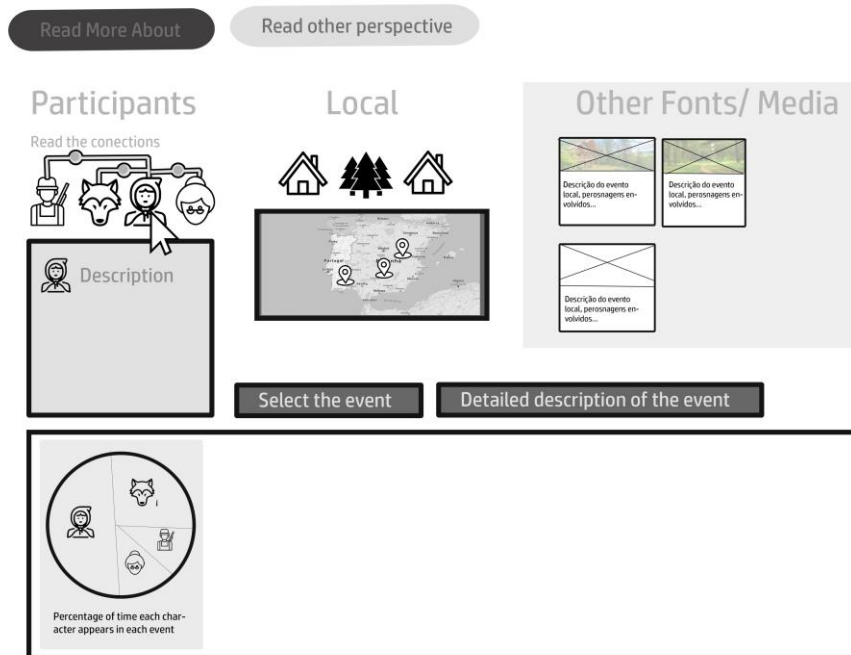


Figure 47 Co-created tool wireframe second part.

7. Prototype development

The wireframe evaluation in the preceding chapter provided invaluable insights into our tools, gleaned from diverse user perspectives. Following this assessment, we developed interactive mockups as prototypes of the two most favored tools from the focus group—Tool 1 and Tool 12—alongside the co-creation tool (Figures 46 and 47) from the co-creation session crafted during the focus group. Departing from the Red Riding Hood theme, we used an actual news story for testing purposes.

From this point forward, we will refer to "Tool 1" as "Tool 1," "Tool 12" as "Tool 2," and the co-created tool as "Tool 3." This naming convention will be used in our evaluation to ensure clarity and maintain a consistent enumeration throughout the assessment.

We selected an incident sourced from the online platform of the Portuguese journal "Diário de Notícias." The chosen article, titled "10 dead in collision between two military helicopters in Malaysia," was published on April 23, 2024, at 08:45 (DN/Lusa, 2024). The article narrates a tragic event wherein ten crew members perished as two military helicopters collided and crashed in western Malaysia during rehearsals for the Navy's 90th-anniversary celebrations. This incident, occurring at approximately 09:32, unfolded during a low-altitude formation flight over the Lumut Naval Base stadium in the state of Perak. You can read in *italic* the translated text of the new:

"The ten crew members of two military helicopters died this Tuesday when the aircraft collided and crashed in western Malaysia, the Malaysian Navy said.

A statement said the helicopters were participating in rehearsals for the Navy's 90th anniversary celebrations in May when the accident occurred at 09:32 (02:32 in Lisbon).

Videos posted on social media show seven helicopters flying in formation at low altitude over the stadium of the Lumut naval base in the state of Perak, western Malaysia.

When two helicopters broke away from the formation and turned to the right, one of them hit the tail rotor of the other, causing both aircraft to lose control and crash.

"All victims were pronounced dead at the scene," the navy said, adding that the remains were sent to a hospital for identification.

The Navy said seven crew members were aboard an AW139 maritime operation helicopter produced by AgustaWestland, a subsidiary of the Italian defense company Leonardo.

Three crew members were aboard a Fennec helicopter manufactured by the European multinational defense conglomerate Airbus.

Prototype development

Local media reported that the AW139 crashed into the sports complex of the naval base, while the Fennec hit a nearby swimming pool.

The navy said it will launch an investigation to determine the cause of the accident.

Malaysian Prime Minister Anwar Ibrahim said on social media that the nation is mourning the "devastating tragedy.""

Upon choosing the news story, our next step involved breaking it down into distinct events to align with our tool frameworks. In instances where specific details were unavailable, we simulated data to ensure the functionality of our mockups, including approximations of timings and the percentage of time each participant was present. This simulation was executed to maintain narrative immersion on the tools. Organizing the information, we outlined vital participants and events as follows:

Participants:

- 10 crew members from two military helicopters.
- Malaysian Navy.
- Prime Minister of Malaysia, Anwar Ibrahim.

Event 1: Collision between the two helicopters.

- Time: 09:32 AM.
- Description: Two military helicopters collided and crashed in western Malaysia during rehearsals for the Navy's 90th-anniversary celebrations. The accident occurred around 09:32, during a low-altitude formation flight over Lumut Naval Base stadium, in the state of Perak.
- Shorter version: Two Military Aircraft Helicopters Collide During Navy Anniversary Rehearsals.
- Local: Western Malaysia in a sports complex of the naval base and also near they're the pool.

Event 2: Consequences of the collision.

- Time: 09:33 AM.
- Description: Videos posted on social media show the moment when the helicopters separated from formation, with one of them striking the tail rotor of the other,

resulting in loss of control and the crash of both aircraft. All 10 victims were declared dead at the scene.

- Shorter version: 10 Crew Members Killed in Helicopter Collision.
- Local: Western Malaysia in a sports complex of the naval base and also near they're the pool.

Event 3: Identification of victims and types of helicopters.

- Time: 09:35 AM.
- Description: Seven crew members were aboard an AW139 maritime operations helicopter, produced by AgustaWestland, while three crew members were on a Fennec helicopter, manufactured by Airbus.
- Shorter version: Victim Identification: Seven Aboard AW139, Three Aboard Fennec Helicopter.
- Local: Western Malaysia in a sports complex of the naval base and also near they're the pool.

Event 4: Location of wreckage.

- Time: 09:40 AM.
- Description: The AW139 helicopter crashed into the sports complex of the naval base, while the Fennec struck a nearby swimming pool.
- Shorter version: AW139 Crashes into Naval Base Sports Complex, Fennec Hits Nearby Pool.
- Local: Western Malaysia in a sports complex of the naval base and also near they're the pool.

Event 5: Commencement of investigation.

- Time: 09:45 AM.
- Description: The Malaysian Navy announced that it will initiate an investigation to determine the causes of the accident.
- Shorter version: Malaysian Navy Initiates Probe into Helicopter Crash.
- Local: Western Malaysia in a sports complex of the naval base and also near they're the pool.

Prototype development

Event 6: Prime Minister's reaction.

- Time: 09:48 AM.
- Description: Malaysian Prime Minister Anwar Ibrahim expressed his mourning for the "devastating tragedy" on social media, reflecting the national sense of grief.
- Shorter version: Prime Minister Anwar Ibrahim Expresses Grief Over Helicopter Tragedy.
- Local: Social media.

After arranging the text, we considered the visual aspect. We decided to design the interactive mockups similarly to the wireframes, keeping them in a black and white scale with line art icons in black. The reason is that the black scale, as considered by (Ryan et al., 2016) is an accessible color pattern for visualizations, allowing everyone, even those with color blindness, to use our tool. This concern was also discussed in the first focus group by the participant 5. Additionally, because we intend to evaluate the structure and functionalities, the presence of color or a more stylized design could bias users based on their visual preferences, leading to unclear evaluations.

The interactive mockups of the three tools were created in Figma, utilizing free images from the “Unsplash” plugin on Figma and free icons from “Freepik.com”. For tool number one, we needed to gather specific images to represent the location of the event and the actions and elements involved (Figure 48). We identified seven required pictures:

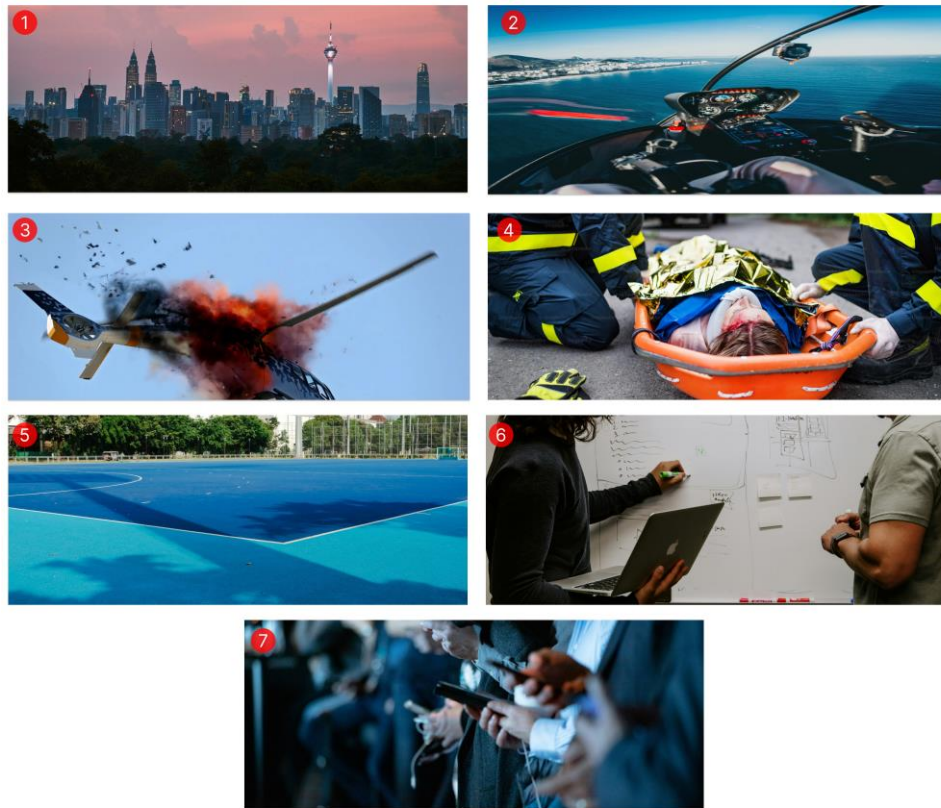


Figure 48 Pictures used on the tools.

- [1] One represents Malaysia, the country where the news occurred.
- [2] One of the helicopters.
- [3] One depicting an explosion involving helicopters.
- [4] One of a rescue team.
- [5] One of a sports complex, since the crash landed there.
- [6] One illustrating element that led to an investigation.
- [7] One of people on social media.

These pictures aim to illustrate the events and provide a contextual background for the user.

Prototype development

As for the icons, we needed representations for each participant, the three locations, and the event itself. We found icons that matched our requirements, but we recognize that the limitations of visual literacy—where not every possible icon can be universally understood—could be a weak point in our interactive mockup.

The visual elements were chosen to enhance the user experience by making the events more relatable and visually comprehensible while ensuring that the black-and-white design-maintained accessibility for all users, including those with color blindness (Ryan et al., 2016). This approach also helped us focus on evaluating the structure and functionalities without introducing biases based on visual preferences.



Figure 49 Icons used on the tools.

The icons present in the tools, and present in the Figure 49 represent:

The locals:

[1] Western Malaysia in a sports complex of the naval base and also near they're the pool.

[2] Social media

The participants:

[3] 10 crew members from two military helicopters.

[4] Prime Minister of Malaysia, Anwar Ibrahim.

[5] Malaysian Navy.

The events:

- [6] Event 1: Collision between the two helicopters.
- [7] Event 2: Consequences of the collision.
- [8] Event 3: Identification of victims and types of helicopters.
- [9] Event 4: Location of wreckage.
- [10] Event 5: Commencement of investigation.
- [11] Event 6: Prime Minister's reaction.

To create the tool's interactivity, we used transitions with "on click" and "hover" actions to make the tool as accessible and interactive as possible. This approach ensures that the evaluation of the tools can proceed smoothly and efficiently and that the user can autonomously investigate the tool for the evaluation.

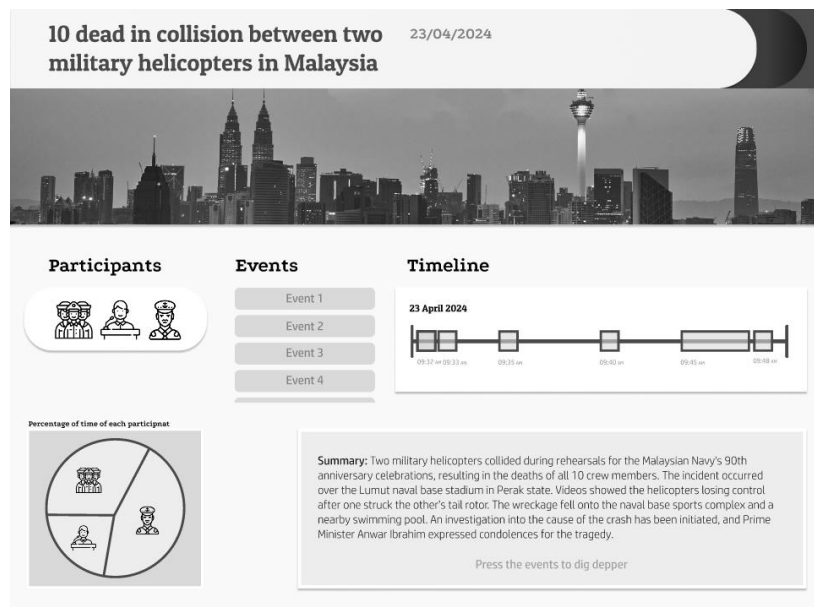


Figure 50 First scene of the prototype of wireframe 1 – Tool 1.

The prototype of the first tool was developed using wireframe 1 as illustrated in Figure 31 and explained in Chapter 5.4, which was identified as one of the top solutions in our focus groups. The prototype is present in Figure 50 and Appendix 6. The interactive mockup is shared online as a video³.

³ <https://youtu.be/dEfxhdSfN5E>

Prototype development

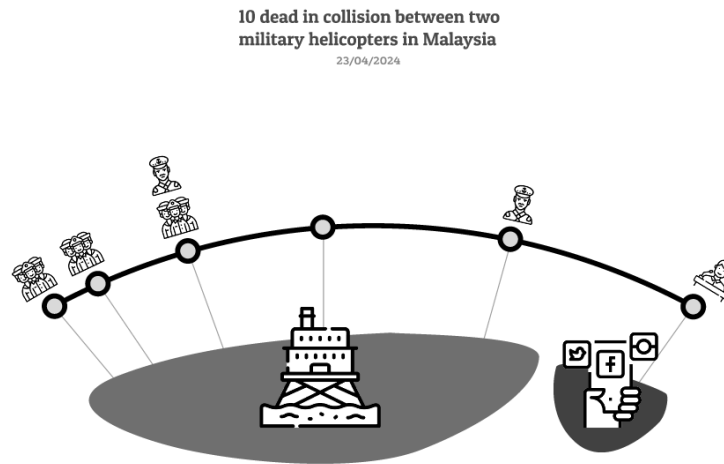


Figure 51 First scene of the prototype of Wireframe 12 – Tool 2.

The prototype of the second tool also emerged from the evaluations conducted during the focus groups. This solution is inspired by wireframe 12, as shown in Figure 42 and described in Chapter 5.4, and it's shown in Figure 51 and Appendix 7. The interactive mockup is shared online as a video⁴.

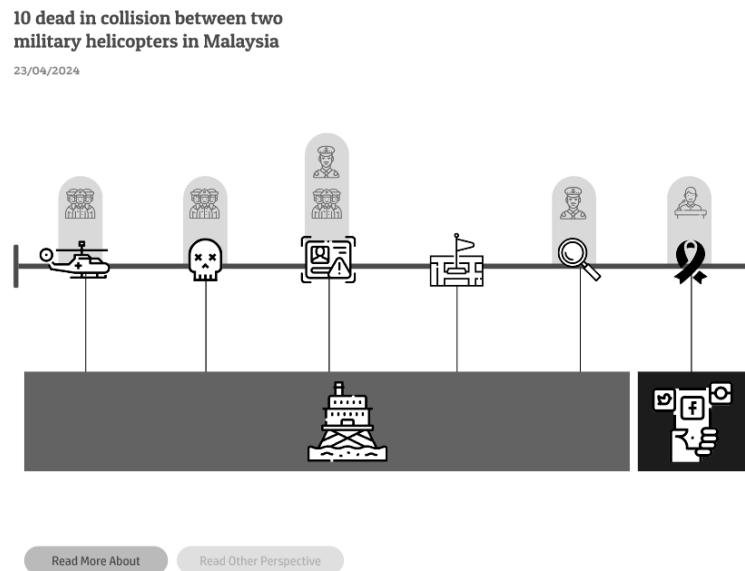


Figure 52 First scene of the prototype of the co-created tool – Tool 3.

⁴ <https://youtu.be/sHjsPI8m1kE>

The prototype of the third tool originates from our co-creation session and integrates insights gathered from participants. The associated wireframes are presented in Figure 46 and 47, discussed in detail in Chapter 6.3 and it's shown in Figure 52 and Appendix 8. The interactive mockup is shared online as a video⁵.

⁵ <https://youtu.be/ZnCawQ0xhkY>

8. Interactive prototypes evaluation

This chapter focuses on the evaluation of three prototypes, as interactive mockups, developed and assessed through two focus groups. Our goal was to compare and evaluate the user experiences of the three tools. To achieve this, we conducted two focus groups with participants who were experts from different backgrounds, specifically in linguistics and journalism. All members of the two focus groups were invited to voluntarily participate in the focus group and consented to the recording of the sessions for subsequent analysis, having their identity confidentially.

We chose to use focus groups for the evaluations because, as Breen (2006) suggests, individual interviews with experts primarily analyze personal experiences, while focus groups generate ideas through collective discussion. Since our process involves exploring solutions to problems, the focus groups provided a more beneficial setting for idea generation and problem identification.

The focus groups were structured into two parts:

- Testing of interactive mockups: Participants interacted with the three tools through their mockups. At the beginning of the session, we provided them with an evaluation questionnaire to rate the design principles on a scale of 1-10 based on our literature review.
- Discussion and feedback: The second part involved a discussion guided by a semi-structured script, which included relevant topics for the research and specific questions to gather responses and suggestions from the participants.

Through these focus groups, we aimed to collect quantitative data from the user testing evaluations and qualitative data from the discussion and feedback session. This dual approach allowed us to assess the tools and gather insights for further development comprehensively.

8.1 Evaluation framework

In this section, we explain how the prototype testing was organized and evaluated and the questions we posed during the discussion phase.

The prototype testing began with a brief introduction to the thesis topic. Each participant was given approximately 14 minutes per tool to engage with and evaluate it, although they were allowed to take additional time if needed. The task involved reading the news and exploring the tool independently and in silence to ensure an unassisted understanding of its functionality.

After testing, participants were provided with printed evaluation forms. The criteria for evaluation, derived from design principles identified in the literature review, included the following, each rated on a scale from 1 to 10:

- First positive impression (Andrews, 2019)
- Reduced cognitive loading (Airaldi et al., 2022)
- Transparency and precision of information delivery (Airaldi et al., 2022)
- Pleasant aesthetic layout (Airaldi et al., 2022; Andrews, 2019)
- Accessibility (Airaldi et al., 2022; Andrews, 2019)
- Engagement (Airaldi et al., 2022)
- Credibility of information (Airaldi et al., 2022)
- Ease of memorization (Airaldi et al., 2022)
- Ease of understanding functionality (Airaldi et al., 2022)
- Appropriateness of visual elements (Zhao & Elmqvist, 2022)

Additionally, participants answered two qualitative questions to provide more detailed feedback:

- What did you like most about the experience?
- What aspects could be improved to enhance the experience?

We conducted a discussion session following the evaluation to generate ideas and gather insights. This session included five questions aimed at addressing the research questions:

1. Was there any tool you did not like or found difficult to understand? Why? What specific characteristics were the most confusing?
2. Which tool communicated the news most effectively for you and why?
3. Is it possible to represent all news with a single tool after this experience? If so, which tool would you choose and why?
4. What did you think of the illustrations used in the prototypes? Did you encounter any difficulties interpreting them?
5. Based on the specific linear illustration presented, would you prefer a different style? (Participants were shown a slide with the exact representation in various styles for comparison (Figure 53).) The icon we choose was the marine crew one, and we generated with AI the icon in different styles. The four attributes—contour, color, shading, and shape (Garces et al., 2017)—were identified as key factors in how people recognize similar styles. Therefore, we aimed to generate illustrations that

Interactive prototypes evaluation

distinctly varied across these attributes to ensure they were easily distinguishable from one another.



Figure 53 Illustrations styles.

This structured approach ensured structured feedback on the prototypes' usability and design, providing valuable insights for future iterations.

8.2 Focus group with linguistic team

The Linguistic focus group occurred on 8 May 2024 at FLUP. The room was silent and had good conditions, and every participant had the necessary material to complete the tasks, a computer, the evaluation paper and writing material. It was composed of six Master's and Doctorate students in Linguistics. They were part of the StorySense project, working on news annotation, and provided valuable insights on how the text should be integrated into the tool, as well as feedback on the visual aspects of the tool to ensure the text was conveyed in the best possible way.

