Contributions of remote collaborative sketching to the design of infovis in public health

Contribuições do sketching colaborativo remoto para o design de infovis na saúde pública

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collaboration, infovis, public health, sketching

This paper presents contributions from using remote collaborative sketching to infovis for public health. The results come from an interdisciplinary study that involved designers, health researchers, public managers and computer scientists in the production of sketches generating alternatives for creating valuable graphics and dashboards. One of the creative stages was the remote collaborative workshops in which design alternatives were proposed based on sketches. The sketches were developed with the support of videoconferencing meetings, virtual boards, and graphic tablets. From this practice, we were able to include as contributions to the creative process in infovis: remote collaboration expansion; agile and iterative cycles improvement; interface design preview; data modeling supporting ; addressing graphic literacy issues; creative process documentation; participant experience improvement; and additional information incorporation.

colaboração, infovis, saúde pública, sketching

Este artigo apresenta contribuições provenientes do uso de sketches colaborativos remotos na infovis para a saúde pública. Os resultados provêm de estudo interdisciplinar que envolveu designers, pesquisadores da saúde, gestores públicos e cientistas da informação na produção de sketches para geração de alternativas no processo de criação de gráficos e dashboards. Uma das etapas foi a realização de oficinas colaborativas remotas em que foram propostas alternativas em sketches. Os desenhos foram desenvolvidos com o apoio de videoconferência, quadros virtuais e mesas digitalizadoras. A partir desta prática, pudemos observar as seguintes contribuições para o processo criativo em infovis: a expansão da colaboração remota; melhoria dos ciclos ágeis e iterativos; antecipação da concepção da interface interativa; apoio à modelagem de dados; abordagem das questões de letramento em gráficos; documentação do processo criativo; melhoria da experiência dos participantes; e incorporação de informação adicional.

1 Introduction

Infovis is an information design area that seeks to generate graphical visualizations that produce evidence in order to attribute greater transparency to an issue (Schoffelen et al., 2015). Therefore, infovis is established at the intersection between computer graphics, graphic design, and project interaction (Lee, 2012; Quintão & Triska, 2014). It is based on a set of guidance techniques capable of improving the quality of information presented in graphs, maps, and diagrams and, consequently, better understanding, by the target audience.

In the language field, graphics are signs that, according to the repertoire of their readers, allow different levels of interpretation (Firat, Joshi, & Laramee, 2022). Each inference in infovis, however, depends on the level of graph literacy achieved by the user. In addition to the analysis techniques, the graphics contain narratives and subtexts, which may, arbitrarily or not, mislead the reader (Cairo, 2019). This competence in data interpretation, also called graphicacy (Aldrich & Sheppard, 2000), justifies the relevance of the human-centered design (HCD) approach to infovis design.

Infovis has a better potential to offer insights when it allows different points of view on an issue (Schoffelen et al., 2015; Moere & Purchase, 2011). A broad view of a problem and the recognition of the cut in which the visualization is located are strategies to make information more transparent. Visualizing is bringing information to the state of tangible objects, allowing people to engage in understanding different perspectives, readings, and debates (Schoffelen et al., 2015). Infovis, therefore, contributes not only to the dissemination of data but also to the stages of its discovery, communication, consumption, and discussion (Moere & Purchase, 2011).

Health data are characterized by their multidimensionality, georeferencing, and temporal evolution, requiring multiple forms of visual representation, interaction techniques, and mathematical treatment. During the COVID-19 pandemic, the need and importance of incorporating innovative digital tools (Mark et al., 2021) in health were highlighted (Kahn, Dubberly, & Rodighiero, 2022), both, to improve clinical care and aspects related to management and collective decision-making, whereby adequacy and timeliness are essential. In this perspective, infovis stands out as a practice adopted in the scope of health systems, to meet the need for the appropriation of visual conventions by the media. Consequently, it could benefit the common citizen, who, due to the relevance of the context, had to absorb complex information presented in choropleth maps, charts of moving averages, and logarithmic representations. Conversely, there was still a great lack of managerial instruments for strategic information and interventions monitoring that help public health managers in decision-making process (Filgueiras & Velloso, 2020).

Brazil has a public, universal, free, and above all, complex health system, due to its magnitude and scope of the Unified Health System (SUS). Its management takes place in a tripartite and decentralized manner, among the union, states, and municipalities, and aditionaly citizens participation. Shared management, however, adds greater

complexity to the system, mainly in the context of health strategic information, currently coordinated by the Department of Informatics (DATASUS) and Department of Monitoring and Evaluation (DEMAS), divisions of the Ministry of Health.

In one of the actions aimed to improve visualizations of public health strategic information, the Department of Health commissioned an infovis project from the University of São Paulo (USP), with funding through an agreement with the Pan American Public Health Organization (PAHO). The infovis project, including research and development objectives, sought to improve the users experience of the Strategic Management Support Room (SAGE), an important artifact in public health communication in Brazil (Lunkes et al., 2016). SAGE is a DEMAS information platform formed by a set of dashboards that aims to present public health data of policies and programs, Brazilian health network information, and financial transfer data.

However, given the social isolation required by the COVID-19 pandemic, a methodological adjustment was necessary (Nifterik, Visser, & Erp, 2021), attributing the remote nature to the activities, which could make collaboration difficult. The work was virtualized, making possible that the professionals and researchers involved were geographically dispersed throughout Brazil. The project team relied on the use of various network technologies to maintain daily communication (Gilson, 2015). The use of a virtual drawing board (http://miro.com) for real-time collaboration was a differentiator from more traditional tools, as it allowed the team to work together on the same sketches as artifacts (Andersen & Mosleh, 2020; Kinch et al., 2022). Through videoconference meetings, associated with the use of the sketching tool, the team was able to create, interpret, discuss, and collaboratively validate ideas, extracting contributions from the materials and methods used for infovis.

