From now on: experiences from user-based research in remote settings

Claiton Marques Correa
claiton.correa@edu.pucrs.br
Farroupilha Federal Institute - IFFar
School of Technology - PUCRS

Gabriel Viegas Maciel de Freitas
gabriel.viegas97@edu.pucrs.br
School of Technology - PUCRS

André Luis dos Santos Eberhardt
andre.eberhardt@edu.pucrs.br
School of Technology - PUCRS

Milene Selbach Silveira
milene.silveira@pucrs.br
School of Technology - PUCRS

ABSTRACT

The COVID-19 disease changed our society in many ways. The social distancing restrictions became mandatory as governments measure to limit the virus spread. These restrictions forced medical appointments, events, meetings, classes, and research experiments, to name a few, to move to an online format. In this new scenario, researchers were also required to redesign their studies, especially the user-based ones. While the virus is still a threat, researchers focus on understanding its long-term effects in research. From this perspective, we explored experiences from three case studies carried out last year: a focus group, a communicability evaluation, and a user observation study. We report on adaptations, challenges, opportunities, and lessons learned in conducting researches with human participation during the social restrictions. The main contribution of this work is a reflection on difficulties, advantages, and changes that may remain in a post-pandemic period from the experiences we met as Human-Computer Interaction researchers in conducting such remote studies. We conclude that the three methods analyzed could be successfully performed with small adjustments without compromising the user involvement in performing the tasks of each study.

CCS CONCEPTS

• **Human-centered computing → User studies**.

KEYWORDS

COVID-19, user-based research, evaluation methods, user-centered design

1 INTRODUCTION

The coronavirus (COVID-19) disease has impacted our society in many ways. Governments over the world adopted measures to limit the virus spread. Social distancing became mandatory, forcing activities such as medical appointments, events, conferences, meetings, classes, and even music concerts, to list a few, to move to an online format. The measures adopted have affected a handful of fields.

The social constraints also affected the academic domain. Aside from events that have been moved to an online setup, researchers had to rethink their researches design. Research projects, especially the human-based ones, such as the Human-Computer Interaction (HCI) research, had to be redesigned. Whereas researchers could adapt their projects to remote settings in some cases, others could not be due to the equipment required to roll the studies [2].

While in 2021, the pandemic keeps threatening us, researchers are investigating and reporting early studies approaching the long-term effects of constraints imposed by measures to control the coronavirus in academic researches. For example, Dalsgaard [3], Porter and Hook [9], Ratcliffe et al. [10], and Wigginton et al. [13] bring reflections on effects caused by social constraints on research directions under these circumstances. Also, they discuss the future of researches.

Regarding this scenario, in this work, we present three case studies from HCI research projects that had been affected, at some stage, by the measures to control the coronavirus. The first case addresses a focus group initially planned to occur in person but changed to a remote setup. The second case relates a communicability evaluation designed to be conducted remotely. Our third case reports on a user observation study prior planned to be rolled in person, but because of the circumstances mentioned before changed to an online format.

All cases required adaptations that motivated us to investigate their implications on current projects and effects on research in a post-pandemic period. This work's main contribution reflects the challenges, difficulties, and opportunities we met as HCI researchers conducting studies with human participation during the social distance restrictions.

To present the study done, the remainder of this paper is organized as follows. Section 2 presents the related work regarding user-based studies during the pandemic. Section 3 describes the three case studies regarding their main characteristics and goals. In Section 4, we discuss the adjustments made in each study, the role of mediators and participants, advantages, difficulties, the participants' feedback, and lessons learned. Finally, Section 5 presents our final remarks and opportunities for future work.

2 RELATED WORK

Human participation in studies is essential for a vast number of research fields. For those related to technology and despite the shape complexity, user participation allows researchers to assess users' needs, observe their behavior using an application, and improve software design, i.e., to get direct feedback [7]. As a general feature, these researches require user presence in-lab to be conducted. The constraints to control the COVID-19 pandemic have led researchers to rethink the design of their studies.

Online research is not a novelty. Researchers have used the internet once it makes it possible to recruit a broad range of participants. Remote settings help HCI researchers to complete their studies with less difficulty and expense [7]. Although the use of the internet presents advantages, this requires attention to constraints to successfully account for the research goals. For instance, the tools required to conduct these studies may have or not audio and video recording or screen sharing capabilities. Also, they may require additional plugins to be installed in participants' computers. These features must be taken into account when designing an online study.