8.2.0 Results

The following table present the evaluation results of the questionnaire for each tool based on the defined criteria and the comparison between the three tools.

Table 10 Evaluation results - Linguistic focus group.

Criteria	Tool 1		Tool 2		Tool 3	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
First positive impression	7.50	1.92	5.50	2.41	8.33	2.56
Reduced cognitive loading	5.17	2.26	5.00	2.60	7.83	1.78
Transparency and precision of information	5.67	2.07	5.00	1.70	7.67	1.46
Pleasant aesthetic layout	8.50	1.80	5.83	2.22	8.67	1.27
Accessibility	8.17	1.64	5.50	3.05	8.00	1.67
Engagement	6.83	1.76	6.83	1.67	7.83	1.96
Credibility of information	5.17	2.20	5.33	1.57	7.17	1.44
Ease of memorization	6.67	2.41	4.00	2.78	7.67	1.63
Ease of understanding functionality	7.50	2.10	5.33	2.92	8.33	1.41
Appropriateness of visual elements	7.00	2.16	6.83	1.67	8.67	1.03

Interactive prototypes evaluation

The evaluation results indicate that the third tool consistently received the highest ratings across most criteria, demonstrating superior performance in areas such as first positive impression, reduced cognitive load, transparency and precision of information, aesthetic layout, ease of interaction, engagement, credibility and quality of information, ease of memorization, ease of understanding functionality, and appropriateness of visual elements. The first tool also received relatively high evaluations, particularly in accessibility and ease of interaction. Conversely, the second tool generally had the lowest ratings, indicating significant areas for improvement.

Since the third tool was co-created and incorporated both tool 1 and tool 2 elements, we can conclude that collaborative design with multiple users led to better results. This approach allowed us to filter the functions and construct a more effective final product. Notably, the criteria of appropriateness of visual elements and aesthetic layout received the highest score of 8.67, whereas the lowest score was for credibility and quality of information. Given that our work focuses on aesthetic and visual elements, it is evident that the quality of information is an area that requires further collaboration with professionals from relevant fields. The co-creation process enhanced the tool's functionality and visual appeal, while collaboration with domain experts will be essential to improving the credibility and quality of the information presented.

These findings underscore each tool's strengths and areas for development, providing a clear direction for future enhancements. In addition to the quantitative evaluations, participants provided qualitative feedback on their experiences with each tool, highlighting both positive aspects and areas for improvement:

Tool 1:

Positive Aspects:

- Participants appreciated the interactive and aesthetically pleasing design.
- The tool's ease of use and clarity of information were highly valued.
- The systematic information organization and visual segmentation of news content received positive comments.
- Features such as visualization of participants and the percentage of time spent on each character were noted as beneficial.

Areas for Improvement:

- Clarify the definition of "event" (semantic event versus occurrence).
- Enhance the timeline feature by removing irrelevant dates/times and improving the temporal sequence of events.
- Better ordering of events on the timeline, improved identification of participants, and avoiding the use of invented dates.
- Adapt the terminology "event" to better reflect the varied nature of catalogued events.

- Establish temporal links between events and use color to enhance the representation of the timeline.

Tool 2:

Positive Aspects:

- Participants enjoyed the tool's interactivity and found the timeline to be straightforward and easy to understand.
- The tool's design was appreciated for its simplicity and reduced visual noise.
- The organization of events was highlighted as a positive feature.

Areas for Improvement:

- The tool was considered more confusing than Tool 1 regarding element arrangement.
- There were issues with the clarity of information and the repetition of content on the timeline.
- The presence of icons without clear explanations and the absence of precise temporal intervals between events were noted as problematic.
- Add more detailed information about news elements and enhance temporal information clarity.

Tool 3:

Positive Aspects:

- Tool 3 was regarded as more intuitive and organized compared to the others.
- Features such as the "read more about" option and the initial news summary were well-received.
- Participants appreciated the complete information provided, including spatial locations and the ability to choose specific details to view.

Areas for Improvement:

- Improve the temporal order of events and refine each character's time interaction percentage.
- Provide more precise identification of participants and events and better event labelling.
- The timeline should visually represent the passage of time more clearly, potentially using a continuous arrow format.
- Introduce color to enhance visual differentiation and emphasize the main event of the news story.

The qualitative feedback highlights that while Tool 3 is the most efficient and user-friendly, there are still areas needing improvement, particularly regarding the temporal organization, clarity of events, and aesthetics aspects.

Interactive prototypes evaluation

8.2.1 Discussion insights

In this section, we analyze the qualitative data collected from the focus group discussions, which provided valuable insights into the usability and effectiveness of the three tools. During this phase, participants were asked five semi-structured questions. The insights gathered are summarized below:

Question 1: Was there any tool you did not like or found difficult to understand? Why? What specific characteristics were the most confusing?

Tool 1 and Tool 2:

- **Timeline Complexity:** Participants identified the timeline as a significant issue. Including hours and time division within events could have been better managed. For example, "Event 5" should have been labelled "Announcement of the investigation" rather than "Start of the investigation" to be temporally accurate.
- **Event Definition:** The notion of events within the news needed to be revised. Each event sometimes included multiple occurrences, such as "two military helicopters collided and crashed." Here, "collided" and "crashed" should be separate events. A suggested solution was to use "Occurrences" instead of "Events."
- **Interactivity Preference:** Clicking was preferred over hovering for interactive elements.
- **Icon Repetition:** Repeated icons for characters could have been more appealing.
- **Element Hierarchy:** In Tool 2, the larger icons for locations compared to other elements caused confusion.
- **Local:** There needed to be more consistency in how the locals worked since social media events presented in Tool 2 had a consistency problem.
- **Information Simplicity:** Tool 2 was criticized for its simplicity, lacking sufficient information.

Tool 3:

- **Timeline and Event Identification:** Despite being recognized as the best tool, participants noted that the timeline and event identification, as well as the temporal relationships between events, could still be improved. The icons also needed to be more sufficiently transparent.
- **Read More Option:** The "read more about" option should display information immediately rather than requiring an additional click.
- **Event Hierarchy:** There should be a way to highlight the main event, through color usage visually.

Question 2: Which tool communicated the news most effectively for you and why?

- Tool 1: Some participants preferred Tool 1 because everything was on the same page, avoiding the need to scroll or explore further. It allowed for a summarized version with the option to delve deeper into the news.
- Tool 3: This tool was most favored overall. It was perceived as the most compelling storytelling, with systematically organized information and all necessary elements for visually understanding the news.

Question 3: Is it possible to represent all news with a single tool after this experience? If so, which tool would you choose and why?

The consensus was that it is only possible to represent some news types with a single tool. The nature of the news story (whether it has a strong narrative or not) plays a crucial role. For instance, sports stories, financial news, or scientific explanations may require different approaches and cannot be effectively represented with the current tools designed for narrative news.

Question 4: What did you think of the illustrations used in the prototypes? Did you encounter any difficulties interpreting them?

- Tool 3 Icons: The icons did not function well, and a more specific icon library was suggested. Many icons needed to match the visual literacy of the audience or were too general for the specific news context.
- Generated Images: Tool 1's credibility was affected by generated images. Real images of the event were recommended.
- Icon Design: The complexity of designing suitable icons was a challenging task that this investigation could not fully address.
- Question 5: Based on the specific linear illustration presented, would you prefer a different style? (Participants were shown a slide with various styles for comparison.)
- Preferred Style: Style 2 was preferred for conveying credibility and seriousness, especially for serious news.
- 3D Representation: Style 5 was noted for its detailed 3D representation, which could benefit more detailed elements.

Interactive prototypes evaluation

- Audience-Dependent Style: The style of illustration should depend on the target audience and on the new type. Those who prefer visualizations might favor different styles than those who prefer reading.

The qualitative data from the focus group discussions highlights the importance of a user-centric design approach for linguistic tools. Tool 3 emerged as the most effective overall, but there is room for improvement, especially in timeline accuracy and event identification. The insights gathered will inform future refinements, emphasizing the need for clarity, effective use of interactivity, and suitable visual representations tailored to the nature of the news and the target audience.

8.3 Focus group with JPN students

The Journalists focus group occur 17, May 2024 at FLUP. The room was silent and had good conditions, and every participant had the necessary material to complete the tasks, a computer, the evaluation paper and writing material. The second focus group comprised four members of JPN. As stated on their website, "JPN-JornalismoPortoNet is a multimedia news outlet that provides general information and continuous updates, keeping pace with the evolution of new communication technologies and implementing the most modern journalistic techniques on the Internet. It is a project from the Bachelor's degree in Communication Sciences at the University of Porto." They were giving voice to the journalism side, and provide another perspective and opinions coming from writers of news itself.

8.3.0 Results

The following table present the evaluation results of the questionnaire for each tool based on the defined criteria and the comparison between the three tools.

Table 11 Evaluation results - JPN focus group.

Criteria	Tool 1		Tool 2		Tool 3	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
First positive impression	<i>7.50</i>	<i>0.58</i>	<i>6.50</i>	<i>3.50</i>	<i>7.25</i>	<i>1.71</i>
Reduced cognitive loading	<i>7.25</i>	<i>1.89</i>	<i>7.75</i>	<i>3.20</i>	<i>8.00</i>	<i>0.82</i>
Transparency and precision of information	<i>8.50</i>	<i>1.50</i>	<i>8.75</i>	<i>1.50</i>	<i>9.00</i>	<i>1.00</i>
Pleasant aesthetic layout	<i>6.50</i>	<i>2.38</i>	<i>6.25</i>	<i>3.70</i>	<i>8.00</i>	<i>0.82</i>
Accessibility	<i>8.00</i>	<i>2.00</i>	<i>7.75</i>	<i>3.86</i>	<i>8.50</i>	<i>0.82</i>
Engagement	<i>7.50</i>	<i>1.50</i>	<i>7.00</i>	<i>2.83</i>	<i>8.75</i>	<i>0.50</i>
Credibility of information	<i>7.75</i>	<i>1.26</i>	<i>6.75</i>	<i>3.50</i>	<i>8.50</i>	<i>0.58</i>
Ease of memorization	<i>8.00</i>	<i>1.41</i>	<i>8.50</i>	<i>1.00</i>	<i>8.75</i>	<i>0.50</i>
Ease of understanding functionality	<i>8.50</i>	<i>2.12</i>	<i>8.25</i>	<i>1.71</i>	<i>8.75</i>	<i>0.50</i>
Appropriateness of visual elements	<i>6.75</i>	<i>2.22</i>	<i>5.75</i>	<i>2.06</i>	<i>6.50</i>	<i>3.11</i>

Interactive prototypes evaluation

When scrutinizing the data gleaned from user feedback, it becomes evident that Tool 3 emerges as the frontrunner across various dimensions. Its consistently high transparency, aesthetic appeal, user engagement, and credibility ratings indicate a robust overall performance—Tool 3 successfully balanced functionality and user experience, offering an informative and visually appealing interface.

Conversely, Tool 2 lags, exhibiting lower scores in many criteria. These findings underscore significant areas for improvement, indicating a potential disconnect between user expectations and the tool's current design and functionality.

While Tool 1 garners positive feedback for its initial impact and ease of interaction, it needs to catch up compared to Ferramenta 3 across most categories. This suggests that while Ferramenta 1 may excel in certain aspects like the positive first impression and de adequate use of images and icons, it could benefit from aligning more closely with the user-centric approach embodied by Ferramenta 3.

Since Tool 3 was co-created and incorporated elements from Tool 1 and Tool 2, we can conclude that collaborative design with multiple users led to better results.

As for the qualitative data provided by the evaluation Tool, 3 emerges as the most favored for its comprehensive approach, interactivity, and rich content offerings. Ferramenta 1 and Ferramenta 2 received mixed feedback, with praise for certain aspects and notable improvement areas, as you can better explore:

Tool 1:

Positive Aspects:

- Participants appreciated the apparent separation and sequential arrangement of events, facilitating comprehension.
- The introduction of a timeline was praised for providing a chronological and sequential visualization, aiding in narrative coherence. Icons were noted for aiding association with story elements, enhancing interactivity, and navigation dynamics.
- Participants valued the real-time updates and coverage of sources, presenting information clearly and succinctly without overwhelming text.

Areas for Improvement:

- Some confusion was expressed regarding the "percentage of time of each participant" icon, suggesting a need for more apparent relevance.
- Suggestions were made to improve the overlay of information bars over event icons, enhance icon association with the timeline, and introduce color and video elements for increased engagement.

Tool 2:**Positive Aspects:**

- Participants appreciated the tool's simplicity, aiding in understanding and clarity of information.
- The chronological order with icon usage was commended for aiding attention and memorization of narrative elements. Navigation was noted for its simplicity and intuitiveness.

Areas for Improvement:

- Feedback suggested a desire for more diverse and detailed information to enhance interest.
- Concerns were raised about potential difficulty in memorization due to text needing to remain fixed on the page and the absence of fixed event times on the timeline. Suggestions were made to improve icon relevance and reduce confusion.

Tool 3:**Positive Aspects:**

- Participants praised the comprehensive nature of the tool, appreciating its organized information and icon association with narrative elements.
- Interactivity features, including the ability to access additional information and multimedia content, were highlighted to enhance exploration.
- The presence of maps and social media content enriched the news experience.

Areas for Improvement:

- Feedback highlighted potential confusion if users stray from focused navigation, emphasizing the need for clarity in usage.
- Concerns were raised about using icons and the absence of fixed event times. Some participants suggested improving icon seriousness and clarity.

8.3.1 Discussion insights

This section analyzes the qualitative data from the focus group discussion with JPN participants. During this phase, participants were asked five semi-structured questions. The critical insights collected are summarized below:

Interactive prototypes evaluation

Question 1: Was there any tool you did not like or found difficult to understand? Why? What specific characteristics were the most confusing?

Tool 1:

- **Unnecessary Features:** The interactive timeline and side menu were considered redundant. The absence of a slider also made navigation confusing. A suggestion was made to make the menu scroll automatically as events were selected, encouraging users to explore further.

Tool 2:

- **Lack of Guidance:** Most participants did not favor Tool 2, feeling lost without more than just the initial title. Some form of guidance was needed to help users navigate.
- **Linear Structure:** Tool 2 was criticized for its linearity and lack of stimulation. Participants noted that modern readers are accustomed to having information presented frontally, and Tool 2 failed to meet this expectation.
- **Icon Repetition:** The repetitive use of character icons was seen as a negative aspect. Participants suggested adding more diverse icons, similar to Tool 3.
- **Absence of Time Indicators:** Tool 2 and Tool 3 were criticized for not including timestamps.

Tool 3:

- **Visibility Issues:** The "read more" button did not attract enough attention, leading to it being overlooked by some participants.
- **Inappropriate Icons:** The skull icon was deemed inappropriate, as it created a childish impression. Additionally, participants suggested including the event title alongside the icon for better clarity.
- **Absence of Time Indicators:** Tool 2 and Tool 3 were criticized for not including timestamps.

Question 2: Which tool communicated the news most effectively for you and why?

- **Tools 1 and 3:** These were considered the most effective for conveying the news. Tool 3 was the favorite among the group, but the participants highlighted that they liked that the Tool 1 occupied the entire screen and did not require scrolling like 3 did.
- **Content Richness:** Tools 1 and 3 were praised for their content richness, encouraging further reading.

- Non-linear/Mixed Pathways: These tools were also commended for their non-linear or mixed pathways, which enhanced the stimulation to explore more.
- Tool 2 Simplicity: While Tool 2 was appreciated for its simplicity and quick understanding, it lacked depth.
- Map and Media Presentation: The presentation of maps and other media in Tool 3 received high praise, adding to its completeness.

Question 3: Is it possible to represent all news with a single tool after this experience? If so, which tool would you choose and why?

The group's consensus was that it is not possible to represent all news types with a single tool. While disasters and similar events might be easier to represent, scientific news and other complex stories require different methods. Some participants suggested that visualizations could be adapted for each news type, which would necessitate significant adjustments.

Question 4: What did you think of the illustrations used in the prototypes? Did you encounter any difficulties interpreting them?

- Tool 3 Icons: Participants had difficulty interpreting some event-related icons in Tool 3. The skull icon was again noted as inappropriate, perceived as sensationalistic and insensitive.
- Credibility Concerns: The style of icons was seen to affect the maturity and seriousness of the news. More realistic and less cartoonish icons were preferred.

Question 5: Based on the specific linear illustration presented, would you prefer a different style? (Participants were shown a slide with various styles for comparison.)

- Preferred Style: Style 2 was the clear favorite among the group, chosen for its sober and formal appearance, which conveys credibility. The lack of expression in the icons contributed to their perceived seriousness.
- Context-Dependent Style: Participants acknowledged that the illustration style might vary depending on the news topic. For instance, cultural news might benefit from more creative styles.
- Neutrality for General Use: Style 2 was considered suitable for any news type due to its neutrality, making it a versatile choice for different audiences.

Interactive prototypes evaluation

The qualitative data from the focus group discussions with JPN participants underscores the importance of design and interactivity in news tools. Tool 3 emerged as the most effective overall, yet it still requires icon design and timeline feature refinements. These insights will guide future improvements, ensuring that the tools are both engaging and informative and cater to a wide range of news types and audiences.

8.4 Focus groups combined results

In this section, we will compare the results obtained from the two focus groups: the Linguistic Team and the JPN Students. This analysis will highlight the similarities and differences in quantitative and qualitative feedback, providing a comprehensive understanding of how each group interacted with and evaluated the three tools.

Quantitatively, both groups consistently rated Tool 3 the highest across most criteria. For instance, regarding the first positive impression, the Linguistic Team gave Tool 3 and 8.33, while the JPN Students rated it slightly lower at 7.25. However, the JPN Students gave their highest score to Tool 1 (7.50), unlike the Linguistic Team, who favored Tool 3. Tool 3 again emerged as the leader when evaluating the reduction of cognitive load, with both groups rating it highest (7.83 by the Linguistic Team and 8.00 by the JPN Students). This pattern persisted in categories such as transparency and precision of information, ease of memorization, and ease of understanding functionality, where Tool 3 consistently received the highest scores from both groups.

Despite this consensus, the JPN Students generally gave higher ratings across all tools compare to the Linguistic Team. For example, in the transparency and precision of information category, the JPN Students rated Tool 3 9.00, whereas the Linguistic Team rated it 7.67. Similarly, the JPN Students rated Tool 3 at 8.75 for ease of memorization, much higher than the Linguistic Team's 7.67. This trend suggests that the JPN Students might have had different expectations or a more favorable overall experience with the tools.

The Linguistics group exhibited higher standard deviations, reflecting a broader range of opinions. Conversely, the Journalism group demonstrated lower standard deviations, indicating more consistent and uniform views. These variations in standard deviations are expected and acceptable, given that the evaluation of the tools is inherently personal and subjective.

Qualitatively, both groups appreciated the interactivity and comprehensive nature of Tool 3. The Linguistic Team highlighted its intuitive design and organized information, while the JPN Students praised its rich content and interactivity. However, there were notable differences in their qualitative feedback. The Linguistic Team focused on how the information should be organized based on the annotation that they follow in linguistic, suggesting improvements in event definition and timeline clarity for Tool 1. In contrast, the JPN Students emphasized real-time

updates and the relevance of icons and colors, reflecting their priority on dynamic and visually appealing interfaces.

For Tool 2, both groups valued its simplicity and clarity but critiqued different aspects. The Linguistic Team pointed out the confusing element arrangement and lack of detailed information, while the JPN Students noted issues with linearity and repetitive icons, indicating different navigational challenges.

Regarding suggestions for improvement, both groups saw the need for better timeline features however in a different way, linguistic team defended the events should be organized by sequence and without time annotations, as for the JPN group was the opposite and they defended that the hours should be always present. Both groups mentioned event identification for Tool 3, mentioning that for the event the title should be written not to depend only in the icon. As for the icons they caused some confusion in both groups even that in a different way. As for the generated images in Tool 1 they contradict again with the Linguistic group not wanting that and the JPN defending it should have more. Still on Tool 1 both groups agreed that they liked a tool that fits the screen without requiring scrolling.

While both focus groups strongly preferred Tool 3, they did so for slightly different reasons and with varying degrees of enthusiasm. The Linguistic Team's feedback centered more on usability and visual segmentation, whereas the JPN Students focused more on real-time updates and comprehensive coverage. These insights underscore the importance of considering diverse user perspectives in tool design to effectively cater to different user needs.

9. Discussion

In this chapter, we discuss the contributions of the results and the limitations of the project.

9.1 Contributions

This section discusses the contributions of the study to the field of narrative visualization in journalism.

From a methodological perspective, this study used a rigorous process for evaluating narrative visualizations, combining focus groups and questionnaires in two of them to gather quantitative data. This approach allowed for an in-depth analysis of readers' preferences and perceptions, providing valuable empirical data to guide the development of future visualization tools and techniques. The employed methodology also demonstrates the effectiveness of using focus group sessions to explore readers' perceptions of narrative elements, visual design principles and illustration practices that can help improve the visualization.