The broader goal of the project was to improve the User Experience when accessing the SAGE information visualizations. To achieve this, the research group applied co-design methodologies (Dörk, 2020; Sanders & Stappers, 2008), among them the production of collaborative sketches during the ideation phase. Therefore, this study presents contributions to Information Design practice gathered from these research activities, focusing on the observation of collective design practices and the analysis of their results. Our main question is: What contributions can remote collaborative sketching activities bring to the process of creating infovis in healthcare?

2 Using remote sketching as an alternative method to remote collaboration

The data collected from more than 30 in-depth DEMAS specialists interviews were analyzed by the research group and resulted in ten design themes: A) Photograph of Installed Capacity; B) Monitoring of Results; C) Arbovirus Risk Map; D) Mobile Emergency Care Service; E) Indicator

Crossing; F) Interfederative Agreement Indicators; G) Support Decision Making; H) Municipalities' Health Overview; I) Inter-municipal Care; J) use of infographics.

In the method adopted, the user participates not only in the initial phases, providing data, or in the final phases, performing tests, but in the whole process. Our approach is similar to the one described by Dörk et al. (Dörk et al., 2020) called Co-Design Visualizations, in which they propose to focus on the interaction between actors, activities, and artifacts (Andersen & Mosleh, 2020; Kinch et al., 2022). In addition to the interdisciplinarity present in the team itself, the co-design process was articulated with public health management users invited to participate in the project. During the elaboration of the experiments, which addressed different themes of public health, managers from public health related areas were invited. All participants could directly interfere with the artifact being produced. The opinions and suggestions were discussed in workshops, during which the designers transferred the decisions to the sketches in real time. At the end of each workshop, the artifact was modified and enriched collaboratively.

The data collection was carried out after the completion of the workshops. The videos and boards with sketches resulting from the process were analyzed. The boards were always worked in an accumulated way, without excluding any information, keeping all the sketches produced, placed side by side. The videos were recorded on the shared screen, with real-time sketches, and the participants' speeches. The research team analyzed the videos and the produced boards, highlighting observable aspects, such as the register of notes, calculations, and evolutions. The insights were gathered and discussed among the authors to organize the following categories of contributions.

2.1 Related Works

This study occurs at the intersection of themes already widely researched in Design, such as the use of sketches in the ideation stages, collaborative processes, and Information Design. More recently, co-design activities are being researched in the creation of artifacts for data visualization, until then largely addressed by technological aspects (Dörk, 2020).

Bresciani (2019) developed a "Collaborative Dimensions of Visualisations framework" that distinguishes seven visualization layers: Structural Restrictiveness, Content Modifiability, Directed Focus, Perceived Finishedness, Outcome Clarity, Visual Appeal, and Collaboration Support. These layers emerged from the literature in both the field of Visual Languages and Information Visualization and the field of Design Studies and Management. The author shows how the values of each of these dimensions vary according to the evolution of the sketches toward the solution.

To increase value for stakeholders connected to a visualization, Kerzner et al. (2019) proposed a Framework for Creative Visualisation-

Opportunities (CVO) Workshops. The framework enabled more collaboration, by sharing expertise and increasing opportunities to explore visualizations. While using the CVO, participants can get a big picture of visualization, rather than discussing isolated technical aspects. The framework was recently adopted in a research project looking at the participation of different stakeholders in data visualization dashboards development in public health (Elshehaly et al., 2022).

Dörk et al. (2020) also describe the use of collaborative workshops for information management and visualization. They were interested in building on previous approaches, such as the nested model (Munzner, 2009) and the design study methodology (McKenna et al., 2014), by examining mutual knowledge exchange and collaborative creativity in infovis design. To achieve this, they establish a working framework based on the Actors, Artifacts and Activities triad, and on how they articulate with each other.

Regarding user participation in remote collaborative activities, Cajamarca et al. (2022) conducted remote co-design activities to explore personal data visualization in health. The researchers connected remotely with older adults in Chile, using clay to propose objects and alternatives for data visualization. "This study demonstrates that remote co-design activities enable older adults in Chile and Ecuador to imagine future health technologies through their personal objects; these activities provide a voice to an underrepresented group that is typically neglected in technology development" (Cajamarca et al., 2022).

Research involving brainsketching has also been underway, with analyses of workshops carried out using techniques such as linkography (Goldschmidt, 2014), and the study of Paay et al. (2023), in which they stimulated the creative process using a new technique of "brainsketching with context cues" by adding context cards into the process.

2.2 Collaborative Remote Sketching

The use of a drawing tool for real-time collaboration allowed the team to work together and simultaneously in the construction of the same object. In videoconference meetings, associated with the use of this tool, the team was able to collaboratively create, interpret, discuss, and validate ideas.

If the workshops were remote due to restrictions given by the Covid-19 pandemic, some advantages were drawn from this: Higher probability of attendance, since the stakeholders did not need to travel from their workplaces; Greater geographical collaboration reach, obtaining the participation of stakeholders from different states of the country, an important condition given the national scope of the project; ease in scheduling the workshops, through the calendar and videoconferencing tools; and optimized documentation, with no costs for video recording and online digital board. Some disadvantages of the remote workshop: Difficulty of engage stakeholders in the production

of the sketches, since the use of digital tablets implies more barriers, material and cognitive, than the use of paper; a higher degree of impersonality, which can interfere with the trust among participants; and possible unforeseen interruptions (Cajamarca et al., 2022), which escape the control of the workshop's facilitator.

Sketching was the central activity in the infovis panels ideation stage. The exercise of rapid design synthesizes visual proposals without committing many resources and effort on the part of the designer; it also guarantees quick, timely, disposable, plentiful, clear vocabulary, distinct gestures, minimal detail, the appropriate degree of refinement, and ambiguity (Wang, Ramberg, & Kuoppala, 2012). Given that sketching involves understanding problems and creating solutions simultaneously (Steen, 2013), it allowed the group to discuss design paths based on product previews. Representing data through hand drawing, before determining solutions based on specific technological tools, helps to reflect on data basic structure, opening space for discoveries and questions about its meaning (Lupi, 2017).