While the pandemic keeps maintaining the world aware of claims for social distancing, researchers investigate its impact in academia. Balestrucci et al. [2] conducted an interdisciplinary reflection on researches in areas as Information Visualization, HCI, among others, and opportunities for researches regarding such studies during the crisis. They carried out a short survey asking experiences considering four scenarios: remote or online studies planned before the lockdown; in-person studies switched to online/remote setup; in-person studies not switched to online/remote setup (i.e., it was paused or continued as planned); and studies planned to tackle issues related to COVID-19. They collected 35 reports from 29 respondents of their survey. Most of the studies planned as in-person were not changed to a remote study, and they halted or paused until they can be resumed. The second-highest occurrence is studies planned as in-person changed to an online study. Also, this study brings reflections on the impact of the pandemic in four research steps: the research conceiving, the study design, the data collection, and finally, the communication of the results.

The work presented here focuses on reasoning about difficulties, opportunities, and takeaways from HCI user-based research by analyzing it through six dimensions: adjustments made, interaction flow, difficulties, advantages of remote studies, participants' feedback, and lessons learned. Regarding Balestrucci and colleagues' study, we envisioned joining efforts from an HCI researcher's perspective of user-based research in remote settings. To do this, we analyzed our case studies employing the same research pipeline adopted in their study.

3 CASE STUDIES

This section describes the three case studies in which some stage has been affected by the social distance constraints. First, we briefly present the general goal of each study and address their main characteristics. So, in the following subsections, we present the focus group, the communicability evaluation, and the user observation study. Table 1 summarizes the case studies considered in this work in terms of stage affected by social constraints and modifications done.

3.1 Focus group

In this case study, the focus group, a technique used to involve multiple participants at one time [7], was conducted to understand users' perception of time-oriented data visualization techniques applied to Open Government Data (OGD) [6].

This study has been initially planned to occur in a physical location during the first semester of 2020. However, because the social restrictions of COVID-19, it was moved to remote settings using the Zoom[1] video conference software[2]. It required extra planning, once the choice for a software implied the participants also to install it. A team of two researchers, one senior and one junior, planned the study.

Five participants were recruited to be part of the focus group. The group was formed by men and women between the ages of 26 and 39 years old. The researchers focused on selecting professionals working in any public area such as public health, security, or transportation and professionals working in private companies, students, or people interested in OGD initiatives.

The dynamic of the focus group consisted of using three prototypes to perform specific tasks; then, the participants answered predefined questions regarding OGD datasets and discussed their perception of these tasks. A total of 5 rounds of interaction encompassing tasks, questions, and discussion were carried out. The first round was dedicated to presentations between the participants and to familiarize them with the dynamic.

At each round, the focus group mediator controlled and presented the visualization prototypes. For each task, the mediator asked participants to decide which actions should be performed to accomplish the task. The tasks were done collectively and, to complete each one, the group of participants needed to understand the problem and orientate the mediator aloud on how to find the answer.

Figure 1 illustrates one of the rounds performed[3]. Note that all participants are in the same call. The user icon represents that they maintained their cameras enabled during the session. The visualization[4] was presented to all participants, and then, they had to guide the mediator about what steps would be needed to complete the tasks.

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[1]https://zoom.us

[2]Zoom was chosen once it is the software adopted for remote academic activities in the authors' University.

[3]All the figures illustrating the case studies are sketches created from the original videos. They were made to preserve participants' anonymity.

[4]Labels in Figure 1 and Figure 2 are written in Portuguese because the original study was conducted with native Portuguese speakers.

Table 1: Case Studies analyzed

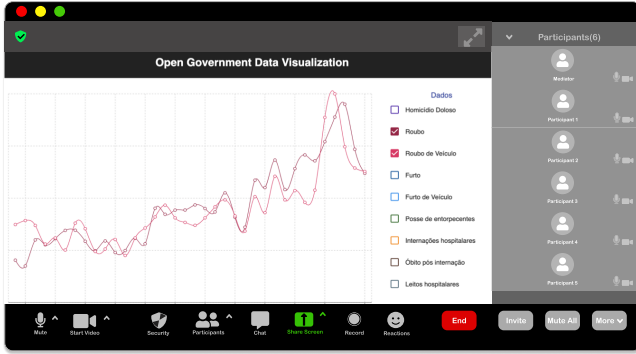| Case Study	Study stage affected by COVID-19 social restrictions
Focus group	Experiment design, data acquisition and data analysis
Communicability evaluation	All the steps were prior planned to be online
User observation study	All the stages have been change, i.e., study planning, experiment design, data acquisition, and data analysis

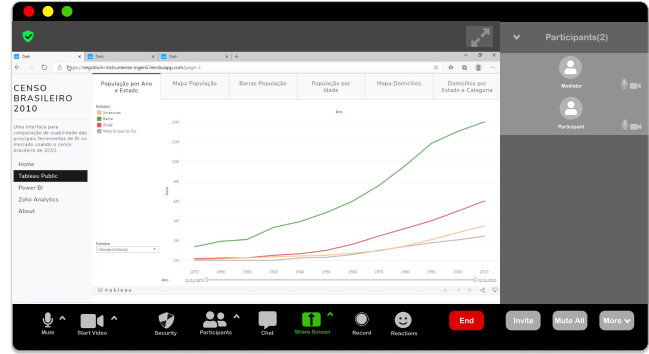

Figure 1: A focus group round.