This study offers several practical contributions for journalists, designers, and developers of new visualization tools:

- **Guidelines for Creating Visual Narratives:** The findings of our literature review enumerated design principles for creating a visualization, resulting in a combination of practical guidelines from different authors for developing more effective and engaging visual narratives. The feedback from our focus groups highlighted several essential practices for successful visualizations: The design should be simple, focusing on the core narrative without overwhelming users with unnecessary details. Using contrast and visual hierarchy helps emphasize critical information and guides the viewer's focus. Incorporating interactive elements, such as clickable features and dynamic content, engages users. Lastly, accessibility is crucial so a diverse audience can easily navigate and understand the information. These principles, validated by our focus group feedback, provide a cohesive framework for developing clear and engaging visualizations.
- **Prototyping Visualization Tools:** The research led to the development of visualization tools prototypes that incorporate the identified principles. These prototypes are concrete examples of how theories and guidelines can be applied to enhance news communication through visualizations.

- **Impact on Reader Engagement:** While we did not measure engagement directly, the focus group discussions showed promising signs that these explorations have considerable potential to motivate and engage readers. Our results support existing literature, suggesting that integrating compelling visualizations can improve the reader's experience and potentially increase audience size and retention.

This study's contributions provide a foundation for future research and practice in journalistic narrative visualization. The findings underscore the importance of an integrated approach that combines solid narrative elements with visual design principles and effective illustration practices.

9.1.0 Research question analysis

This section aims to discuss our study's findings in relation to the existing literature and highlight our work's contributions. We will address each research question, compare our results with the state of the art, and indicate how our findings add to or diverge from existing knowledge.

RQ1: What are the most important elements in the representation of a narrative?

Previous studies have laid the groundwork for understanding the essential elements of narrative representation. Segel and Heer (2010) identified that the core components for constructing a narrative include events, participants, time, and space. They emphasized that these events are interconnected through various links, such as temporal resonance, which helps create a timeline. These elements are fundamental for structuring stories and engaging audiences. Similarly, Weber (2020) and Zhao and Elmqvist (2022) described narratives as intricate sequences of events that unfold within specific places and involve diverse characters. (Weber, 2020) further delineated four essential narrative characteristics: spatial and temporal dimensionality, characters and events, sequence, and tellability. Notably, these findings across different studies converge, supporting the use of these four elements in narrative construction.

We used Segel and Heer (2010) elements and our findings confirm that it is possible to develop tools that tell narratives based on news by representing these four elements. Focus group participants consistently highlighted events as the most impactful component. For the other components, the order of importance varied depending on the specific news story and its type. The linguistic team in their focus groups suggested referring to events as occurrences, considering this terminology more fitting. They also emphasized that the main event, which encapsulates the essence of the story, should be distinctly highlighted to convey its importance.

Our study advances the state of the art by providing empirical evidence that these four elements—events (or occurrences), participants, time, and space—are crucial for representing a narrative from news in a visualization tool. Through focus groups, we identified events as the

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most significant element, thus validating and expanding upon previous theoretical frameworks. It was also agreed that the hierarchy for the other elements can vary depending on the type of news story.

RQ2: Which principles of visual design are most relevant to improving the communication of narratives?

Research by Andrews (2019), Ryan et al. (2016), Benoît (2019), and Airaldi et al. (2022) emphasized the importance of visual design principles in constructing appealing visualizations. Our study corroborates the relevance of these principles, highlighting the preferences and insights of our focus group participants.

Participants in our focus groups favored simple designs with a clear hierarchy of information. They expressed a preference for strategic uses of color, which were elements we were unable to fully test in our study. By validating these visual design principles through user feedback and the construction of interactive tools, our research contributes to the existing body of knowledge.

Our findings suggest a heightened preference for minimalistic and simplistic designs by our participants in the three focus groups. This preference is crucial for practitioners aiming to enhance the effectiveness of their visual narratives. Simplicity emerged as the most frequently mentioned design principle among focus groups. This preference is driven by the limited time users have to check news, the ease of learning how the tool functions, and the inviting nature of a simple, clear tool, which contrasts with the complexity that can deter user engagement and transmit an intimidating first opinion. Accessibility was another critical design principle. Participants emphasized the importance of easily navigating the tool and discovering the narrative. Contrast in information was considered essential for distinguishing the importance of different pieces of information. This could be achieved through varying hierarchy sizes, interactive elements, and color usage. Regarding layout, participants preferred designs that fit an entire screen without requiring scrolling. Simple graphics were favored for their accessibility, and there was a clear preference for neutral icons without facial expressions, accompanied by text when representing specific situations. Generated images were discarded due to their potential to induce mistrust in the news. Interactivity was highlighted as a very important principle, as it is connected to user engagement and immersion. A user-friendly tool that guides the user and intrigues them to explore further is essential.

Our study corroborates several key visual design principles through empirical evidence provided by our focus groups, in summary:

1. Simplicity: Preferred due to time constraints, ease of use, and user-friendliness.
2. Accessibility: Crucial for easy navigation and narrative discovery.

3. Contrast: Essential for highlighting important information.
4. Layout: Full-screen designs without scrolling are favored.
5. Graphics: Simple graphics enhance accessibility.
6. Imagery and Icons: Neutral icons and text are preferred; generated images are avoided.
7. Interactivity: Key to engagement and immersion.

These principles collectively enhance the effectiveness of visual narratives, making them more appealing and comprehensible to modern audiences.

By validating these principles through user feedback and constructing interactive tools, our study contributes to existing knowledge and provides practical guidance for improving the effectiveness of visual narratives.

RQ3: What practices and aspects of illustration can help improve the visualization of narratives?

Soliman (2019) outlines the importance of illustrations in design, emphasizing their ability to express abstract ideas, handle ambitious themes, facilitate storytelling, represent complex data accessibly, and fulfill specific stylistic needs. Illustrations are instrumental in conveying nuanced abstract concepts and bringing ambitious themes to life creatively and cost-effectively. They play a crucial role in crafting cohesive narratives, making complex data comprehensible, and transmitting a unique image and personality.

Siricharoen and Siricharoen (2015) identify key attributes of effective infographics, such as contrast, hierarchy, accuracy, relevance, and truth, which ensure the effectiveness of visual communication. Garreton et al. (2023) further suggest that combining visualization techniques with illustrations yields better results in terms of memorability, persuasiveness, and emotional impact, with illustrations enhancing the overall visual appeal.

In our study, illustrations proved helpful from the outset. During the initial wireframe designs in the first focus group, tools lacking illustrations were discarded. Participants recognized that illustrations reduce the cognitive burden and provide a broad understanding of the narrative.

Illustrations offer several positive aspects, such as imbuing a tone into the narrative (whether neutral, childish, or creative), tailoring visualizations to different types of news and audiences, and outperforming generated images, sometimes leading to doubts about news authenticity. However, considerations arise concerning users' visual literacy, as not all icons are universally recognized or appropriate. Therefore, text should accompany illustrations to clarify or replace more specific ones.

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Our study supports these findings, with participants indicating that illustrations significantly improved their understanding of the content. They favored illustrations highlighting key points and providing visual summaries without overwhelming the narrative. By empirically demonstrating the effectiveness and also considerations of illustrations in improving engagement and interest, our study agrees with the others work and adds valuable insights to the existing literature on narrative visualization.

9.2 Limitations

While this study provides valuable insights into the role of narrative elements, visual design principles, and illustrations in enhancing news visualizations, it is important to acknowledge its limitations. These limitations may affect the generalizability of the findings and provide directions for future research to address.

One of the primary limitations of this study is the relatively small and homogeneous sample size used in the focus group sessions. The participants were primarily from similar demographic and educational backgrounds in the last two focus groups, which may limit the applicability of the findings to a broader audience. A more diverse sample, including participants from various age groups, cultural backgrounds, and professional experiences, would provide a more comprehensive understanding of how different audiences perceive and interact with news visualizations.

The study relied heavily on qualitative methods like focus groups to gather data. While this method is effective for exploring complex phenomena and gaining in-depth insights, it is inherently subjective and may introduce bias. Future research could incorporate quantitative methods, such as surveys and experiments, to complement the qualitative findings and provide a more robust analysis.

The news stories and visualizations used in the study were limited to specific topics and formats. This constraint might affect the generalizability of the findings to other types of news content and visualization styles. Future studies should explore various topics and formats to determine whether the identified principles and practices are universally applicable.

The time frame for conducting the focus group sessions and analyzing the data was relatively short. This limitation may have affected the depth of the analysis and the ability to explore specific aspects in greater detail. Longitudinal studies, which track changes over time, would provide more comprehensive insights into how audience engagement and information retention evolve with different visualization techniques.

The findings of this study are based on a specific context and may not be generalizable to all news organizations or audiences. The organizational culture, resources, and objectives of different

news outlets can significantly influence how visualizations are created and perceived. Future research should consider these contextual factors to enhance the applicability of the findings.

Acknowledging these limitations is crucial for interpreting this study's findings and understanding their scope. While the study provides valuable contributions to the field of news visualization, addressing these limitations through future research will help validate and expand upon the insights gained. By considering diverse audiences, incorporating quantitative methods, exploring a broader range of content, leveraging emerging technologies, and conducting longitudinal studies, future research can build on the foundation established by this study and further advance our understanding of effective news visualization practices.

10. Conclusions

This chapter summarizes the main findings and implications from this study's in-depth exploration of news narrative visualization and suggests directions for future research to encourage further exploration and innovation in this field.

This thesis explored the visualization of news narratives through a comprehensive approach that integrated theoretical research, empirical analysis, and practical application. The core problem addressed was how to effectively communicate news narratives using visual tools. To tackle this problem, we aimed to identify essential elements in narrative representation, determine relevant visual design principles, and evaluate illustration practices that could enhance narrative visualization.

Based on the literature review, we identified four elements that constitute a narrative: Events, participants, time, and space. Incorporating these elements, along with collected design principles and illustration practices we collected we built 15 wireframes of possible ways to tell a story, using "Little Red Riding Hood" as a familiar narrative to facilitate user comprehension and focus on tool understanding. Subsequently, these wireframes underwent evaluation in a focus group setting, and as a result we choose three possible solutions, the two most popular tools, distinguished by unique features and aesthetics falling into different categorical groups, and a tool combining features from popular options and other tools was collectively designed.

The interactive mockup of each tool were then evaluated in two separate focus groups comprised of specialists from linguistics and journalism. These evaluations yielded final insights, contributing to the culmination of the study's findings and recommendations. With this study we confirmed that the four essential elements for constructing narratives can also construct it in a representation—events (or occurrences), participants, time, and space—are fundamental for creating narrative visualization tools. Our focus groups consistently highlighted events as the most impactful component, emphasizing the importance of clearly highlighting the main event to convey the essence of the story effectively. As for the other elements, we concluded that the hierarchy can vary depending on the type of new.

Secondly, our study validated the visual design principles identified by previous researchers, such as simplicity, accessibility, contrast, and interactivity. The participants' preference for minimalist and coherent designs reinforces the importance of creating intuitive and user-friendly tools that allow for efficient navigation and quick comprehension of information. Interactivity, in particular, was highlighted as a crucial element for enhancing user engagement and immersion.

Other preferences, such as a layout without scrolling, the use of simple over complex graphics that can be understood by most people, and neutral icons.

Finally, our investigations into the use of illustrations demonstrated their valuable role in effective narrative visualization. Illustrations not only improve the aesthetics of the tools but also simplify complex information, aid in the understanding of abstract ideas and set the tone for the narrative, adapting effectively to various news types and audiences. The inclusion of illustrated icons was especially valued by the participants, highlighting the role of illustrations in reducing cognitive load and facilitating narrative comprehension. However, due to varying levels of visual literacy, it is essential to pair illustrations with text to ensure clarity and universal recognition.

This thesis contributes to the field of narrative visualization by providing evidence supporting the importance of the discussed narrative elements, design principles and the contributions from illustration.

10.1 Future work

While this research contributed to understanding narrative visualization in journalism, several areas remain open for exploration in future studies. This chapter outlines potential directions for future research, building on the limitations and contributions of this thesis.

One area for future exploration is the influence of cultural factors on visual design perceptions and preferences in visualization tools. As mentioned, different target audiences, particularly those segmented by age or the specific news domain, would yield different responses to the visualization tool. This exploration could examine how different cultures have distinct sensitivities to colors, typography, illustration styles, and visual literacy. Comparative studies across various cultural contexts could provide valuable insights into adapting narrative visualizations for diverse audiences, ensuring that stories are understood and appreciated more broadly.

Future research should aim to broaden the sample of participants to gain a more comprehensive and representative understanding of readers' preferences. Including a more diverse audience regarding age, gender, educational level, and news consumption familiarity could help identify patterns and trends not evident in this study, which relied on focus groups with a limited sample. Additionally, incorporating more qualitative data collection methods, such as surveys, could provide deeper insights into user perspectives. This broader sampling could also assist in creating more inclusive and accessible narrative visualizations.

An additional direction for future research involves a deeper investigation into the role of color and typography, as emphasized in the focus group discussions. This can be pursued by incorporating insights from current literature and testing these design elements with various types of news content and user groups.

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Another avenue for future work involves advancing the interactive mockup of visualization tools developed in this study, which served as proofs of concept. Future efforts could focus on creating more robust and intuitive software that incorporates the identified design principles. Large-scale usability testing and continuous evaluations could refine these tools, ensuring they meet the needs of journalists and designers. Additionally, these mockups could investigate untouched aspects such as color and typography, test other types of news, and implement various illustration styles, ultimately creating more comprehensive and accessible tools tailored to target audiences.

Another suggestion for future work is to shift the medium in which the visualization tool is designed, leveraging emerging technologies to create new products. The rapid evolution of design and visualization technologies offers numerous opportunities for future research. Integrating emerging technologies such as augmented reality (AR), virtual reality (VR), and artificial intelligence (AI) could open new possibilities for narrative visualization. Studying how these technologies can be applied to create more immersive and interactive narrative experiences could revolutionize how news are consumed.

Future research could also benefit from longitudinal studies that track reader engagement over time. Analyzing how different types of narrative visualizations influence reader behavior and retention over longer periods could provide insights into the long-term effectiveness of visual design techniques. These studies could help identify which practices have a sustainable impact on reader engagement.

Finally, while this study identified some effective illustration practices, there is much more to explore. Future research could investigate how different illustration styles, animation techniques, and interactive elements influence narrative comprehension and memorability. Collaborating with professional illustrators could offer new perspectives and enhance best practices. The creation of a specialized icon library for visualization tools, as suggested in the focus groups, could further expand this area.

The field of narrative visualization in journalism is vast and dynamic, with many areas yet to be explored. This study has made contributions to its understanding, but numerous opportunities exist to expand and deepen the research. By addressing the directions outlined in this chapter, future researchers can contribute to the development of techniques and tools that transform how stories are told and consumed, creating richer, more engaging, and more accessible narrative experiences.

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12.Appendices

Appendix 1: Focus groups consent

Autorização de gravação áudio e Contrato de confidencialidade do Focus Group

No âmbito da frequência no Mestrado Multimédia na Faculdade de Engenharia da Universidade do Porto, desenvolvemos um projeto de investigação. É neste sentido, que pedimos a sua colaboração na participação do focus group. Vimos por este meio solicitar-lhe autorização para que sejam realizadas gravações áudio durante a realização do focus group, gravações essas que servirão apenas como instrumento de recolha de dados para a investigação. Asseguramos-lhe que em momento algum a sua identificação será divulgada e que todos os dados serão confidenciais.

Eu, _____ autorizo que para os devidos efeitos sejam realizadas gravações áudio durante a realização do focus group, servindo somente como instrumento de recolha de dados para a investigação em causa. A minha identificação e todos os dados serão confidenciais.

|

(Assinatura do participante do focus Group)

Appendix 2: First focus group guide

Focus group:

1. Introdução contextual

- Agradecer a colaboração, e explicar aos participantes o contexto da tese e o objetivo do focus group. :
- Explicar como a discussão vai contribuir para o trabalho
- Reforçar questões de confidencialidade
- Entregar documento do acordo de confidencialidade e ler para explicar o documento
- Pedir que não se mantenham conversas privadas.
- Tempo estimado da discussão: cerca de 90 minutos

Caros participantes,

Quero expressar o meu sincero agradecimento pela vossa disponibilidade e entusiasmo em participar deste focus group. A vossa colaboração é essencial para o sucesso deste estudo e para o avanço do conhecimento nesta área. Espero, sinceramente, que tenhamos uma tarde produtiva, divertida e repleta de criatividade.

O propósito deste encontro é discutir o modelo de visualização que devo adotar para a minha tese. Para contextualizar, o meu trabalho de investigação centra-se em como contar narrativas provenientes de notícias através da visualização. Como todos já experienciaram, o mercado jornalístico está saturado e somos inundados com informações de várias fontes, o que resulta numa sobrecarga cognitiva, dificuldades em distinguir notícias falsas e numa grande quantidade de tempo gasto diariamente na filtragem da informação.

A partir destas condições, surge a necessidade de comunicar de forma mais acessível e cativante num mundo sobrecarregado de informação. Com o nosso projeto, almejamos despertar o interesse pelas notícias, solucionar as dificuldades na seleção e interpretação das mesmas e minimizar a carga cognitiva dos leitores.

A visualização de notícias é uma prática que consiste na representação visual de informações e conteúdos jornalísticos. Em vez de se limitar ao texto escrito, esta abordagem utiliza elementos gráficos, como gráficos, mapas, infográficos, vídeos, entre outros, para comunicar de forma mais eficaz e atrativa as histórias e dados noticiosos.

Elaborámos wireframes de 15 possíveis ferramentas de visualização que iremos apresentar e gostaríamos de discutir cada uma como uma possível solução. No final, gostaríamos também de realizar uma ronda de questões, pedindo que votem na ferramenta que consideram mais adequada para cada um de vocês.

Este focus group seria gravado para fins de transcrição e análise das contribuições. Por isso, peço que assinem o acordo de confidencialidade, no qual está especificado que posso gravar

áudio durante a sessão, sem a necessidade de identificar individualmente cada um de vocês, garantindo assim o anonimato das vossas opiniões.

Durante a nossa conversa, gostaria de ouvir as vossas opiniões, perspectivas e experiências relacionadas com este tema, bem como o vosso feedback sobre cada ferramenta proposta. As vossas contribuições serão valiosas para identificar insights e padrões que podem informar as conclusões da pesquisa. Espero que este encontro sirva como um guia para selecionar no máximo apenas duas ferramentas de visualização para prosseguir.

Por favor, sintam-se à vontade para partilhar abertamente as vossas ideias e experiências. Este é um espaço seguro e respeitoso, onde todas as vozes são valorizadas. Pedia apenas que evitassem conversas privadas e que colaborassem apenas para a conversa de grupo.

Uma vez mais, agradeço imensamente a vossa participação e colaboração. Sem mais demoras, vamos iniciar o nosso "focus group" que terá a partida em volta dos 90 minutos.

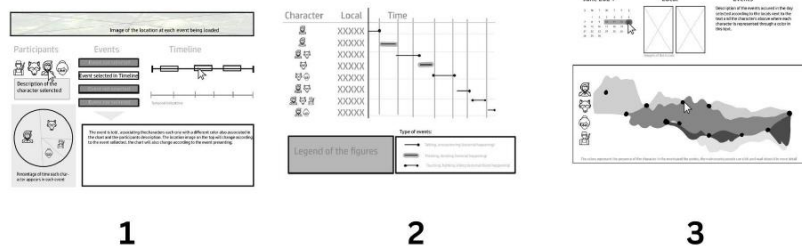
Muito obrigado.

2. Apresentação do material

- Apresentação rápida de todas as visualizações e de como estão a representar a história do capuchinho vermelho assim como esclarecimento do conto

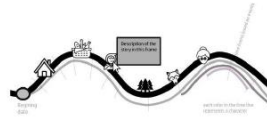
Conto : Capuchinho Vermelho, uma menina, é enviada pela sua mãe para levar comida numa cesta à sua avó que vivia do outro lado do bosque. No caminho, encontra um lobo que a engana, chegando primeiro à casa que ela, devorando a avó e tentando engoli-la também quando a mesma chega. Um caçador intervém, salva-as e mata o lobo.

Ferramentas de visualização agrupadas e numeradas:

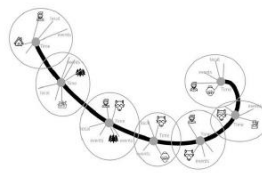


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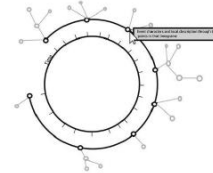
Grupo 1 Dashboard style (1,2,3): Neste grupo as ferramentas de visualização contém mais que um painel, com diversas informações interativas em cada bloco, muito em base de uma construção geométrica com sub-seções dentro.



4

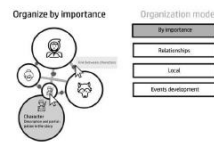


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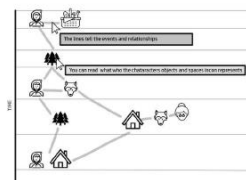


6

Grupo 2 Event focus (4,5,6): Os eventos são como o personagem principal destas ferramentas, sendo que o resto dos elementos deriva deles.