Using drawing in panels ideation can be characterized as a type of brainsketching (Lugt, 2002). This is a dynamic solution generating that can be compared to brainstorming, but which uses drawing as a resource, instead of verbal language. In brainsketching, drawings are more purposeful than words in brainstorming, as they anticipate solutions (Lugt, 2002). The brainsketching process is shown to be a more suitable way for creation in design projects, since it allows the elaboration around previously proposed solutions, resulting in the evolution of the first alternatives. This process is called by Van der Lugt (Lugt, 2002) generative-interpretative.

2.3 Sketching sprints and workshops

Each prototype was built in a three-week sprint, with specific goals. In the first week, dedicated to ideation, the objective was to develop a low-fidelity prototype through sketches. This process was important as a way of making communication tangible, contextualizing design concepts, and revealing underlying thoughts at the beginning of the project. The outcomes resulting from the first week, consolidated through hand drawing, served as a representation of the requirements for the project (Wang, Ramberg, & Kuoppala, 2012). The second week was dedicated to user interface refinement, with adaptation to the guideline and data collection, and the third week was reserved for interface programming and user testing (Figure 1).

Remote collaborative sketching, therefore, took place in the first week, taking the form of ideation workshops organized in three different ways: elaboration, inspection, and validation (Figure 1). At all times, the brainsketching technique was used. All three activities took place on all days of the week. In elaboration activities, the designers met to consolidate ideas. Inspection activities took place with the collaboration

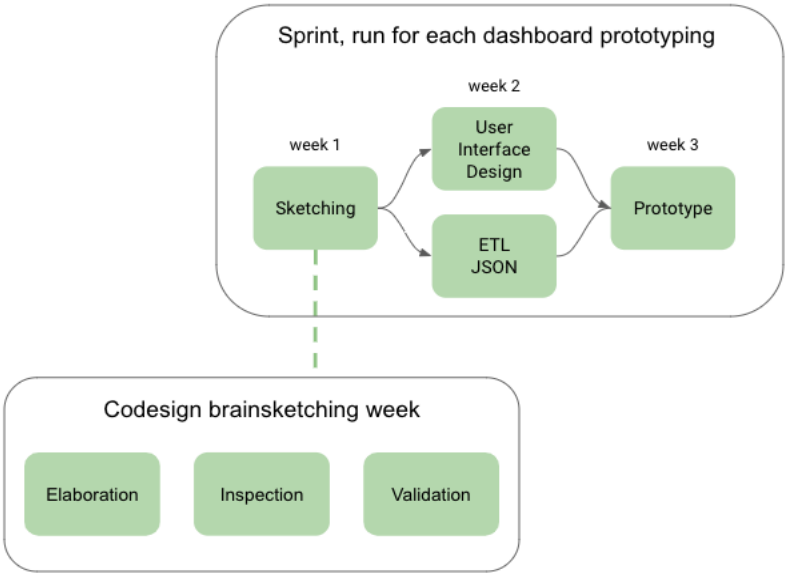

Figure 1 Diagram of the adopted method, demonstrating the sequence of activities for the elaboration of each prototype, highlighting the three different objectives of the brainsketching activities.

of user managers or experts on the topic. The validation meetings also took place daily with the collaboration of the Department of Health's technical team. These co-design practices in remote collaborative sketching, using a virtual board, are the focus of this text.

In the following, we describe the three activities of sketching: elaboration, inspection, and validation. The screenshots presented in Figures 2, 3, and 4 show the evolution of the decisions made in the design process of the dashboard for the Mobile Emergency Care Service, which corresponds to theme D. The drawings were chosen to exemplify the process, which also occurred in the sketching phases of all the prototyped dashboards. It is not our goal in this paper to detail the solutions in infovis.

2.3.1 *Workshop for elaboration*

During the elaboration workshops, we consider the sketching process to be collaborative, as it results in drawings produced collectively. This exercise was made possible in team meetings through video conferences, associated with the production of sketches in a shared panel. Group activity resulted in fairly simple real-time visual representations, still in an embryonic stage, but already presenting possible work approaches. The sketch example shown in Figure 2 reflects the group's initial understanding of the granularity of the Mobile Emergency Care Service, from the distribution of national control centers to the level of equipment and personnel operating in each mobile unit. Attendees:

- Designer main facilitator (team member);
- Designer graphic facilitator (team member);
- UX researcher (team member);
- Database Expert (team member).

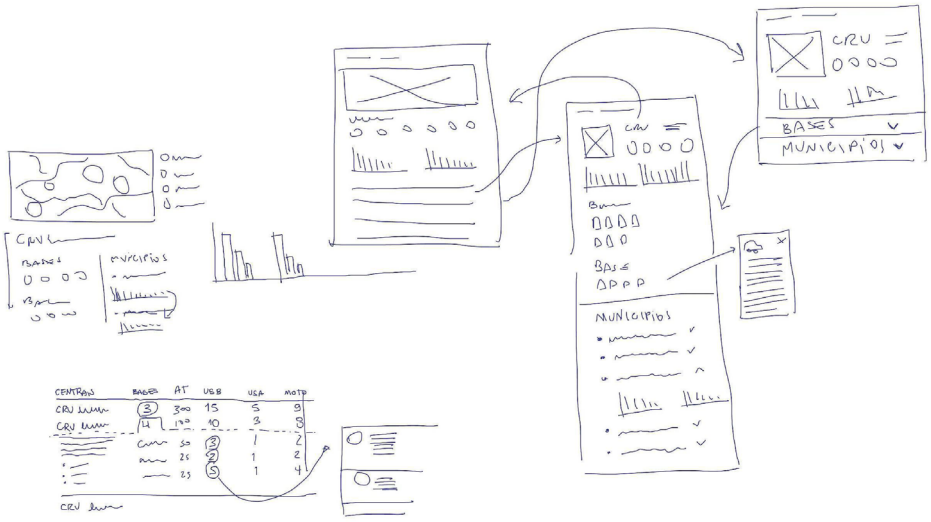

Figure 2 First sketches for the Mobile Emergency Care Service dashboard, made in the collaborative elaboration workshop, identifying the need for visualizations at different data levels (national, local, base, unit).

2.3.2 *Workshop for inspection*

In the inspection workshops, sketching was treated in a collaborative way, serving as a presentation piece for the user and exercising the function of stimulating reflection and questioning. In this activity, the sketch was presented to an external remote user, who made comments and suggestions. As dashboards are artifacts to support the decision-making of public agents, many times the end user is also a domain expert, collaborating with complex information and presenting real pain points (Dörk, 2020). The facilitating designer followed the process by refining the drawings live and taking notes for further improvement. Attendees:

- Designer main facilitator (team member);
- Designer graphic facilitator (team member);
- UX researcher (team member);
- Database Expert (team member);
- Federal public health technician;
- End user or Domain expert (municipal health managers or other end users).

In the case of the Mobile Emergency Care Service dashboard, the user was a technical operator who was monitoring the mobile units nationwide. His contribution has resulted in a better visual organization

of the financing and understanding of the granting procedures and expiration alerts. Visualizations for route planning and service counts, for example, were discarded at this stage, since these data are not provided with the necessary timeliness at the federal management level. In the sketches for inspection, the designers already work with aspects of visual identity, indicating the use of spacing, colors, and navigation elements (Figure 3). The database expert's participation is fundamental to making the visualization proposals feasible for the known data, or to stimulating them to search for other data sources.

These workshops were repeated daily, lasting one hour, and for one week, different users were recruited for the meetings.

Figure 3 The second version of sketches for the Mobile Emergency Care Service dashboard was made after the collaborative elaboration workshop. Aspects of visual identity are already present at this stage. (The handwritten texts are thematic and have been preserved in Portuguese as in the original sketches).

2.3.3 *Workshop for validation*

By the end of the first week of the sprint, the sketches had reached an advanced level of refinement and information. Thus, a last remote workshop was held, with the participation of a stakeholder for final adjustments and validation. This activity was extremely important for closing the alternative generation stage (Figure 4). Attendees:

- Designer main facilitator (team member);
- Designer graphic facilitator (team member);
- UX researcher (team member);
- Database Expert (team member);
- Database Expert (DEMAS member);
- Developer (DEMAS member);
- Federal public health technician (DEMAS member);
- Federal public health manager (DEMAS coordinator).

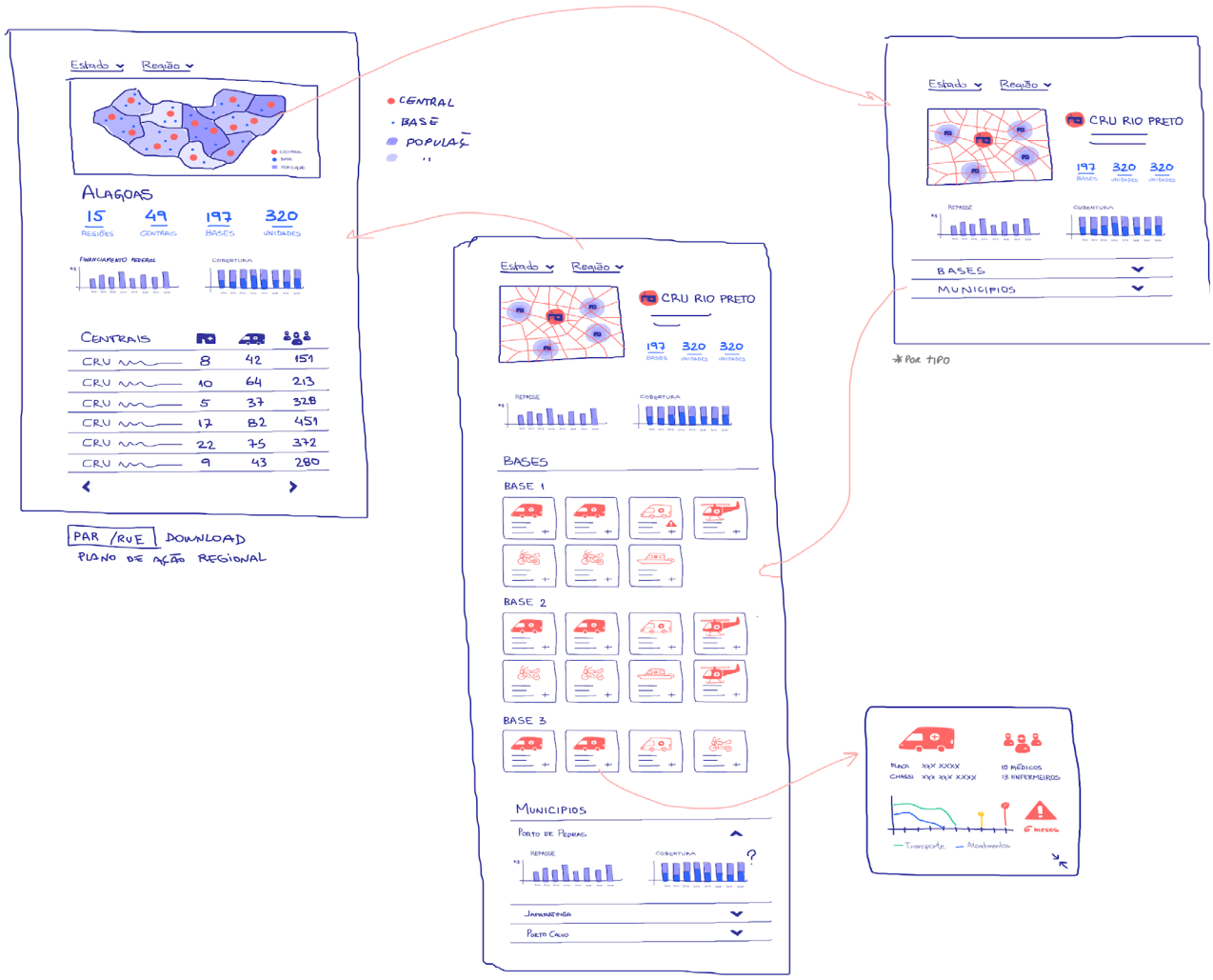

Figure 4 The third version of the sketches of the Mobile Emergency Care Service panel, discussed in the validation workshop, with more details. (The handwritten texts are in Portuguese as in the original drafts).