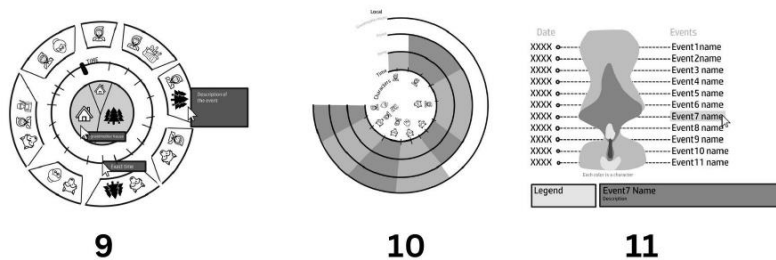


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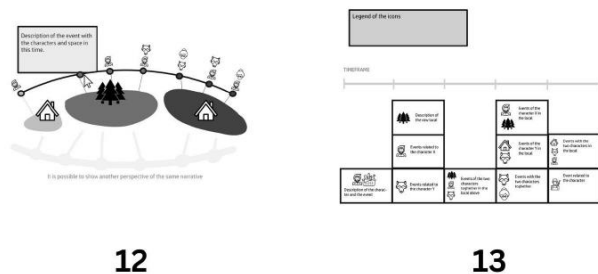


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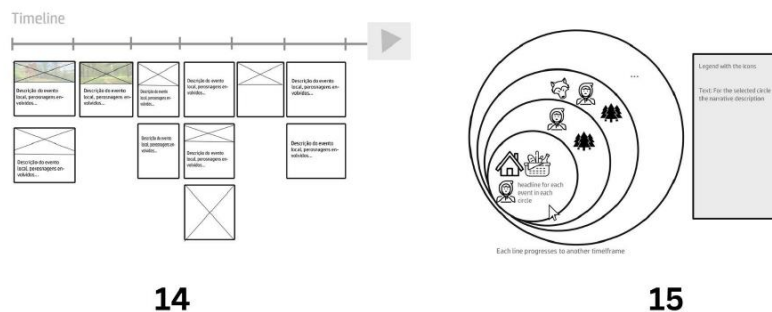
Group 3 Participants link (7,8): A narrativa deriva da ligação estabelecida entre os participantes com outros participantes, locais ou objetos ao longo do tempo.



Group 4 Mixed focuses (9, 10, 11): Os elementos interativos são focados nos eventos e nos participantes, desvendando a narrativa visualmente com esses dois elementos expostos.



Group 5 Perspective(12,13): Nestas duas ferramentas existe a possibilidade de ver mais do que uma só perspectiva sobre uma história.



Group 6 Construct mechanic (14, 15): A lógica aqui é a construção de uma narrativa então funciona com o conceito de se sentir que se está a acrescentar ou mesmo a tirar os elementos,

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conseguindo transmitir a mesma narrativa de uma forma muito simples ou muito complexa dependendo da intenção.

À medida que se apresenta deixar espaço para os participantes acrescentarem ou comentarem algo. Por exemplo após a explicação perguntas abertas como:

- Mudava algo ou acrescentariam algo a estas ferramentas?
- Conseguem perceber a lógica pela qual a narrativa se desenrola?
- Como acrescentariam interatividade?

3. Após análise das ferramentas

- Perguntas:

- Foi possível compreender todas as ferramentas e como a história do capuchinho vermelho estava representada nas mesmas?
- Quais ferramentas preferem e porquê? Tendo em conta a vossa opinião pessoal.
- Quais ferramentas gostaram menos a nível pessoal? E porquê?
- Qual dos grupos mostrados acharam o mais importante, dentro do grupo qual a melhor ferramenta e porquê?
- Ordena por ordem de importância os elementos de uma narrativa: personagens, eventos, tempo, espaço;
- Tendo em conta estas duas narrativas trazidas, indiquem quais ferramentas não conseguem visualizar a contar as duas narrativas e o porquê de escolherem essas.

<https://www.jn.pt/5076613490/vai-defender-irma-e-acaba-barricado-para-escapar-de-cunhado-a-irmao/>

Um homem de 68 anos foi detido em Loures por suspeita de violência doméstica, ameaça agravada e posse ilegal de arma. Ele cortou o abastecimento de água da casa e agrediu verbal e fisicamente a sua companheira. Quando o cunhado dela foi em seu auxílio, o agressor ameaçou-o com uma arma. A polícia interveio e deteve o agressor, que havia se barricado em casa. A vítima relatou ter sido vítima de abusos contínuos e pediu ajuda ao irmão. Após confronto entre o cunhado e o agressor, o irmão da vítima teve que se refugiar e se barricar na casa do casal. O agressor foi detido e aguardava interrogatório judicial.

<https://www.jn.pt/3948076057/manuel-serrao-e-julio-magalhaes-alvos-de-buscas-por-suspeitas-de-fraude-com-subsidios/>

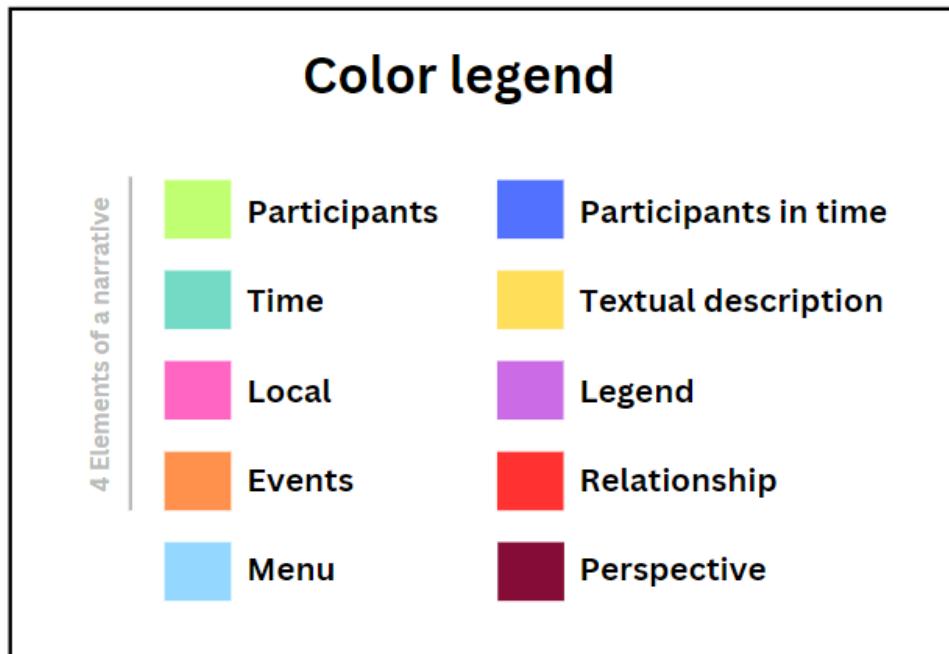
Resumo: Manuel Serrão e Júlio Magalhães estão a ser investigados pela Polícia Judiciária por suspeitas de fraude na obtenção de subsídios comunitários. As buscas estenderam-se a várias empresas e associações dirigidas pelos suspeitos, incluindo a Associação Selectiva Moda, com suspeitas de uso de faturas fraudulentas para inflar os valores de projetos financiados pela União Europeia. A investigação, desde 2015, envolveu cerca de 40 milhões de euros em subsídios do programa Compete 2020. As acusações incluem fraude na obtenção de

subsídios, fraude fiscal, branqueamento de capitais e abuso de poder. A entidade gestora de fundos Compete confirmou as buscas e comprometeu-se a colaborar com a investigação, enfatizando sua dedicação à gestão transparente e rigorosa dos fundos públicos.

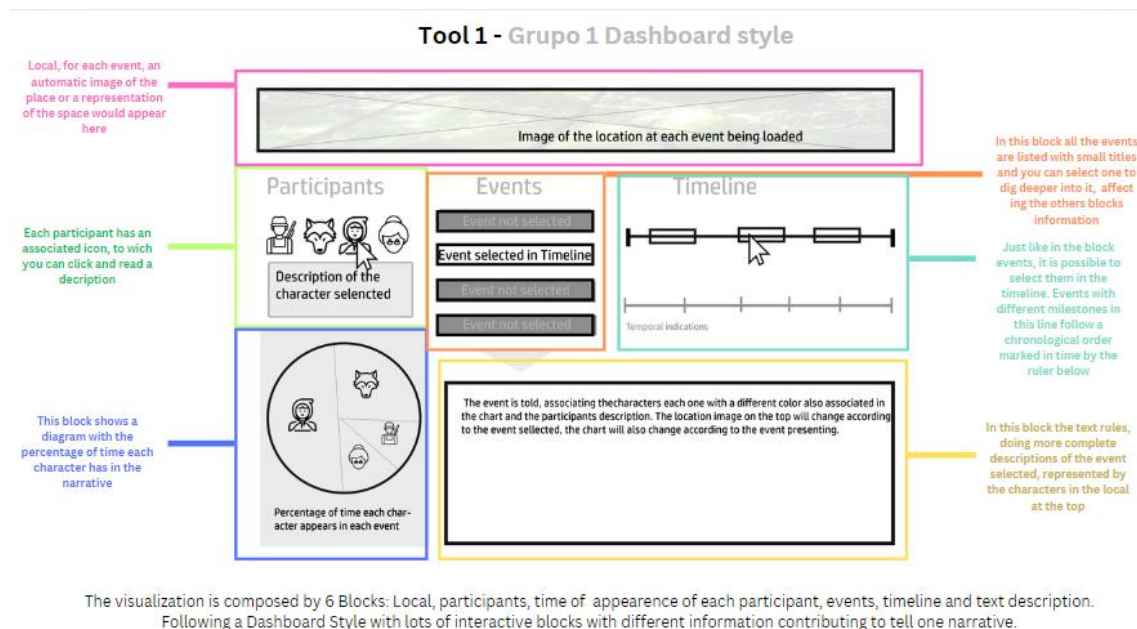
- Acha que para cada estilo de visualização, encaixa melhor tipos de notícias diferentes?
- Dentro dos diferentes grupos, algumas ferramentas utilizam menos gráficos e dão mais importância ao texto (6) , outras priorizam texto e gráficos (11), a maioria utiliza ícones (1,2,3,4,5,7,8,9,10,12,13,15) havendo uma mistura dos próprios ícones interligados com gráficos, e algumas imagens geradas (1,14). Mediante estes suportes visuais comenta e ordena os elementos que achas mais importante nas ferramentas para visualizar uma narrativa: Texto, Gráficos, Ícones, Imagens geradas.
- Da legenda organiza por ordem de importância os elementos presentes nas visualizações

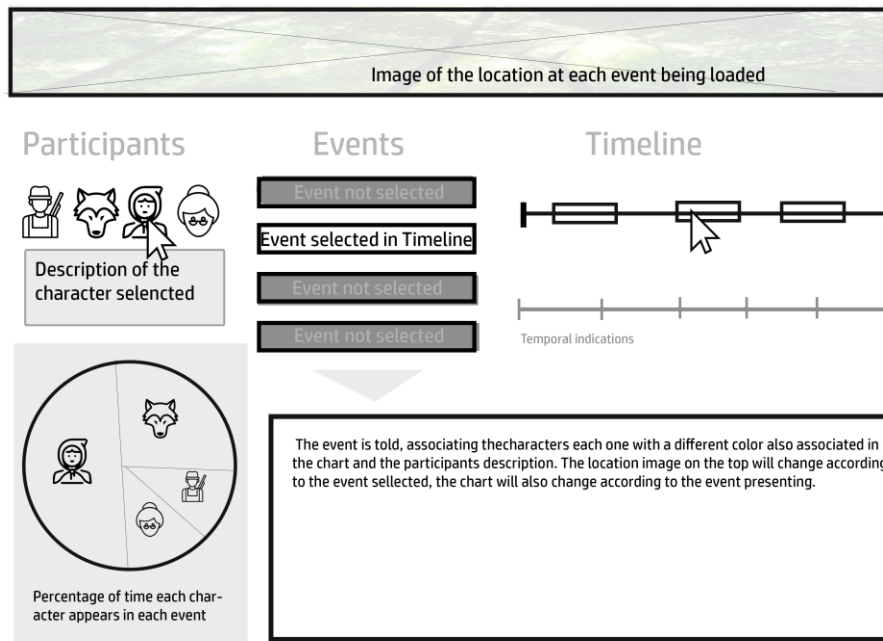
Appendix 3: Focus group materials

Color legend:



Printed materials:



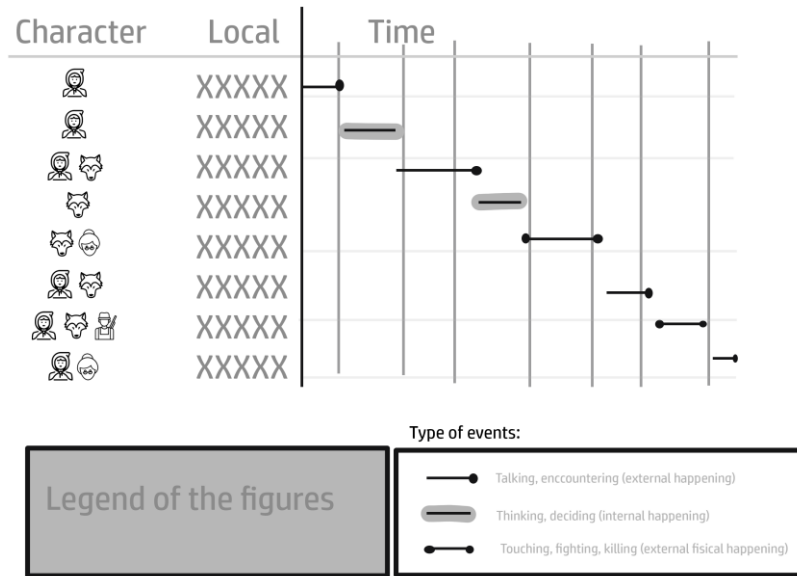


Tool 2 - Grupo 1 Dashboard style

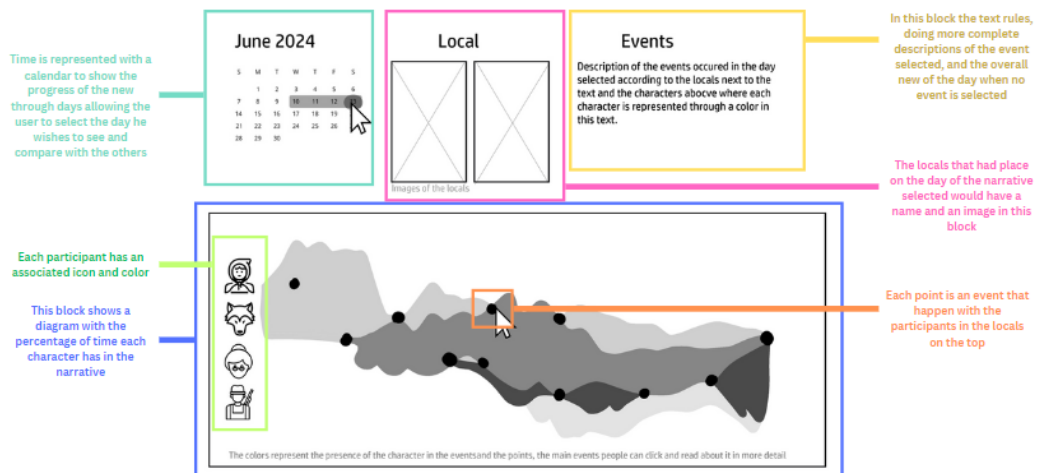


The visualization is composed by 4 Blocks: Participants, local, time and legend. The events can be found drawn inside the time block and explained in the legend. This tool follows Dashboard Style with lots of interactive blocks with different information contributing to tell one narrative.

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Tool 3 - Grupo 1 Dashboard style

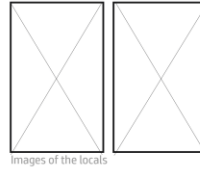


The visualization is composed by 4 Blocks: Time, local, text description, and appearance of each participant with the events. Following a Dashboard Style with lots of interactive blocks with different information contributing to tell one narrative, better suited for long narratives that happen over time to compare data and study the evolution of the happening.

June 2024

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	
21	22	23	24	25	26	
28	29	30				

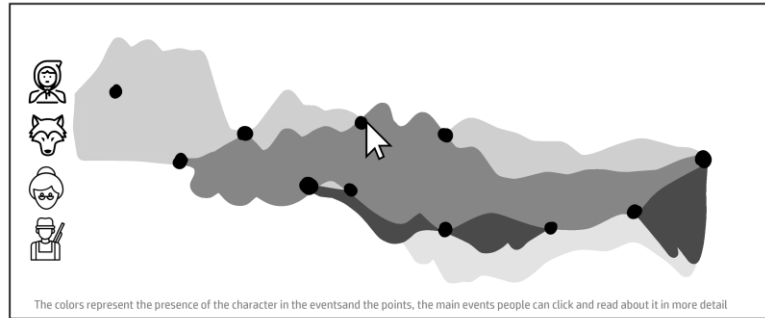
Local



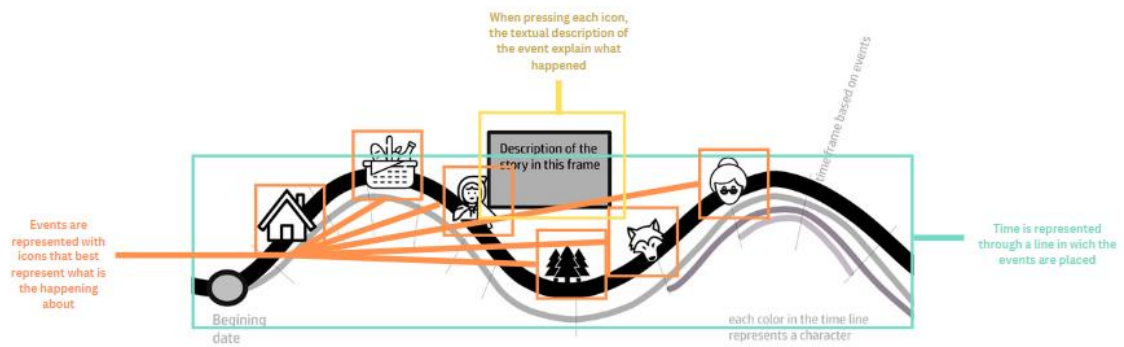
Images of the locals

Events

Description of the events occurred in the day selected according to the locals next to the text and the characters above where each character is represented through a color in this text.

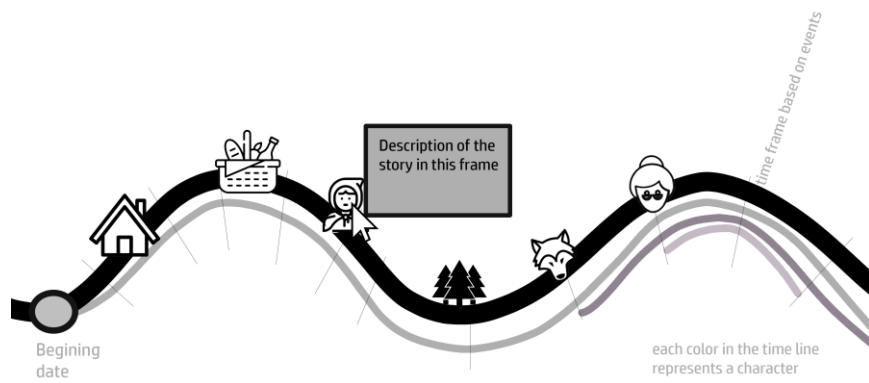


Tool 4 - Grupo 2 Event focus

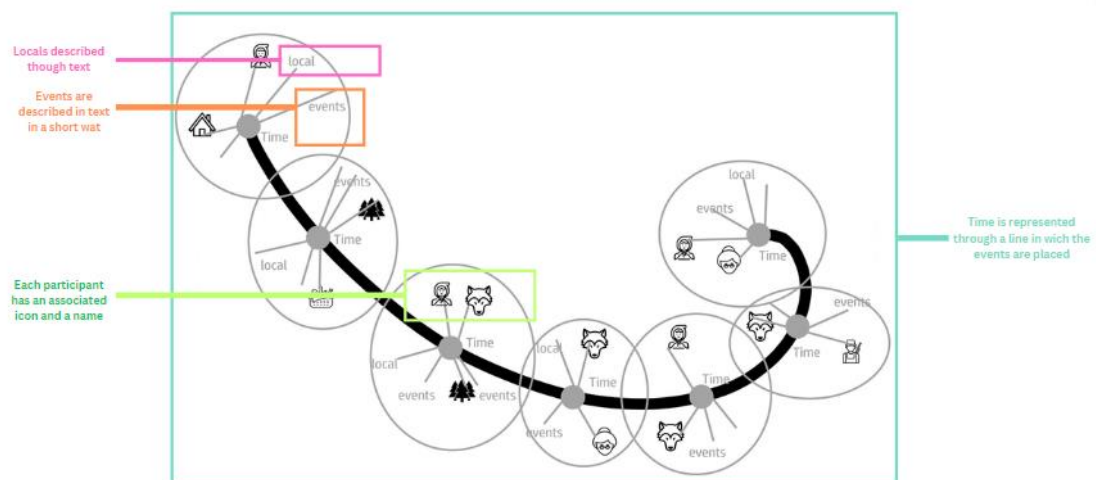


The visualization is composed by a line representing time where the events, represented by icons occur. This Visualization focus a lot on the events since is the only button you can press to read more about it, interacting with the timeline to see more events forward.

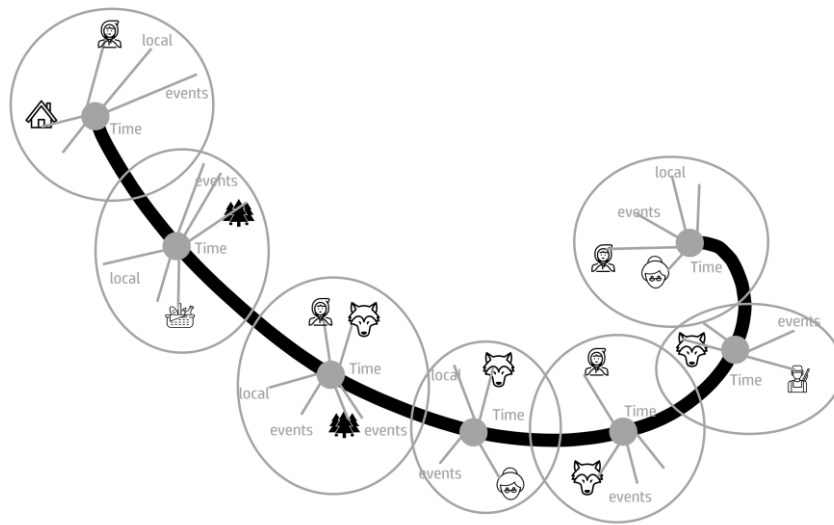
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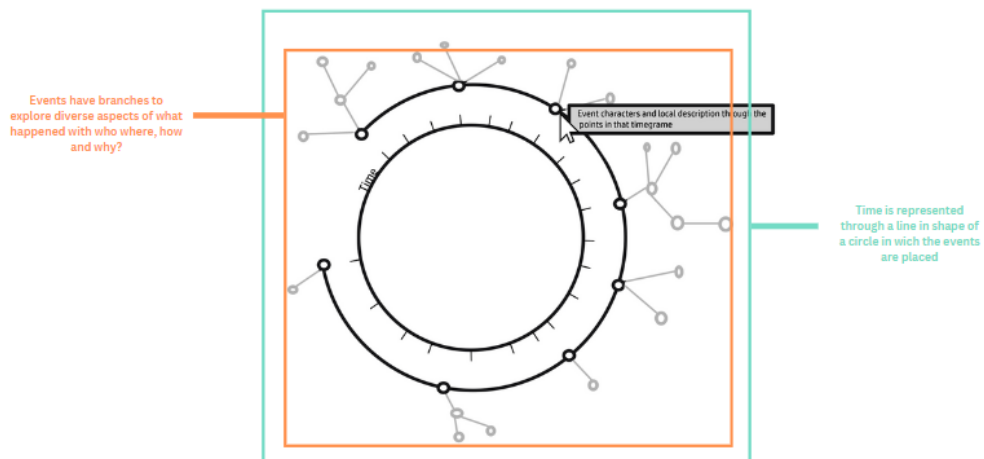
Tool 5 - Grupo 2 Event focus



The visualization is composed by a line representing time where the events, represented by circles. Each circle has branches to elements that compose the event in terms of participants, local and actions and the description of the event itself. This Visualization focus a lot on the events since they mark the timeline and is the only button you can press to read more about it, interacting with the timeline to see more events forward.

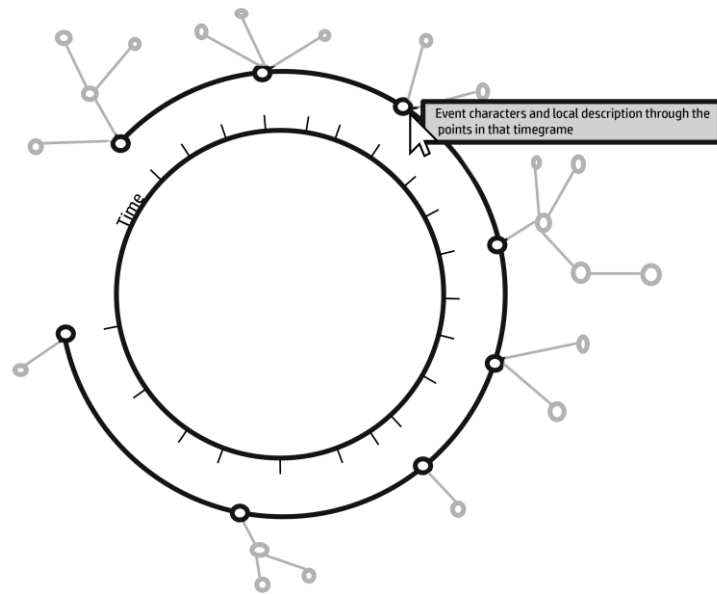


Tool 6 - Grupo 2 Event focus

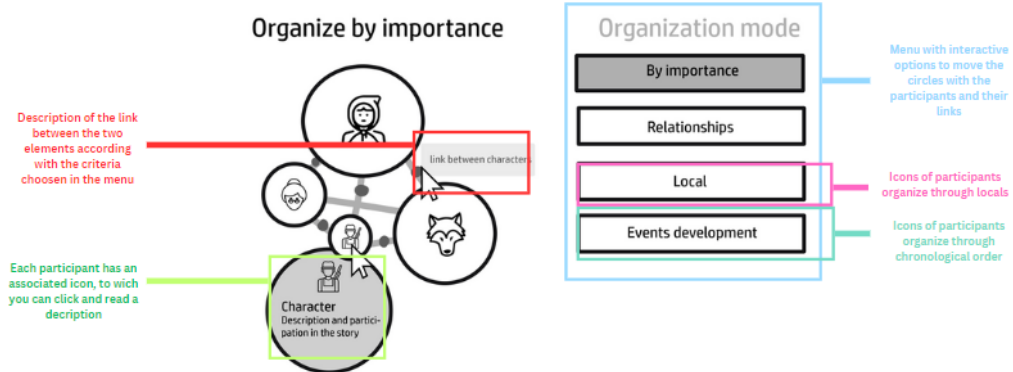


The visualization is composed by 2 elements the timeline and the events that are explored with all the branches in form of text. This Visualization focus a lot on the events since they mark the timeline and is the only button you can interact.

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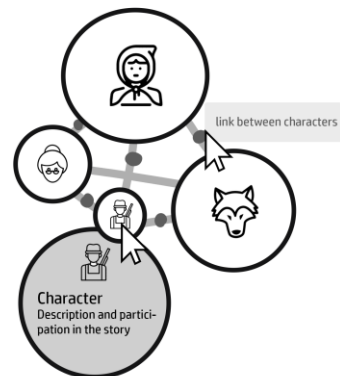


Tool 7 - Group 3 Participants link

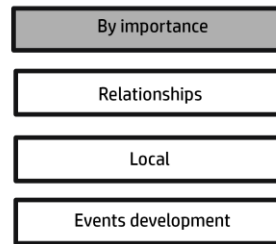


The visualization is composed by two blocks: the interactive circles countaining the characters and their links with each other, and a menu where you can choose the mode that will organise and rewrite the elements and link descriptions. The focus in this visualization is the links because is through there that the narrative will be described.

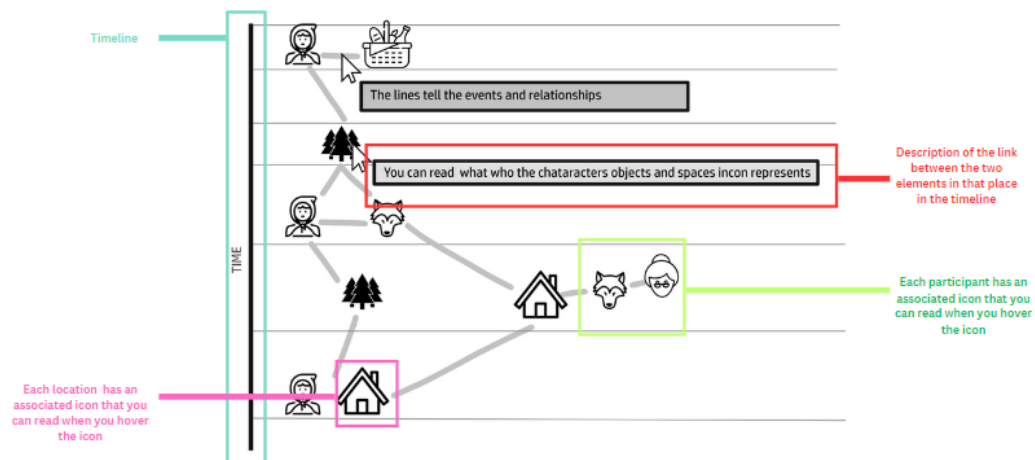
Organize by importance



Organization mode

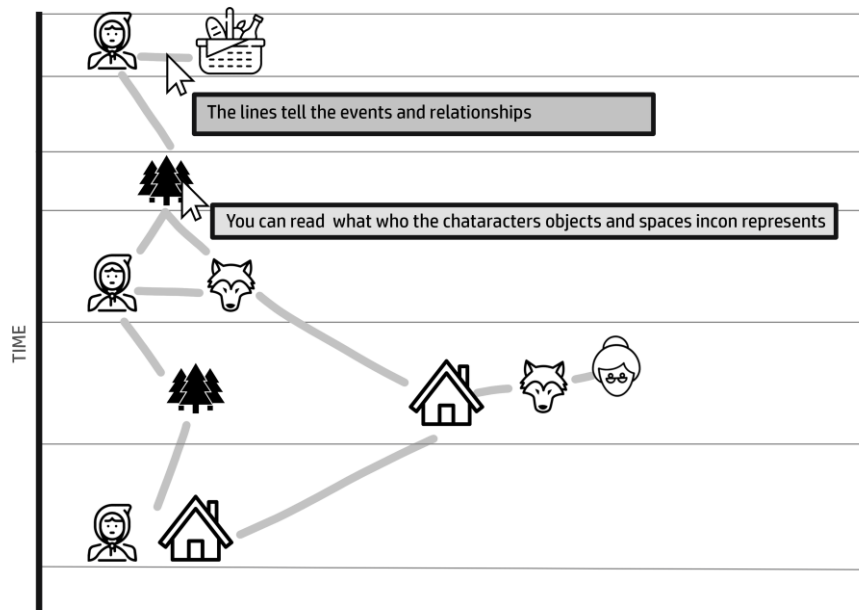


Tool 8 - Group 3 Participants link

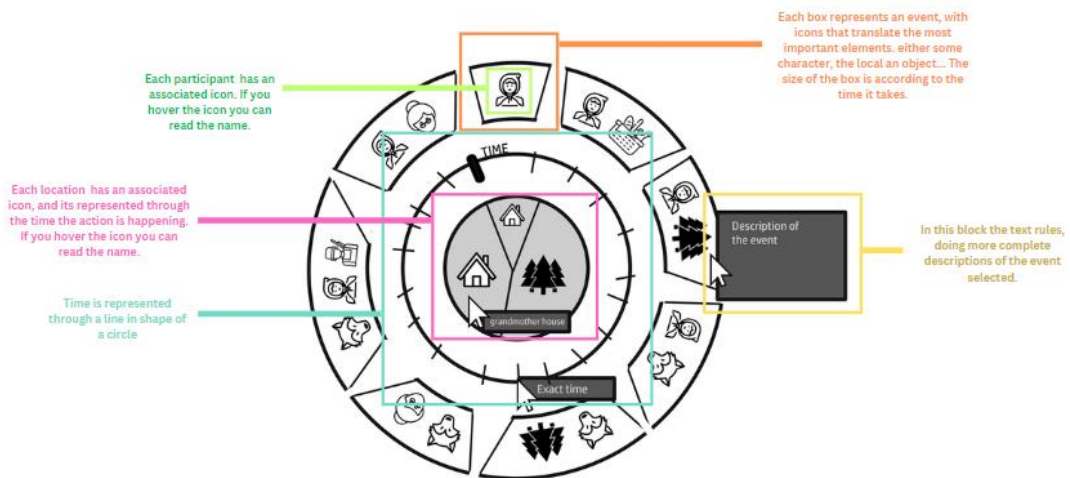


The visualization is composed by a table that puts the icons representing participants, objects and locals according to the timeline of the happening. The focus in this visualization is the links because is through there that the narrative will be described.

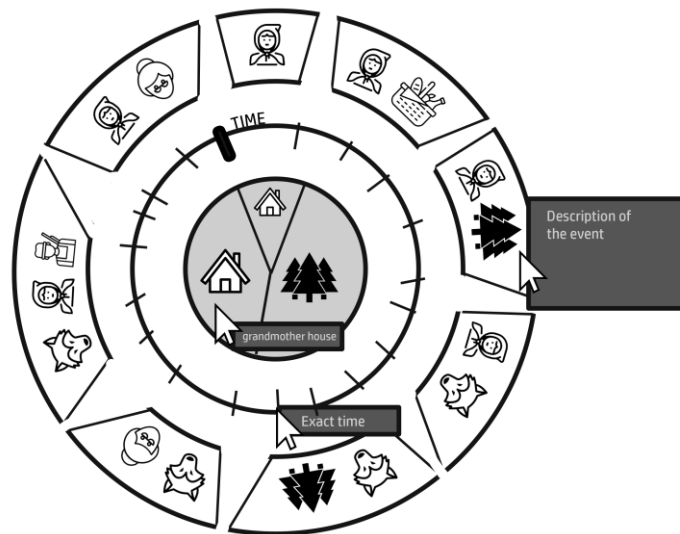
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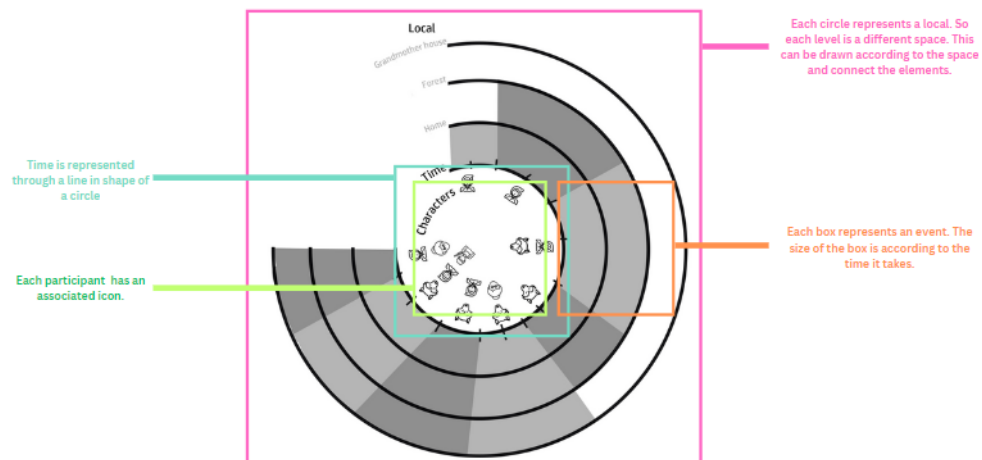
Tool 9 - Group 4 Mixed focuses



The visualization is composed by 3 circles: Local, timeline and events. They are all connected through the shape of the circle where everything fits according to the narrative. This visualization has a mix focus on the events, local and the characters adding interactivity in all without making any of them seem more important to the eye.

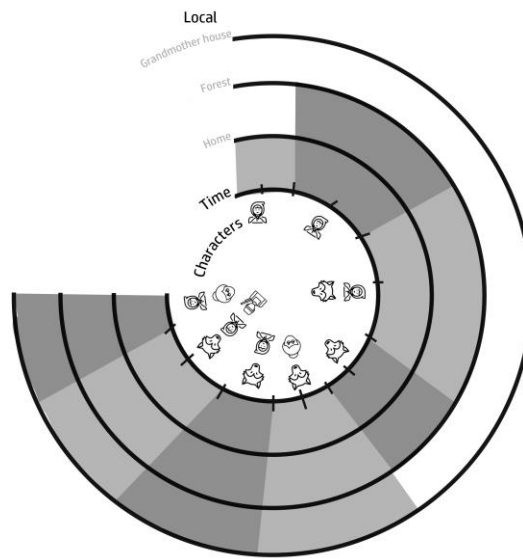


Tool 10 - Group 4 Mixed focuses

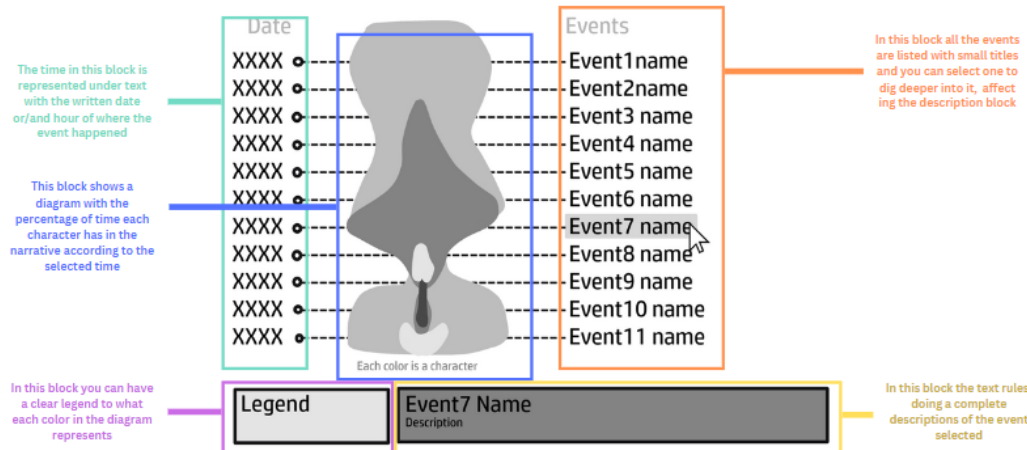


The visualization is composed by 3 elements, participants, local and events. Both compose a visualization together being the three the focus with this mixed focused visualization.

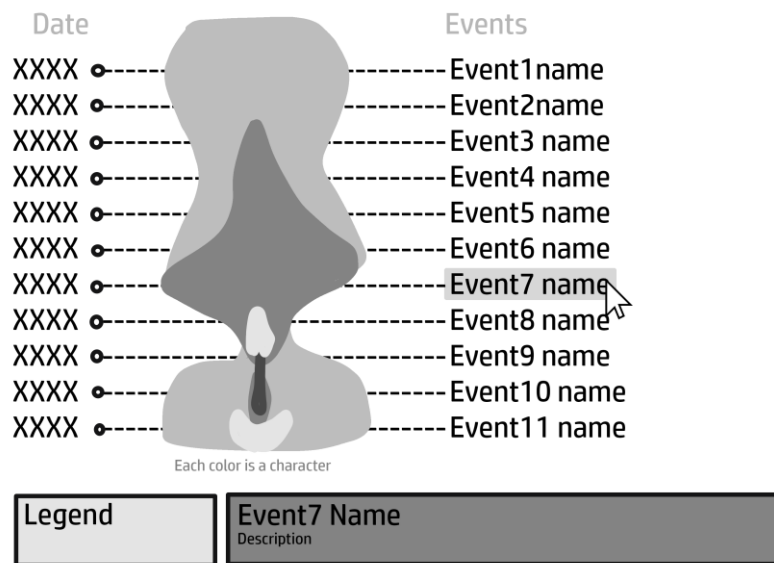
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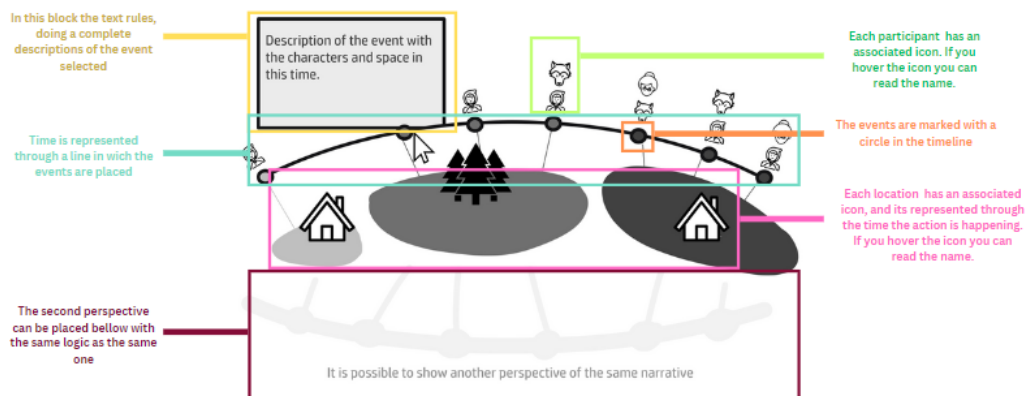
Tool 11 - Group 4 Mixed focuses



The visualization is composed by 5 Blocks: Time, time of appearance of each participant, and a legend that explains who are the characters, events, timeline and text description. The focus is mixed, since we concentrated on the events and the characters.