The experiments, in their sketching phase, were successful in all prototypes, defining design decisions that were taken and adopted in the following phases of prototype development. In the case of the example given for the Mobile Emergency Care Service dashboard, this phase was important, for example, in deciding on the data that should be included in the detailing of the mobile units, and in the final understanding of how to reference the bases and their control centers by name and on the map. The role of the Federal public health manager in this phase was critical to validate the decisions. Figures 5 and 6 show some details of the functional prototype subsequently generated.

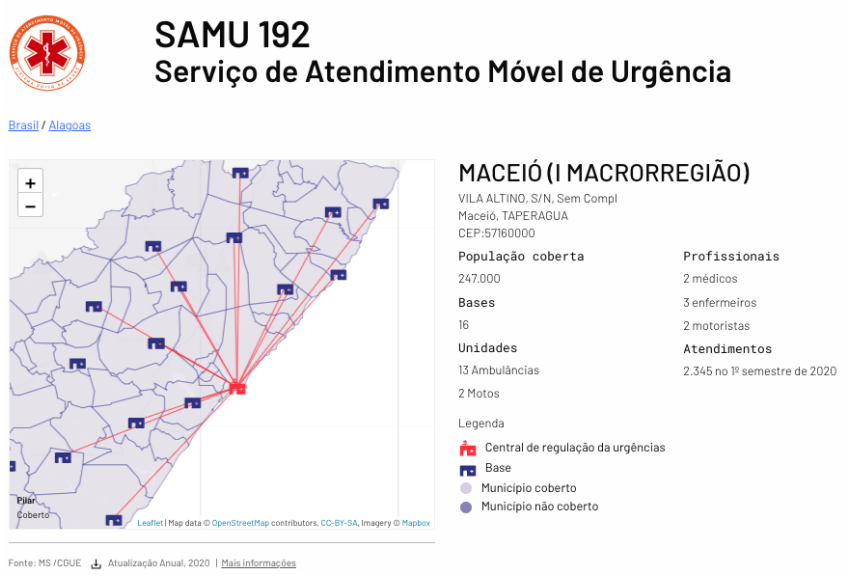

Figure 5 Detail of the later prototyped dashboard, displaying the distribution of mobile unit bases in a state of the country. http://infovisparasaude.fau.usp.br/prototipo-d

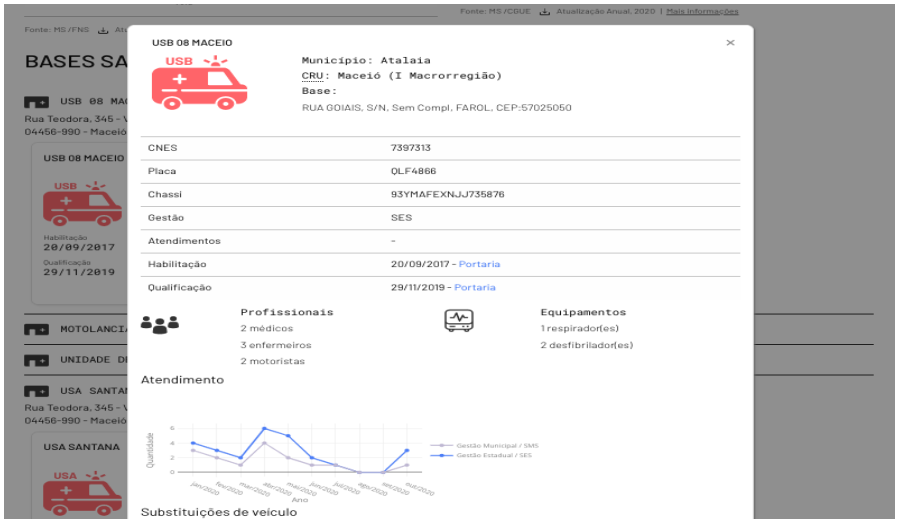

Figure 6 Detail of the later prototyped dashboard, with a card displaying the details of a mobile unit, such as ID, enablement date, staff, and equipment. http://infovisparasaude.fau.usp.br/prototipo-d

3 Contributions of remote collaborative sketching to infovis

3.1 Contribution 1: Expanding remote collaboration

The method was important to expand collaboration and participation among researchers, designers, and specialists remotely. This contribution was observed in all aspects described by Groth et al. (2020): 1) Close practical collaboration, and intellectual exchange; 2) Motivation to solve

the same research problem; 3) Trust, personal chemistry, and the ability to leave one's comfort zone; 4) Knowledge production: the importance of being open to multiple perspectives. We believe that this collaboration has a strong relationship with the rituals of the agile method, in which a reduced scope received focus for a week, bringing the team together in daily rituals, strengthened by the playful engagement of the shared design in real-time. Remote dailies enabled all the necessary alignment, queries, and task prioritization.

3.2 Contribution 2: Enhancing iterative cycles

In brainsketching, ideas are linearly connected, suggesting an evolution of results. This characteristic could be observed in all the experiments carried out. Each board was collaboratively worked on over five days. The evolution of the first ideas containing sketches, not yet defined to a detailed drawing that could inform the high-fidelity prototype design, was an active pursuit by the team. The generated documentation demonstrates this evolution. In the sketches, we noticed a process of generating alternatives that evolved into the definition of details. It should be noted that user involvement in the process was important to drive design refinement.

In this sense, it is important to incorporate ideas from a diverse group into the creative process of infovis. The exchange of knowledge between the disciplines provides an awareness of how complex the problem can be so that the project can contemplate, in its representation, the different interpretations or make its position clear in the context. Due to our Design Research approach (Simonsen, 2010), all researchers have focused on the artifact, which in turn has received a multidisciplinary view. For the designer, promoting this exchange can be an opportunity to promote co-design with specialists, thus ensuring 'enabling issues'.