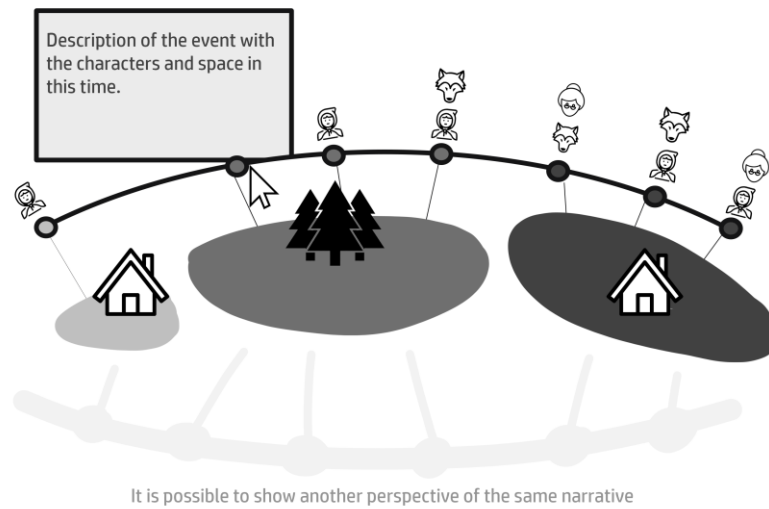


Tool 12 - Group 5 Perspective

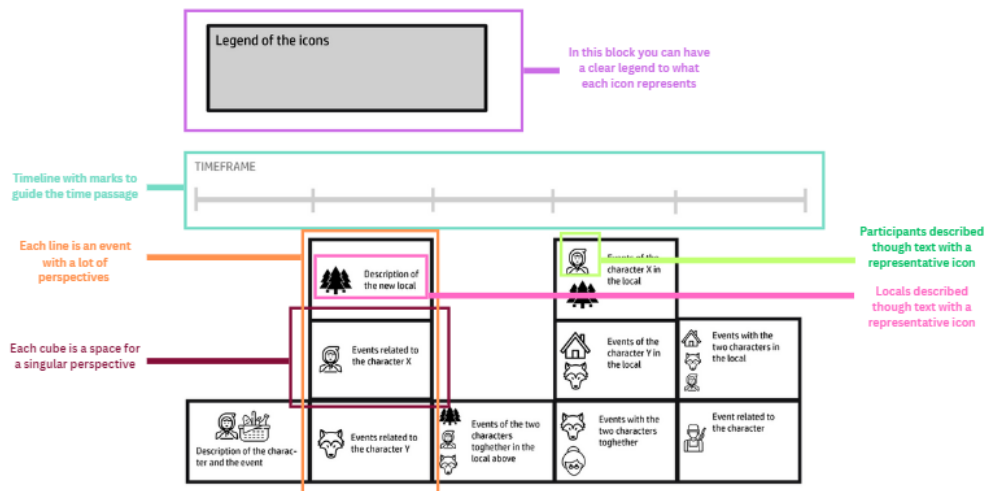


The visualization is composed by a line were the events are marked and associated to characters represented by icons and a location. It is possible to represent other side of the story since the focus of this visualization is the multiple perspectives.

Appendices



Tool 13 - Group 5 Perspective

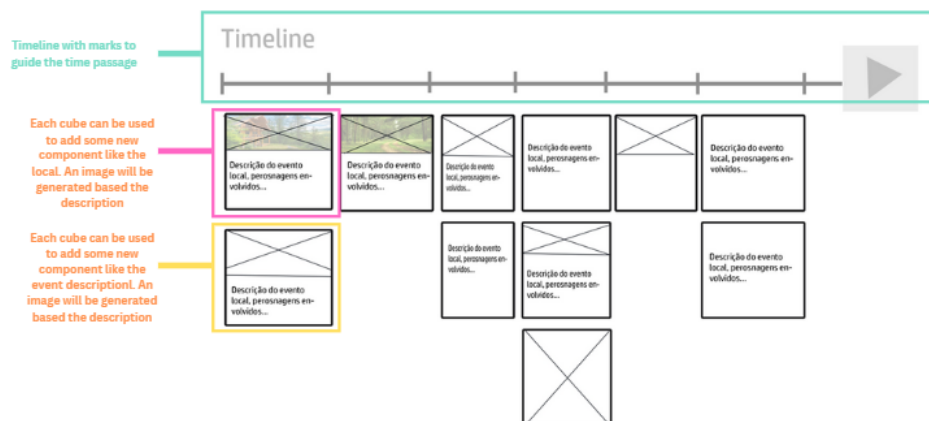


The visualization is composed by 2 Blocks: one for the legend and clarification of the icons and one where the narrative is born, with a timeline to help mark moments, and lines that represent events with different perspectives each one in one rectangle. This visualization leaves space for a lot of perspectives, since it was the focus of its creation to be able to do that.

Legend of the icons

 Description of the character and the event	 Events related to the character Y	 Events of the two characters together in the local above	 Events with the two characters together	 Event related to the character
 Events related to the character X	 Events of the two characters together in the local	 Events of the character Y in the local	 Events with the two characters in the local	
	 Description of the new local		 Events of the character X in the local	

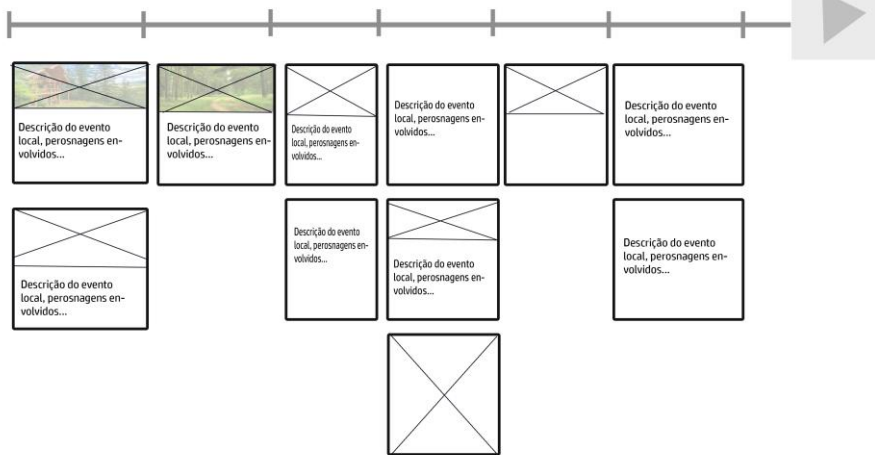
Tool 14 - Group 6 Construct mechanic



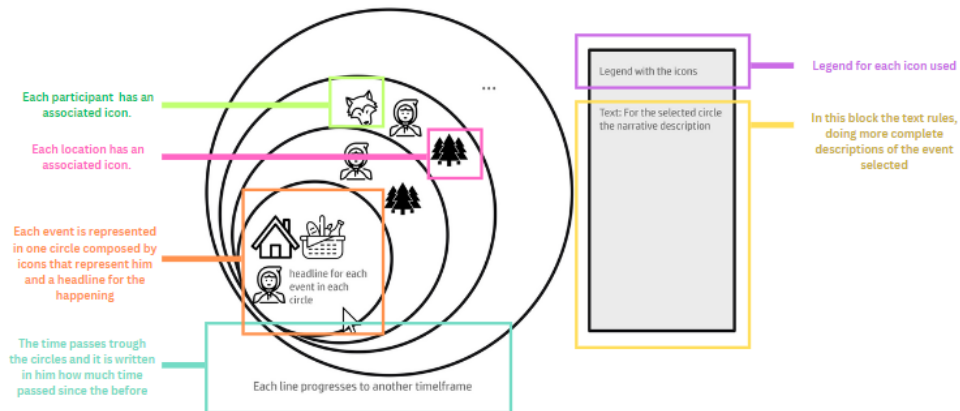
The visualization is composed by a timeline that guide the happenings, and blocks that can be add and can represent everything for the new that happen in that moment. It can be a description of the local, the characters, their link, the event/action that happen. The idea is that you can take and add and its about constructing the narrative with the level of detail that the user wishes. The blocks can have generated images, or choosen images or just have the text.

Appendices

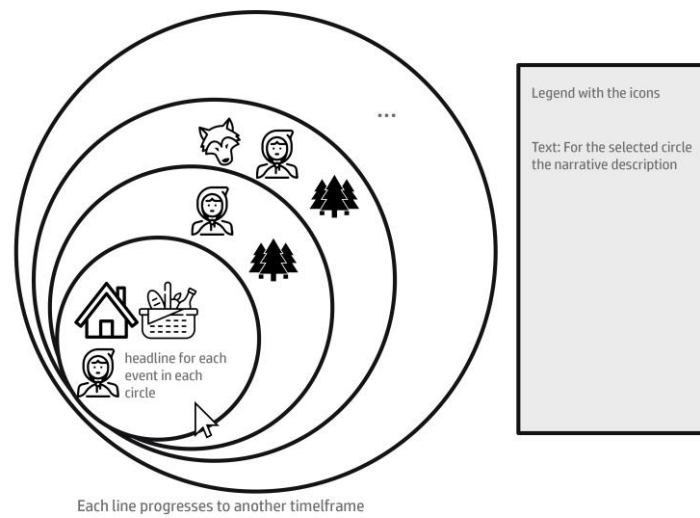
Timeline



Tool 15 - Group 6 Construct mechanic



The visualization is composed by 2 Blocks: The interactive one with circles inside circles that tell the narrative through chronological order, and a part that is made for better understanding the interactive one with a legend to the icons and a detailed description of each event. This visualization focuses on the construction of the narrative with the circles and icons, the user can decide how much circles want and icons, so the level of detail is in his hands.



Digital booklet:



Mestrado Multimedia Faculdade de Engenharia da Universidade do Porto

Como Contar Histórias a Partir de Notícias Usando Visualização?

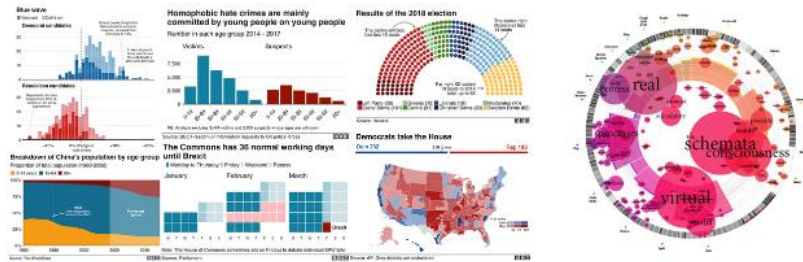
Rita Silva

Orientador: Prof. Sérgio Nunes, PhD
Coorientador: Prof. Ricardo Campos, PhD

Appendices

Definição

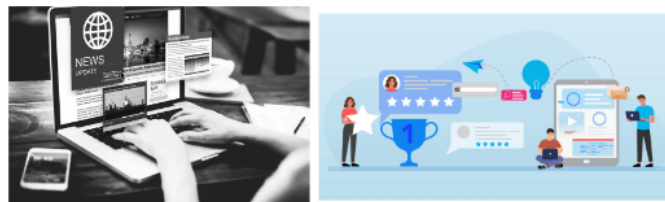
A visualização de notícias é uma prática que consiste na representação visual de informações e conteúdos jornalísticos. Em vez de se limitar ao texto escrito, esta abordagem utiliza elementos gráficos, como gráficos, mapas, infográficos, vídeos, entre outros, para comunicar de forma mais eficaz e atrativa as histórias e dados noticiosos.



Contexto

Atualmente verificamos transformações no jornalismo devido ao avanço da tecnologia e da internet, tornando o mercado extremamente competitivo com acesso gratuito a informações online 24/7.

Isto deu origem a várias formas de transmitir narrativas, através ds novos media, redes sociais, datificação de vários aspetos e a importância crescente da visualização e dos infográficos como formas de comunicação mais acessíveis e envolventes num cenário de sobrecarga informativa



Problema

Dentro das condições mencionadas, surge a necessidade de comunicar informação de forma efetiva, acessível e cativante num mundo sobrecarregado com informação de múltiplas fontes.



Solução proposta

Elaborámos wireframes de 15 ferramentas de visualização. Estas ferramentas encontram-se numa forma simplificada devido à possibilidade de alterações e também para não limitar a forma destas ideias, deixando espaço para as vossas interpretações e sugestões



Appendices

Ferramentas

De seguida vais conseguir ver as 15 ferramentas e a sua explicação. A legenda inicial também determina que cada cor está associada a um elemento, mas se leres o texto consegues entender mais profundamente como irá funcionar. Estas ferramentas estão divididas em 6 grupos que diferem o seu foco e objetivo:

- **Grupo 1 Dashboard style (1,2,3):** Neste grupo as ferramentas de visualização contém mais que um painel, com diversas informações interativas em cada bloco, muito em base de uma construção geométrica com sub-seções dentro.
- **Grupo 2 Event focus (4,5,6):** Os eventos são como o personagem principal destas ferramentas, sendo que o resto dos elementos deriva deles.
- **Grupo 3 Participants link (7,8):** A narrativa deriva da ligação estabelecida entre os participantes com outros participantes, locais ou objetos ao longo do tempo.
- **Grupo 4 Mixed focuses (9, 10, 11):** Os elementos interativos são focados nos eventos e nos participantes, desvendando a narrativa visualmente com esses dois elementos expostos.
- **Grupo 5 Perspective(12,13):** Nestas duas ferramentas existe a possibilidade de ver mais do que uma só perspectiva sobre uma história.
- **Grupo 6 Construct mechanic (14, 15):** A lógica aqui é a construção de uma narrativa então funciona com o conceito de se sentir que se está a acrescentar ou mesmo a tirar os elementos, conseguindo transmitir a mesma narrativa de uma forma muito simples ou muito complexa dependendo da intenção.

Ferramentas

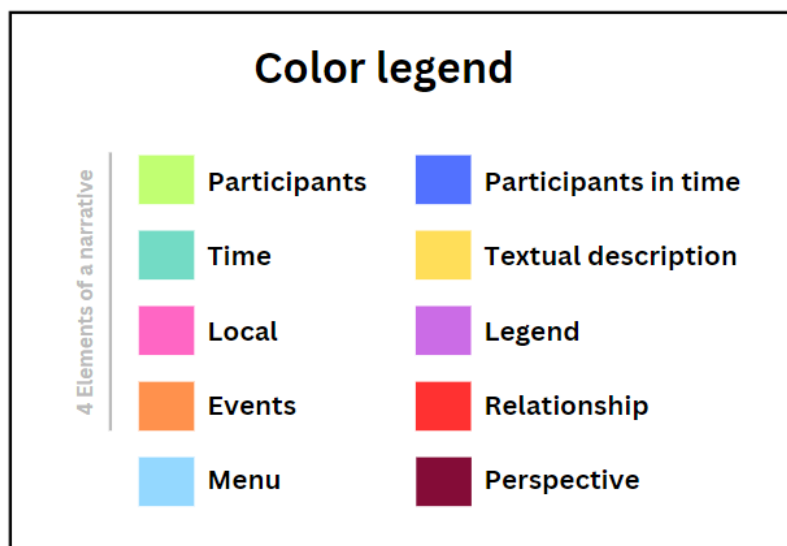
Para ajudares a avaliar e comparar cada ferramenta usamos sempre a história do capuchinho vermelho como ponto de partida escrita desta forma:

“Capuchinho Vermelho, uma menina adorável, é enviada pela mãe para levar comida para a sua avó doente. No caminho, ela encontra um lobo que a engana, devorando a avó e tentando engoli-la também. Um caçador intervém, salva-as e mata o lobo, ensinando a lição sobre os perigos de confiar em estranhos.”

Contamos com o teu interesse e empenho na leitura!
Qualquer dúvida podes apontar para levar ao FocusGroup.

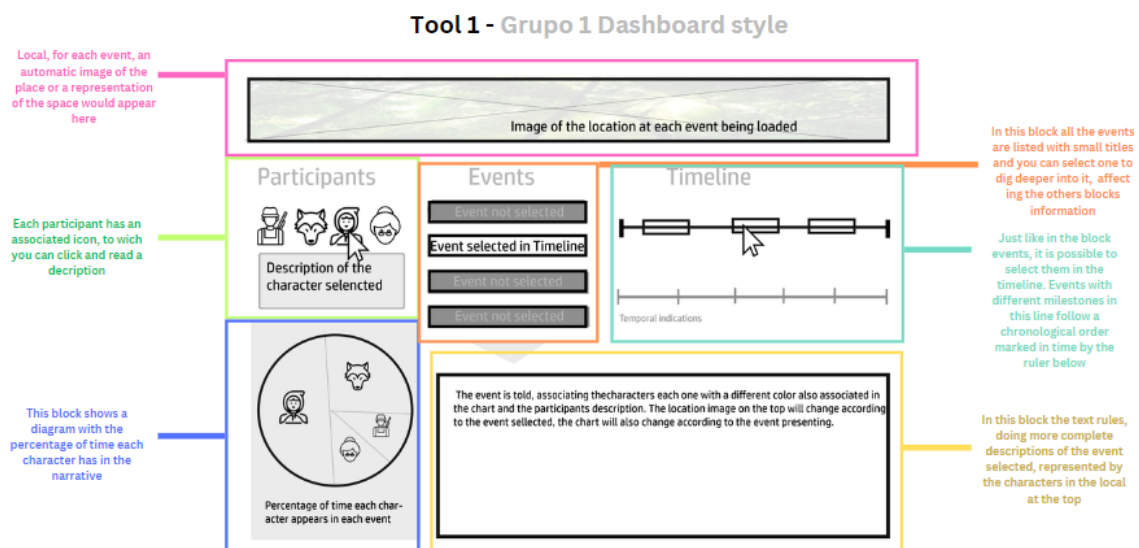
Tarefa

Identificar dois pontos fortes e dois pontos fracos de cada uma das ferramentas.



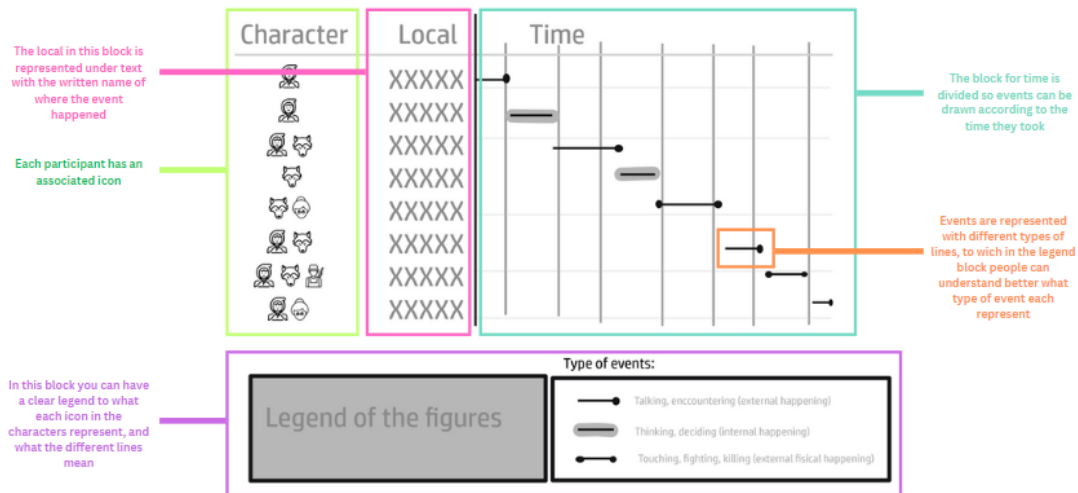
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Grupo 1 Dashboard style



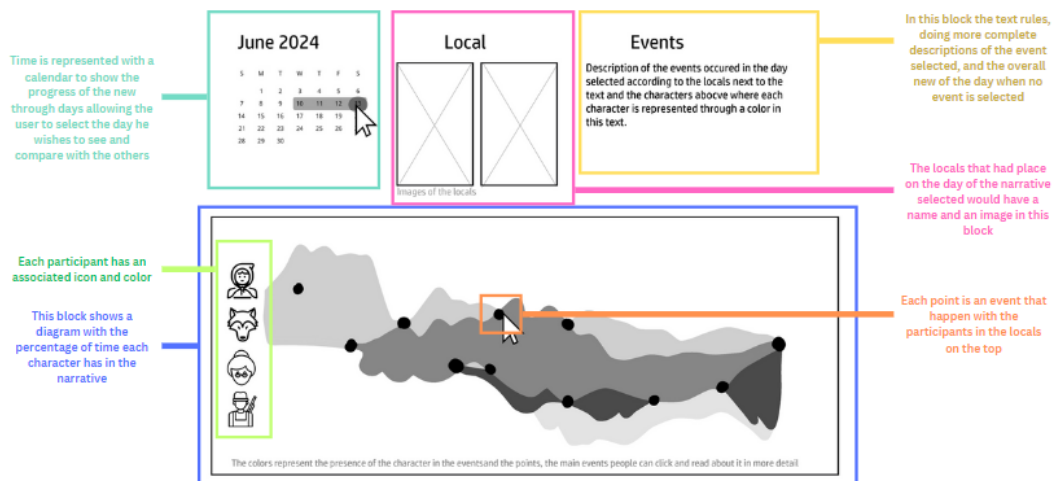
The visualization is composed by 6 Blocks: Local, participants, time of appearance of each participant, events, timeline and text description. Following a Dashboard Style with lots of interactive blocks with different information contributing to tell one narrative.

Tool 2 - Grupo 1 Dashboard style



The visualization is composed by 4 Blocks: Participants, local, time and legend. The events can be found drawn inside the time block and explained in the legend. This tool follows Dashboard Style with lots of interactive blocks with different information contributing to tell one narrative.