3.3 Contribution 3: Preview the interface design

With the representation in sketches, it was possible to discuss and validate aspects of the interaction and interface design (Lee, 2012) from the very beginning of the ideation process. Starting with the architecture of the panels, a stage in which the creation of diagrams is necessary for the team to become familiar with the hierarchy of contents. When designing each panel element, layout parameters, color, typography, graphic styles, and pictograms were considered. User interactions were also sketched over the design of the interfaces. From the generation of a series of alternatives, the participants could collaborate on the definition of guidelines that best meet the objective of the project. The practice, therefore, allows the elaboration of both aspects of the graphs and the architecture of the dashboards.

3.4 Contribution 4: Support data modeling

The preliminary design of the visualizations can contribute to the data collection and modeling. Collaboration between designers and developers in graphic ideation was a two-way street. While it contributed to the final design representing viable visualizations, it served as a guide for development activities. From the definition of visualization models through the sketch, it was possible to list which dimensions should be searched in the data, as well as which technological resources should be used. As a way of supporting the modeling, data structure diagrams were drawn, following the design of the visualization alternatives. Thus, the formatting performed during development followed a path previously consolidated by the sketch.

Figure 7 is an example of a data structure manifesting at the sketch level, where we can see big numbers representing the most important metadata concerning the health facilities in the territory. The metadata is also reflected in the columns of the table below the map. This example

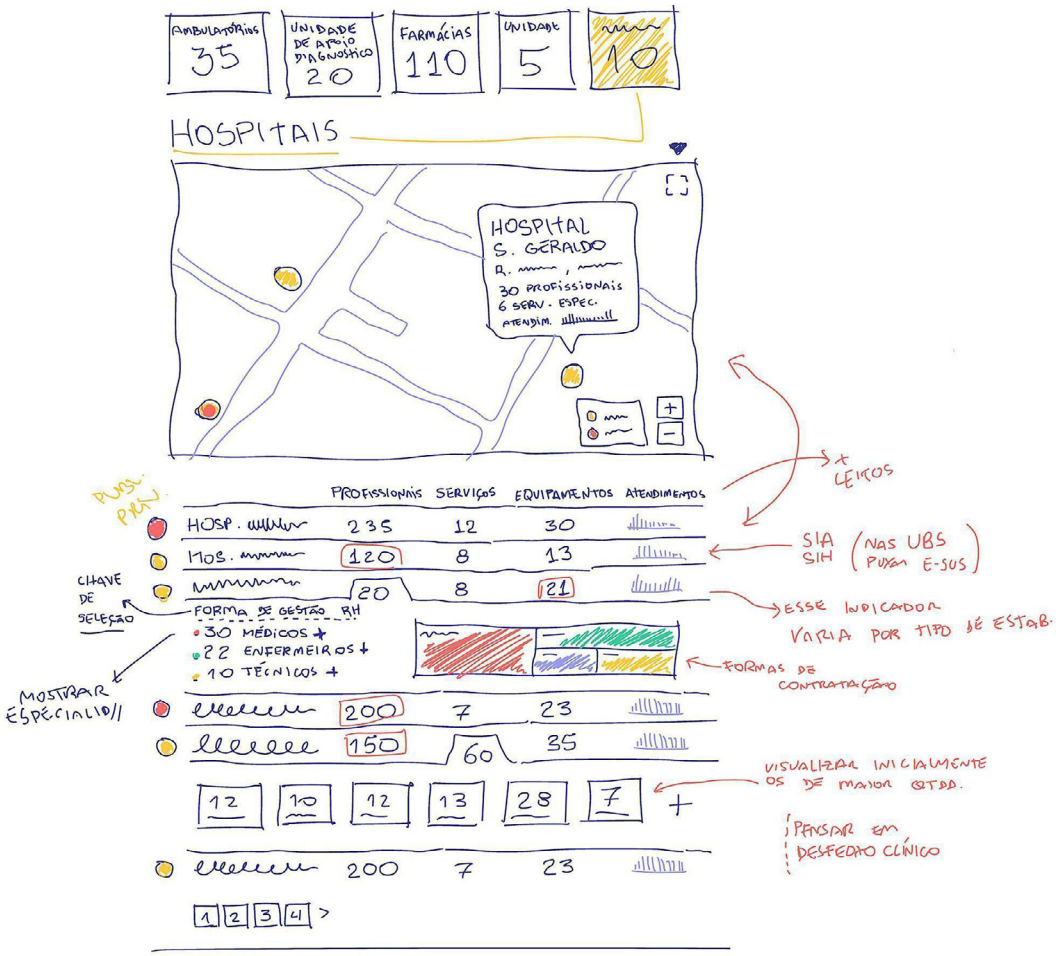

Figure 7 The detailed sketch allows for the prediction of the dashboard data structure. In this sketch it is possible to observe the prediction for organizing the data. (The handwritten texts are in Portuguese as in the original drafts).

also shows how the quality of the information coming from the data can guide design decisions in detail, as in the extensible content in each row of the table.

3.5 Contribution 5: Addressing Graphic Literacy Issues

Including data visualization in the interface sketches made it possible for issues related to graphic literacy to appear early in the process. Based on the inspection results, the visualizations could undergo an adaptation process still in the ideation phase, to meet the required level of interpretation. This contribution is of great importance as it ensures the reduction of the complexity of the visualizations, which attracts user attention and engagement (Schoffelen et al., 2015; Firat, Joshi, & Laramee, 2022).