Tool 3 - Grupo 1 Dashboard style

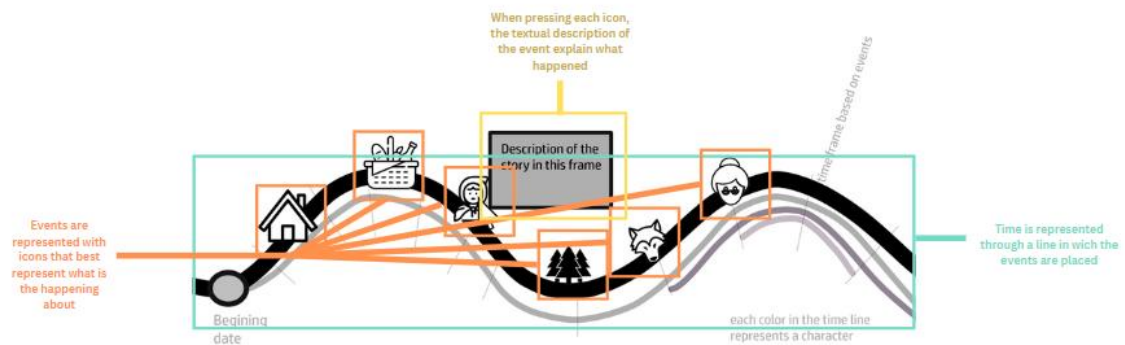


The visualization is composed by 4 Blocks: Time, local, text description, and appearance of each participant with the events. Following a Dashboard Style with lots of interactive blocks with different information contributing to tell one narrative, better suited for long narratives that happen over time to compare data and study the evolution of the happening.

Appendices

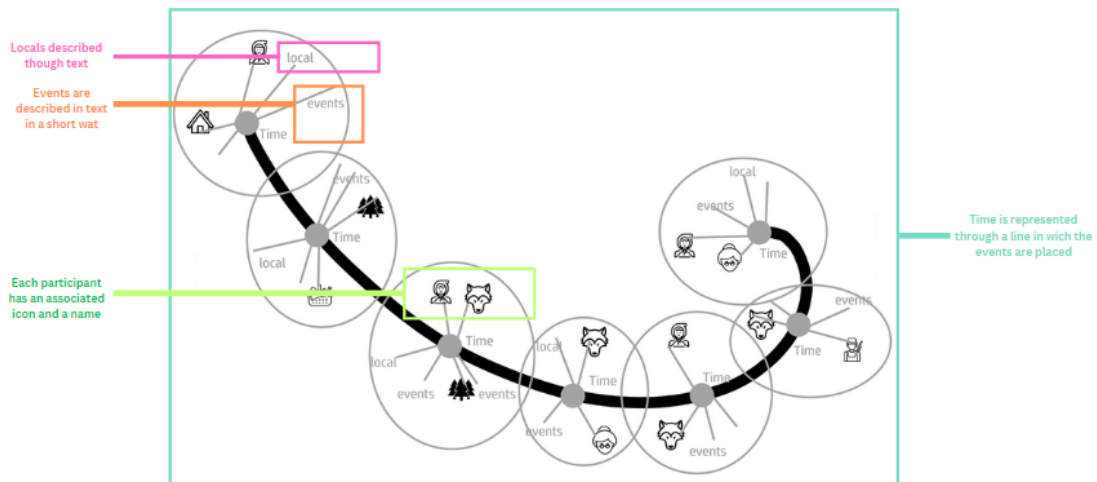
Grupo 2 Event focus

Tool 4 - Grupo 2 Event focus



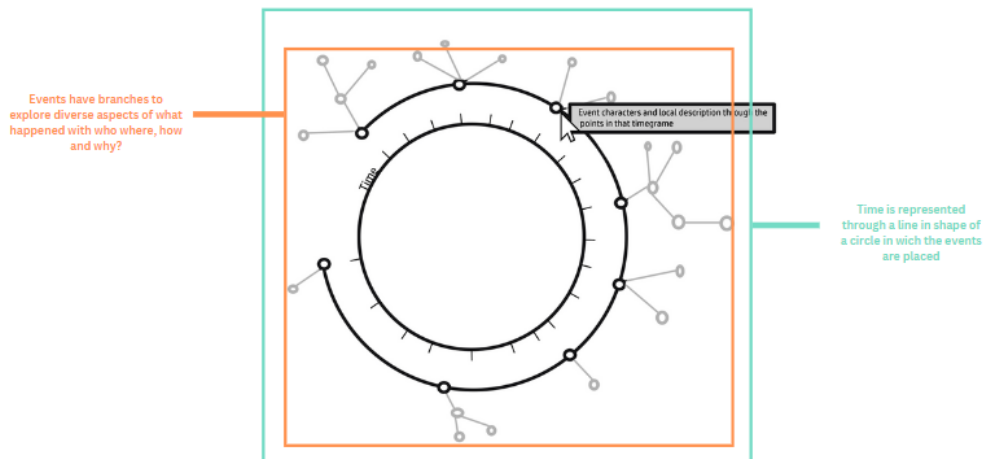
The visualization is composed by a line representing time where the events, represented by icons occur. This Visualization focus a lot on the events since is the only button you can press to read more about it, interacting with the timeline to see more events foward.

Tool 5 - Grupo 2 Event focus



The visualization is composed by a line representing time where the events, represented by circles. Each circle has branches to elements that compose the event in terms of participants, local and actions and the description of the event itself. This Visualization focus a lot on the events since they mark the timeline and is the only button you can press to read more about it, interacting with the timeline to see more events forward.

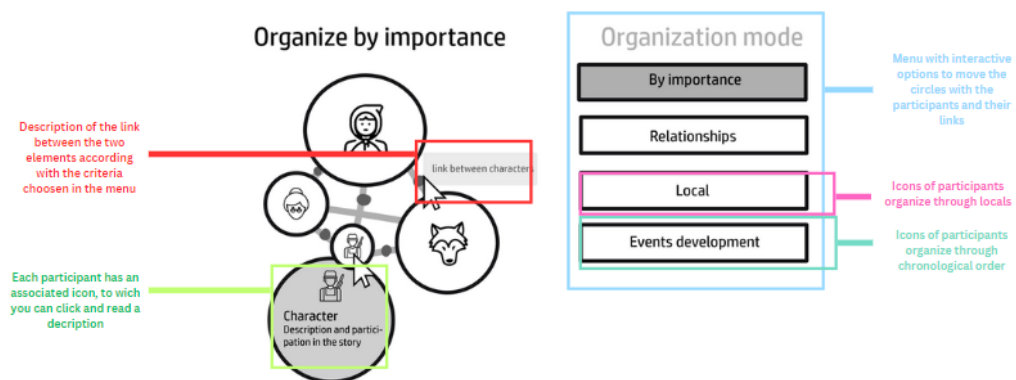
Tool 6 - Grupo 2 Event focus



The visualization is composed by 2 elements the timeline and the events that are explored with all the branches in form of text. This Visualization focus a lot on the events since they mark the timeline and is the only button you can interact.

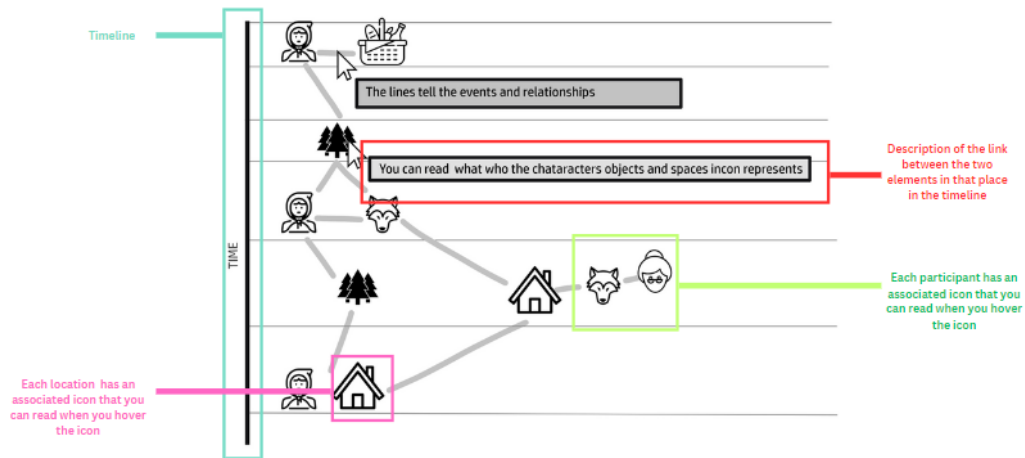
Group 3 Participants link

Tool 7 - Group 3 Participants link



The visualization is composed by two blocks: the interactive circles containing the characters and their links with each other, and a menu where you can choose the mode that will organise and rewrite the elements and link descriptions. The focus in this visualization is the links because is through there that the narrative will be described.

Tool 8 - Group 3 Participants link

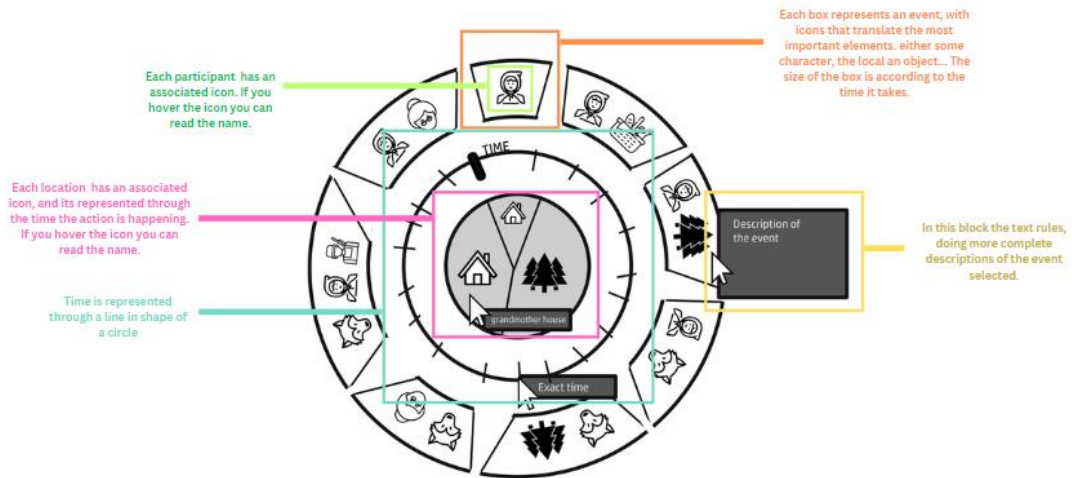


The visualization is composed by a table that puts the icons representing participants, objects and locals according to the timeline of the happening. The focus in this visualization is the links because is through there that the narrative will be described.

Group 4 Mixed focuses

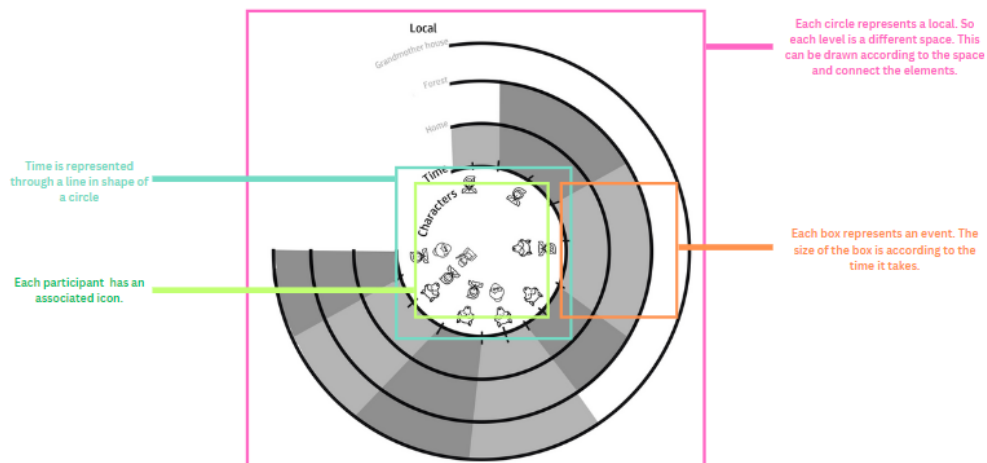
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Tool 9 - Group 4 Mixed focuses



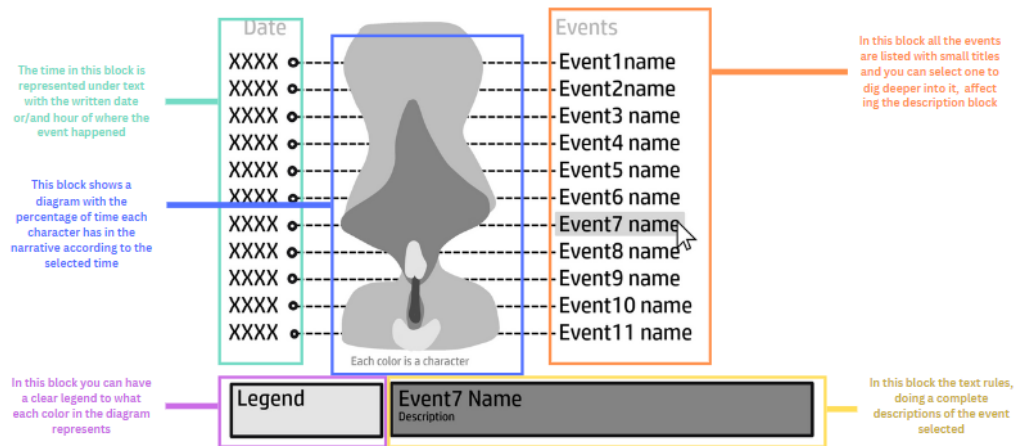
The visualization is composed by 3 circles: Local, timeline and events. They are all connected through the shape of the circle where everything fits according to the narrative. This visualization has a mix focus on the events, local and the characters adding interactivity in all without making any of them seem more important to the eye.

Tool 10 - Group 4 Mixed focuses



The visualization is composed by 3 elements, participants, local and events. Both compose a visualization together being the three the focus with this mixed focused visualization.

Tool 11 - Group 4 Mixed focuses

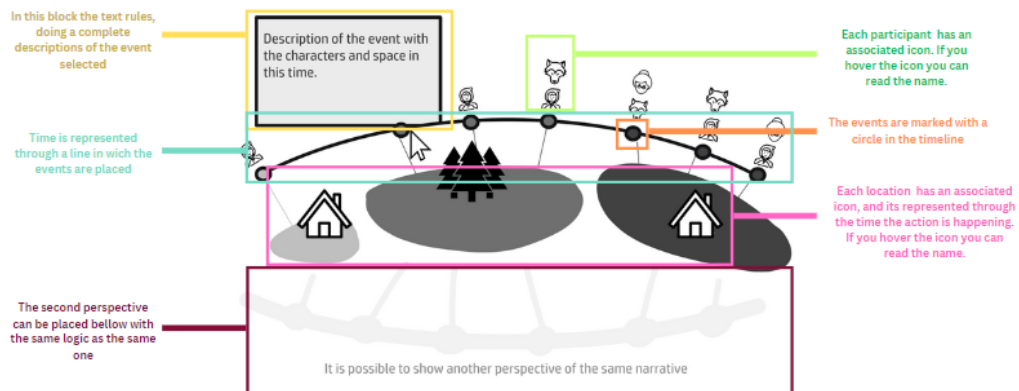


The visualization is composed by 5 Blocks: Time, time of appearance of each participant, and a legend that explains who are the characters, events, timeline and text description. The focus is mixed, since we concentrated on the events and the characters.

Group 5 Perspective

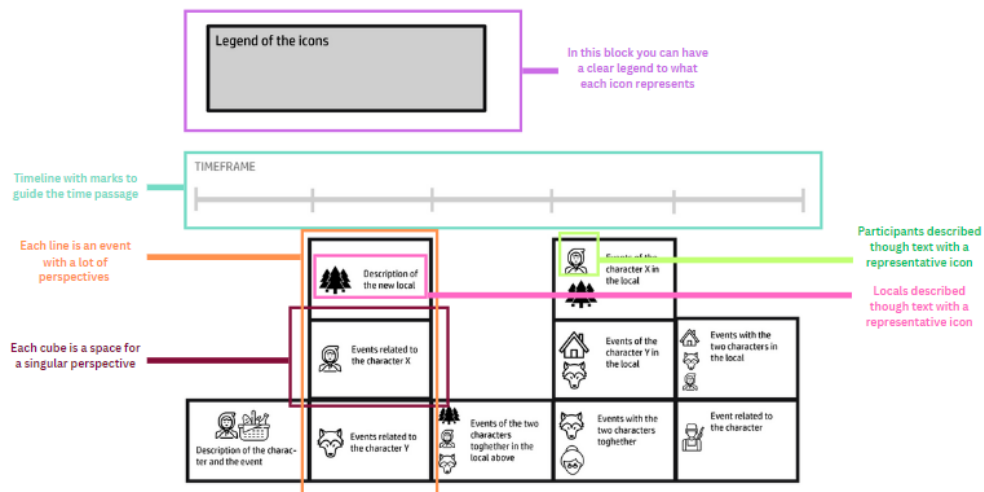
Appendices

Tool 12 - Group 5 Perspective



The visualization is composed by a line where the events are marked and associated to characters represented by icons and a location. It is possible to represent other side of the story since the focus of this visualization is the multiple perspectives.

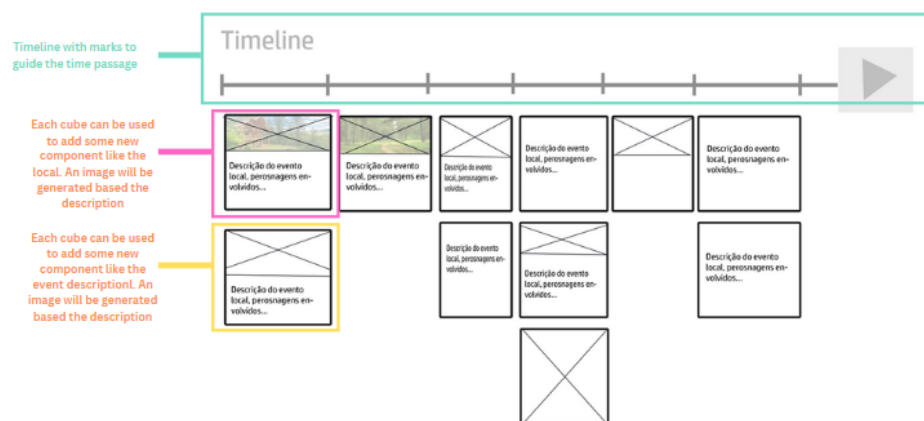
Tool 13 - Group 5 Perspective



The visualization is composed by 2 Blocks: one for the legend and clarification of the icons and one where the narrative is born, with a timeline to help mark moments, and lines that represent events with different perspectives each one in one rectangle. This visualization leaves space for a lot of perspectives, since it was the focus of its creation to be able to do that.

Group 6 Construct mechanic

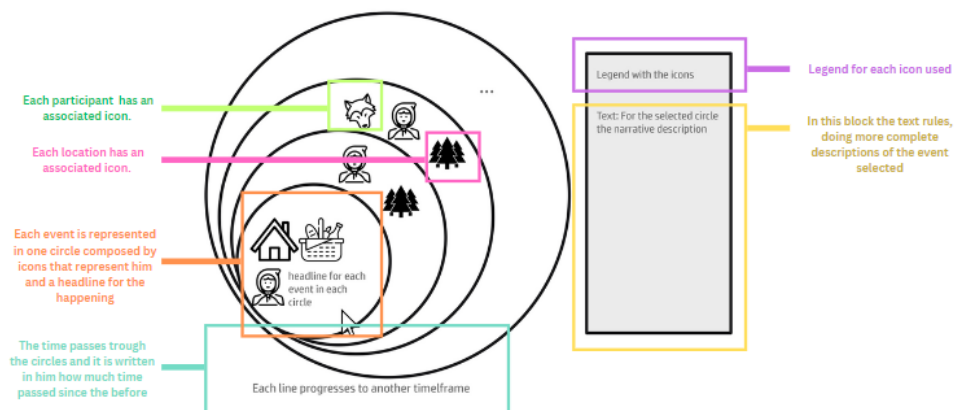
Tool 14 - Group 6 Construct mechanic



The visualization is composed by a timeline that guide the happenings, and blocks that can be add and can represent everything for the new that happen in that moment. It can be a description of the local, the characters, their link, the event/action that happen. The idea is that you can take and add and its about constructing the narrative with the level of detail that the user wishes. The blocks can have generated images, or choosen images or just have the text.

Appendices

Tool 15 - Group 6 Construct mechanic



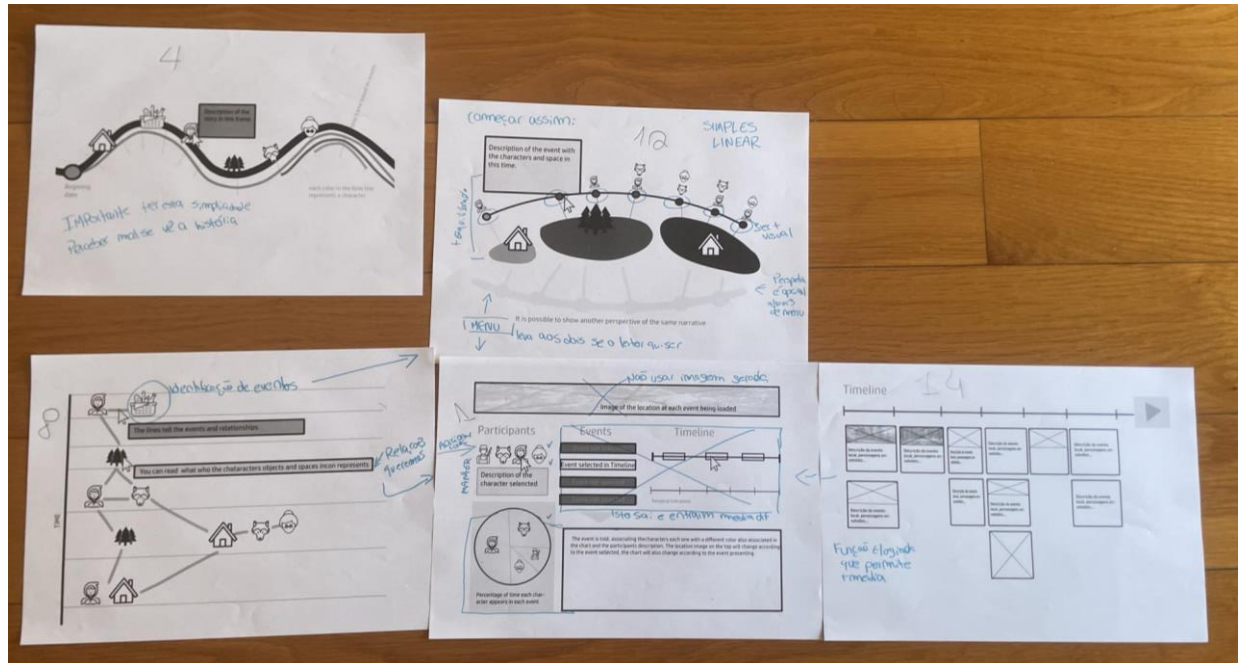
The visualization is composed by 2 Blocks: The interactive one with circles inside circles that tell the narrative through chronological order, and a part that is made for better understanding the interactive one with a legend to the icons and a detailed description of each event. This visualization focuses on the construction of the narrative with the circles and icones, the user can decide how much circles want and icones, so the level of detail its in his hands.



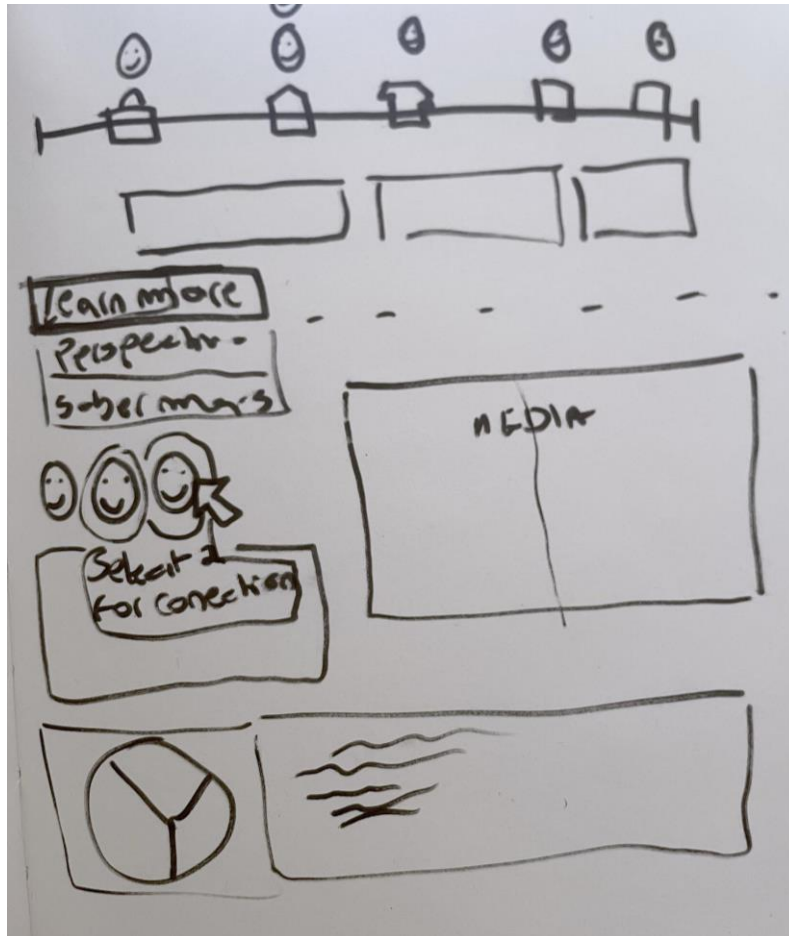
Obrigada pela tua participação!

Vemo-nos a 29/03/2024

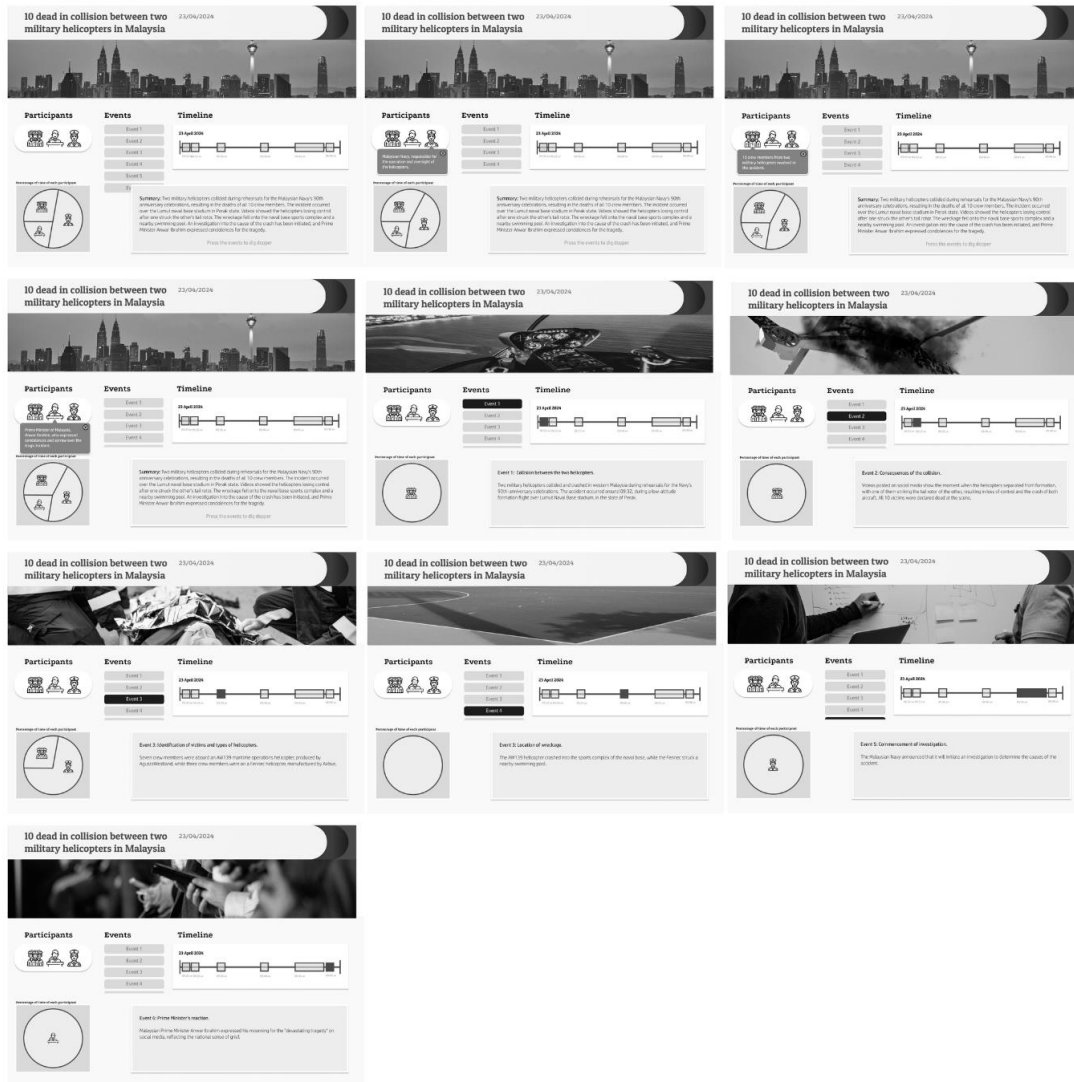
Appendix 4: Co-creation session annotation on printed tools



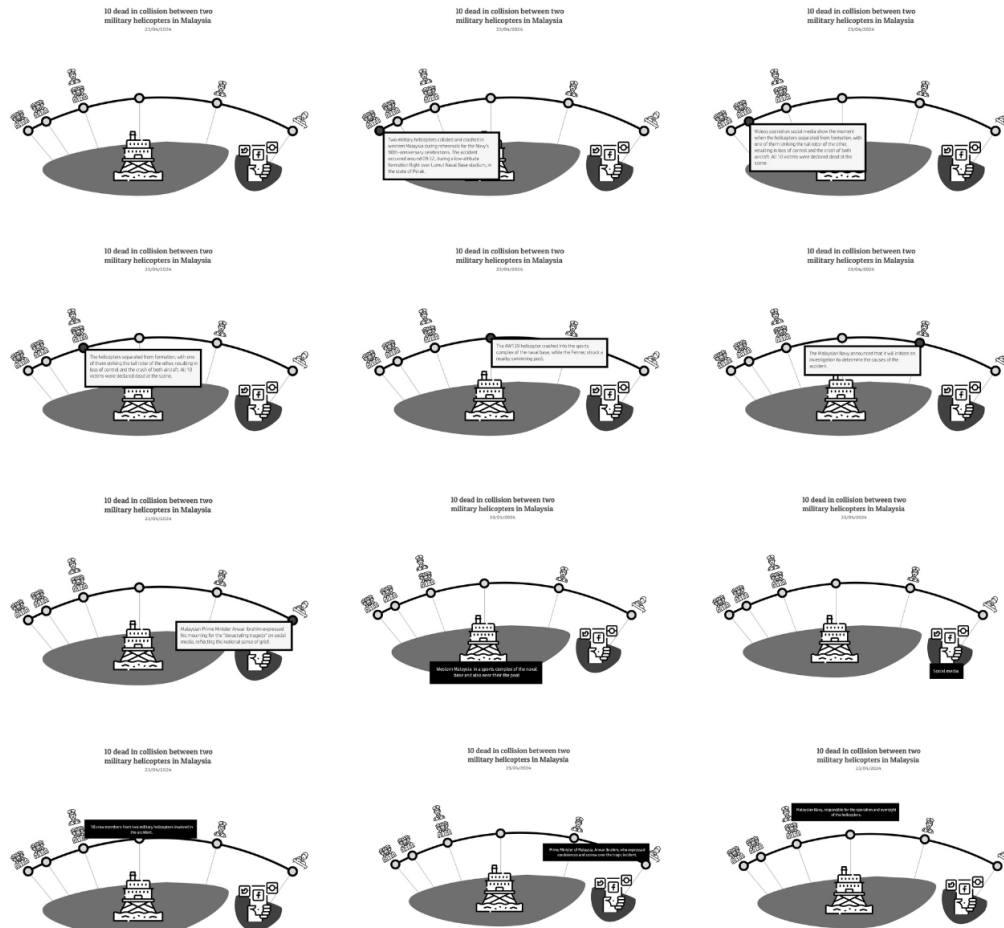
Appendix 5: Co-created tool sketch



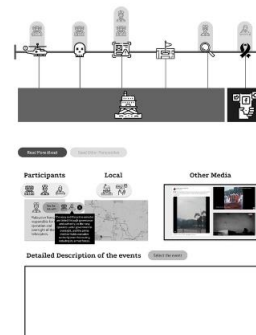
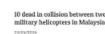
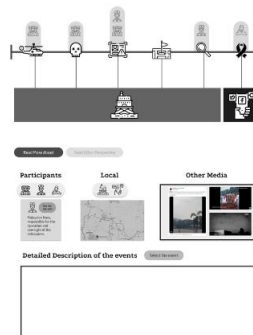
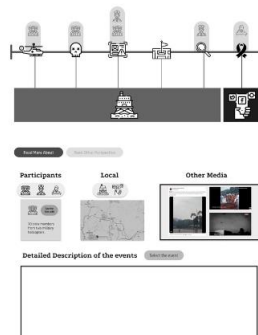
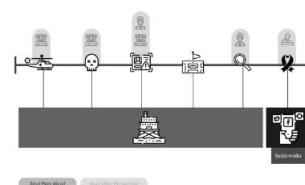
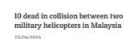
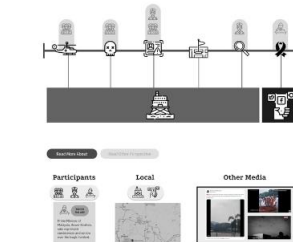
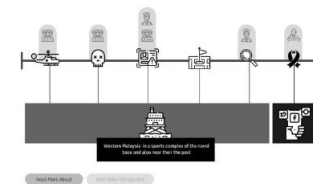
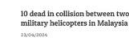
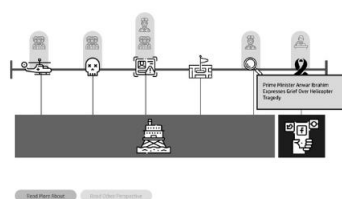
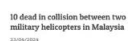
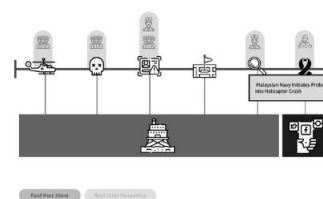
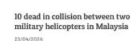
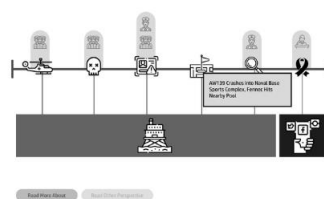
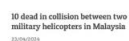
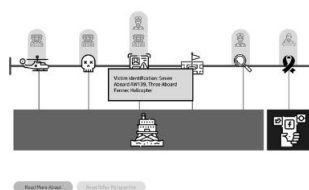
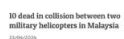
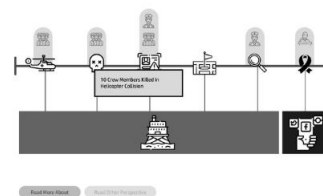
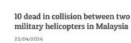
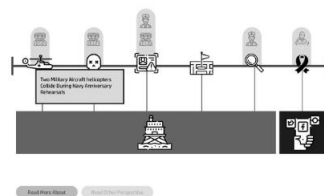
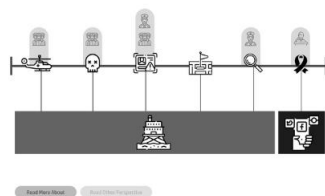
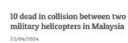
Appendix 6: Prototype of tool 1



Appendix 7: Prototype of tool 12

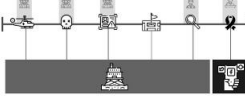
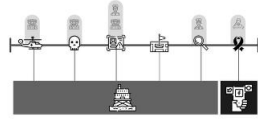


Appendix 8: Prototype of the co-created tool

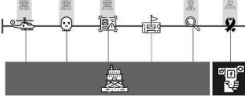
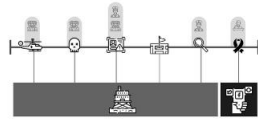


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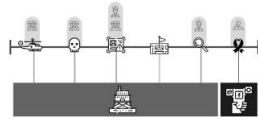
10 dead in collision between two military helicopters in Malaysia
12/04/2014



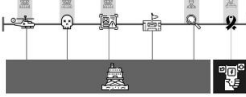
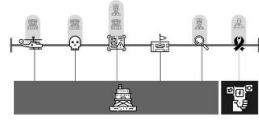
10 dead in collision between two military helicopters in Malaysia
12/04/2014



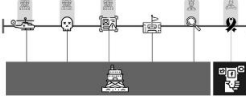
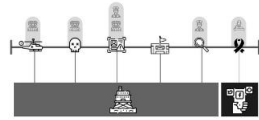
10 dead in collision between two military helicopters in Malaysia
12/04/2014



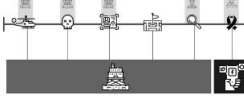
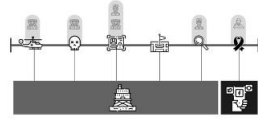
10 dead in collision between two military helicopters in Malaysia
12/04/2014



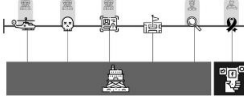
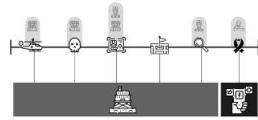
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10 dead in collision between two military helicopters in Malaysia
22/04/2014

Participants

Local

Other Media

Detailed Description of the events

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Appendix 9: Evaluation focus group guide

Guião

1. Apresentação do tema: 5 Minutos

Quero expressar o meu sincero agradecimento pela vossa disponibilidade e entusiasmo em participar deste focus group. A vossa colaboração é essencial para o sucesso deste estudo e para o avanço do conhecimento nesta área.

O propósito deste encontro é discutir os modelos de visualização explorados na minha tese, assim como as suas características a nível de design, comunicação e experiência. Para contextualizar, o meu trabalho de investigação centra-se em como contar narrativas provenientes de notícias através da visualização. Como todos já experienciaram, o mercado jornalístico está saturado e somos inundados com informações de várias fontes, o que resulta numa sobrecarga cognitiva, dificuldades em distinguir notícias falsas e numa grande quantidade de tempo gasto diariamente na filtragem da informação.

A partir destas condições, surge a necessidade de comunicar de forma mais acessível e cativante num mundo sobrecarregado de informação. Com o nosso projeto, almejamos despertar o interesse pelas notícias, solucionar as dificuldades na seleção e interpretação das mesmas e minimizar a carga cognitiva dos leitores.

A visualização de notícias é uma prática que consiste na representação visual de informações e conteúdos jornalísticos. Em vez de se limitar ao texto escrito, esta abordagem utiliza elementos gráficos, como gráficos, mapas, infográficos, vídeos, entre outros, para comunicar de forma mais eficaz e atrativa as histórias e dados noticiosos.

Elaborámos wireframes de 3 protótipos de ferramentas de visualização que iremos apresentar e gostaríamos de discutir cada uma como uma possível solução, assim como ter as vossas opiniões manifestadas nos formulários que vos dei. No final, gostaríamos também de realizar uma ronda de questões e discutir alguns temas coletivamente.

Este focus group seria gravado para fins de transcrição e análise das contribuições. Por isso, peço que assinem o acordo de confidencialidade, no qual está especificado que posso gravar áudio durante a sessão, sem a necessidade de identificar individualmente cada um de vocês, garantindo assim o anonimato das vossas opiniões.

Durante a nossa conversa, gostaria de ouvir as vossas opiniões, perspetivas e experiências relacionadas com este tema, bem como o vosso feedback sobre cada ferramenta proposta. As vossas contribuições serão valiosas para identificar insights e padrões que podem informar as conclusões da pesquisa. Espero que este encontro sirva como um guia para otimizar a comunicação de narrativas através da aplicação eficaz de princípios de design visual e práticas de ilustração, ajudando-nos a criar protótipos mais envolventes e impactantes.

Por favor, sintam-se à vontade para partilhar abertamente as vossas ideias e experiências. Este é um espaço seguro e respeitoso, onde todas as vozes são valorizadas. Pedia apenas que evitassem conversas privadas e que colaborassem apenas para a conversa de grupo.

Uma vez mais, agradeço imensamente a vossa participação e colaboração. Sem mais demoras, vamos iniciar o nosso "focus group" que terá a partida em volta dos 90 minutos.

Muito obrigado.

2. Apresentação dos protótipos 40 min

De seguida gostava que usassem os vossos pcs ou caso não haja prestassem atenção ao meu para testar os protótipos, sendo que alguém se pode voluntariar para mexer no meu pc. Todos eles foram construídos mediante critérios de design e segundo componentes de uma narrativa. Assim sendo este é o primeiro protótipo:

2.1 Protótipo 1: Deixar as pessoas mexerem nele. 5min

2.2 Agora agradecia que preenchessem a avaliação e seleccionassem o ponto que mais se adequa à avaliação do primeiro protótipo. 8min

2.4 Protótipo 2: Deixar as pessoas mexerem nele. 5min

2.5 Agora agradecia que preenchessem a avaliação e seleccionassem o ponto que mais se adequa à avaliação do primeiro protótipo. 8min

2.6 Protótipo 3: Deixar as pessoas mexerem nele. 6min

2.7 Agora agradecia que preenchessem a avaliação e seleccionassem o ponto que mais se adequa à avaliação do primeiro protótipo. 8min

3. Discussão 45 min - 9 min cada

Gostava então de conversar então sobre a vossa experiência com estas ferramentas. Vamos seguir para uma ronda de 5 perguntas.

P1: Houve alguma ferramenta que não gostaram/perceberam a forma como ela conta a história? Porque? Que característica pode ter sido mais confusa?

P2: Qual a ferramenta que contou melhor a notícia para vocês e porque?

P3: Depois desta experiência acreditam que é possível representar todas as notícias com uma só ferramenta? Porque? E com qual ferramenta se sim?

P4: O que acharam das ilustrações utilizadas nos protótipos? Tiveram dificuldade em interpretar alguma?

P5: Partindo desta ilustração linear específica, se fosse um estilo diferente preferiam? (mostrar slide com a mesma representação noutros estilos)

Appendix 10: Prompt

The prompt used to generate the story used in this work was:

"Tendo em conta a versão da história dos brother grimm do capuchinho vermelho. O foco é contares-me a história numa versão muito resumida, focando mais nos eventos, e evitando adjetivos e não fazendo nenhuma descrição detalhada nem nenhum diálogo. Escreve a história em um paragrafo."