Figure 8 shows a sketch in the inspection phase referring to design theme A (Photograph of Installed Capacity). The example shows some attempts to create a visual element that could represent a public

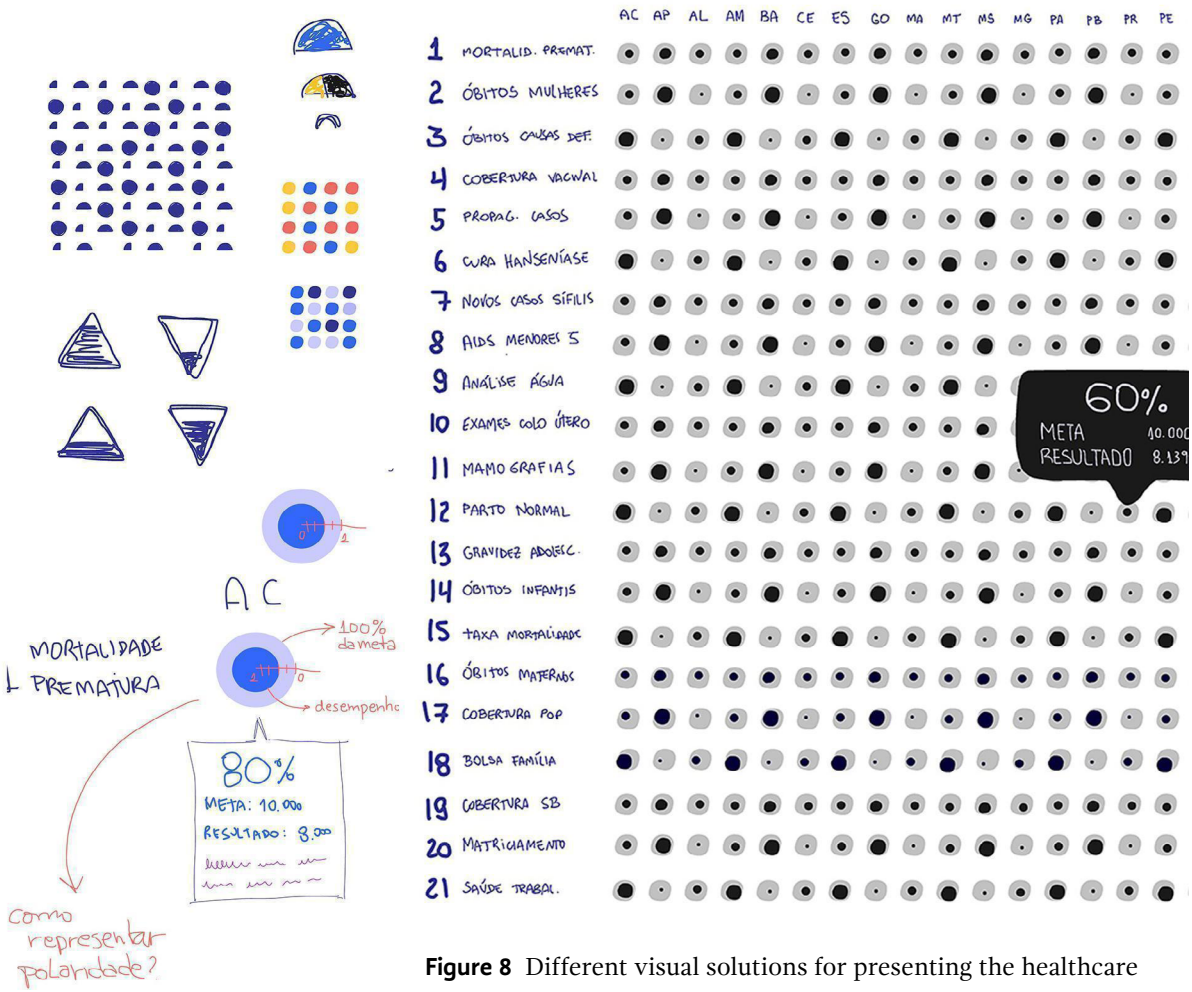

Figure 8 Different visual solutions for presenting the healthcare indicators were collaboratively validated. This image shows the attempts to develop a symbol to represent a public health indicator. (The handwritten texts are in Portuguese as in the original drafts).

health indicator, showing its value and its distance from the target. The symbol chosen was the more or less filled circle, as it indicates your distance from the target, regardless of whether the rate is better if it is going down (e.g. number of premature deaths) or up (e.g. number of people vaccinated).

3.6 Contribution 6: Documenting the creative process

The sketch on a remote collaboration platform had a double advantage for documenting the creative process. The first occurred due to the very nature of the drawing exercise to generate alternatives: a sketch is more easily memorized and identified among other sketches, compared to ideation in verbal language. In this sense, in the process, we observed the formation of a visual history of easy access by the memory of the participants at later moments. The second advantage refers to the editing capabilities of dashboards and graphics available in the remote collaboration platform. Thus, the team can manage the documentation of this step. One of the management possibilities is the organization of panels in chronological order or by association with sprints. The graphical platform features also allow the reproduction of visual patterns, contributing to language coherence between sprints. This favors the perception of the most relevant changes in the sketches. Sketches are never deleted, are easily stored, and remain archived as research data.

3.7 Contribution 7: Enhancing the Participant Experience

We observed that freehand drawing had the same 'psychological benefits' for participants' creativity that Carolyn Snyder (2003) advocates for paper prototypes for users: it is less intimidating than a full-featured user interface (UI), for participants who are not comfortable with digital technology; its ephemerality encourages feedback and contributions; in turn, it discourages what might be called 'thorough feedback', that is, attention to low-level interface details (Snyder, 2003).

It was possible to observe that the evolution of sketchings increased the complexity of the drawings as the participants understood the problem better. This process, which promotes intense participant engagement, can be seen as the result of the contradictory positions of the participants (Andersen & Mosleh, 2020).

3.8 Contribution 8: Incorporating additional information

One of the features of the collaborative platform is the possibility of incorporating additional information, in different formats, on the same board (Figure 9). Thus, during the sketch generation process, the team added notes, images, and tables, among other support materials to the

drawing. This feature was very useful both in the creation and inspection phases. During the inspections, additional information was included in the form of notes containing the experts' observations and the team's doubts.

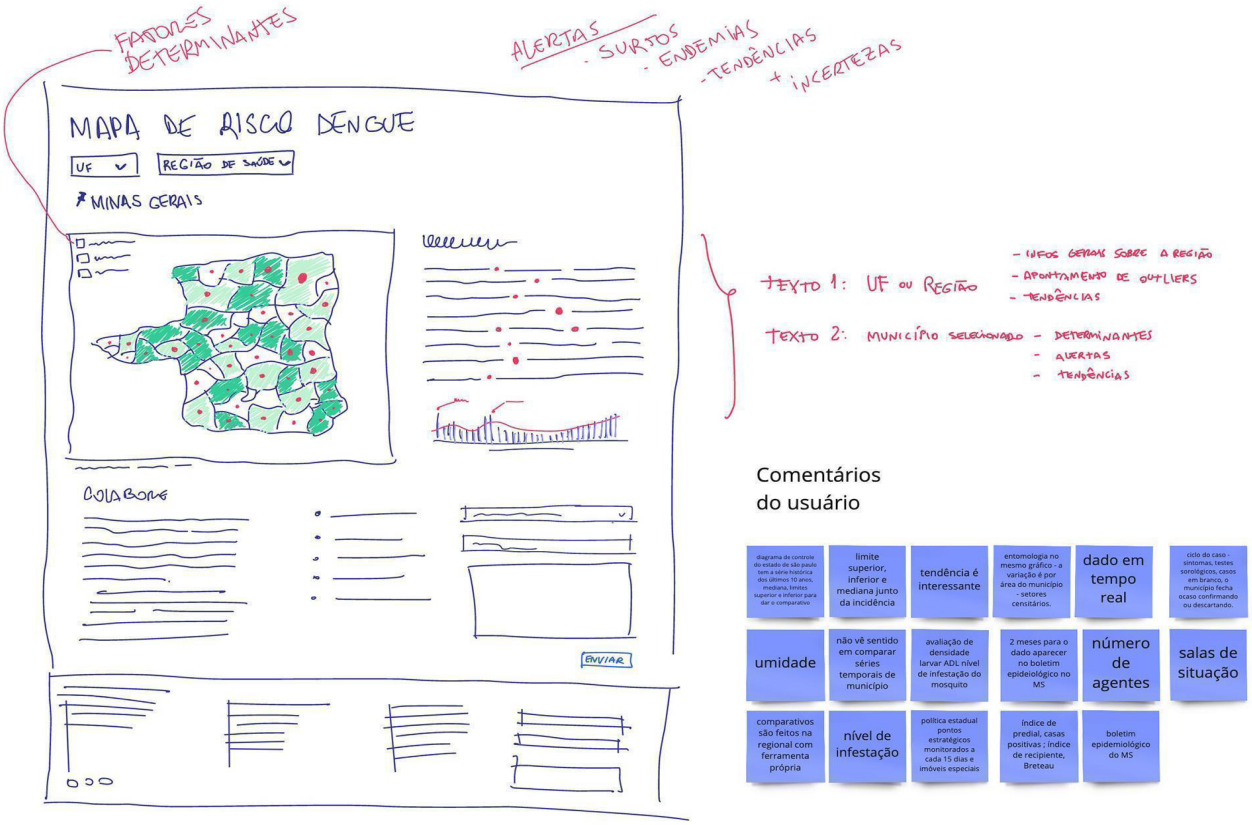

Figure 9 Textual notes and stickers were added by participants during sketching workshops. (The handwritten texts are in Portuguese as in the original drafts).

3.9 Other important issues

In addition to the contributions identified in the collaborative remote sketching experiments carried out, some issues permeated the research process and deserve further investigation and reflection, namely: difficulties arising from the imbalance in the domain of design techniques in collaborative teams; the problem of fixation in the sketch (Vasconcelos & Crilly, 2016); the need to generate alternatives within an evolutionary process such as collaborative sketching; the risks of evolution in sketching graphics without in-depth knowledge of the data; versioning and process documentation issues; the potential for managing the process with the integration of other applications; and issues about the transition to the high fidelity prototype and development of dashboards (Walny, 2019).

3.10 Discussion

The advantages of using sketches in the collaborative design process are well known, Bresciani (2019), after presenting a sequence of studies conducted since the 1970s on the use of visual practices in the collaborative design process, defines seven dimensions of collaborative visualization. These dimensions refer to the level of contribution given by the generated output, they are Structural Restrictiveness, Content Modifiability, Directed Focus, Perceived Finishedness, Outcome Clarity, Visual Appeal, and Collaboration Support.

The contributions of the remote collaborative sketching method, presented in this paper for application in infovis, collaborate to optimize the dimensions observed by Bresciani (2019), since: expands collaboration (3.1); previews aspects of interface beyond graphics (3.3), address graphic literacy issues (3.5), document the creative process (3.6), and incorporate additional information (3.8).

In the co-design process for infovis described by Dörk (2020), the types of actors, artifacts, and activities planned may vary strategically, always with attention to the triad arrangement. In the process experienced in this research, the focus remained on a series of remote meetings, the participants chosen varied according to the stage, and the sketches were kept as the main artifact throughout the process. One of the advantages observed in this process was enhancing iterative cycles (3.2) by staying longer in the sketching phase, another was enhancing the participant experience (3.7) as the drawings are less intimidating than a high-fidelity interface.

A contribution observed in this work refers to how the data structure can be revealed with the evolution of the sketch (3.4). This contribution is relevant, especially in projects in which the data has not yet been organized or even collected.

4 Conclusion

The project developed in the area of infovis for public health used remote collaborative sketching tools for developing the artifacts demanded by the Brazil Department of Health, which, in their implementation process, reinforce the potential of using this methodology for projects of this nature. The combination adopted in this research between interdisciplinary approaches and co-design methods was fundamental to understanding the possible approximations between HCD and infovis.

The use of remote collaborative sketching was fundamental as a technique for generating alternatives in the early stages of sprints aimed at creating the dashboards produced in the project. The method has brought to the project, in a broad way, potential contributions that can be extended to other uses of infovis design, involving co-design, data quality, and user literacy (graphicacy).

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