Figure 2: A communicability evaluation session.

3.2 Communicability evaluation method

The communicability evaluation is a method based on observing a number of users' experiences with an application to analyze and interpret communication breakdowns during the interaction with this application [5]. This method was employed to evaluate the communicability of an application that bundles three dashboards built employing three different Business Intelligence (BI) tools to analyze Open Government Data from Brazilian Census [8]. The data available in all dashboards were the same. However, each dashboard differs from the other by having resources and user interface elements provided by the BI tool in which it was developed.

This study was carried out by a team of six researchers in the first semester of 2020, after the first government efforts to limit the spread of coronavirus. Because of this, the study was planned to be executed entirely online.

To record users' screens during the test, the Zoom application was employed once it has this capability. Five participants performed a set of activities described by three scenarios. They performed the tasks from their home under the supervision of the mediator, i.e., a team member responsible for the test. After introducing the application and the set of tasks, the mediator started to observe the interaction happening while the participants are solving the tasks required. The mediator's role was to take notes about the performance, doubts, and difficulties participants found during the task execution without interrupting them.

Figure 2 shows a session while a participant is performing a task under mediator's supervision. Both mediator and participant enabled their cameras. The left panel shows the BI tools available in the test. The tabs on the top present the dashboards created to analyze the data. Finally, in the middle, the visualizations are shown.

3.3 User observation study

In order to analyze a method proposed for the rapid prototyping of Augmented Reality (AR) applications [4], a user observation study was conducted.

To analyze the participants impressions about the proposed method, they were exposed to an AR application, and then they were asked to perform a set of tasks to achieve some goals in it. After this, they answered a semi-structured interview conducted by the mediator.

The study was conducted by two researchers and it was initially planned to roll as an in-person study, i.e., it was planned to take place in a physical environment, such as a laboratory. However, due to the social distancing, the study's design had to change.

The Figma[5] tool were employed to build the remote environment and support the interaction between participants, the AR application, and the mediator. This tool was chosen because its capability of offering an environment in which the users can edit a unique file simultaneously. Thus, it helped in simulating physical dynamics in a remote setup.

In this case study, both participants and the mediator interact with each other and the application. The Wizard of Oz technique was applied to handle the communication and interaction between the mediator and the participants. This technique allows a user to use an application controlled by a human, creating an illusion that a computer controls it [1]. Once the study aimed to simulate an AR application, the mediator was responsible for playing the wizard role and, thus, for changing the information exhibit in the interface as long as the participant interacted with it. The context built has three layers: the physical environment, the device viewer, and the AR view.

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[5]https://www.figma.com/

Figure 3 shows a user observation session in which the user is exploring a world map through a telephone frame that reveals AR information, from AR view layer, as long as the frame is moved. Both mediator and participant enabled their cameras.

A total of 10 professionals from software development participated in the experiment. Three were software programmers (two senior and one junior professional), 4 were designers (three senior and one junior professional), and 3 were senior product managers. Six of all participants had already experience with AR. All the observations were done remotely by using Zoom video conference software. All of them were recorded to analyze the user interaction with the prototype in further steps.
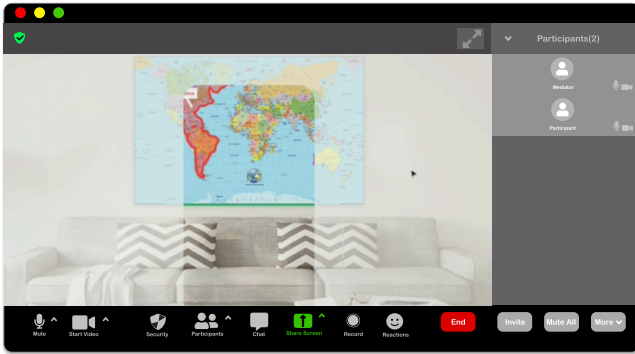

Figure 3: A user observation session.

4 DISCUSSION

In this section, we discuss the experience gained conducting the studies earlier described in this work. Our goal is to raise a discussion about user-based research methods in remote conditions. To this end, we organized our discussion considering the following dimensions for each case study: **Adjustments made**, **Interaction flow**, **Difficulties**, **Advantages**, **Participants feedback**, and **Lessons learned for the post-pandemic research**.

4.1 Adjustments made

Adjustments had to be made into the studies' planning to redesign them and make each study fit the established social constraints. Each study was organized into four steps: study planning, study design, data acquisition, and data analysis. The case studies presented in this work have been affected by pandemic controlling measures in different stages.

The **focus group** was initially designed to be executed at a physical location. Because of the constraints, it was redesigned to a remote setting. This change also implied in the data acquisition and analysis once the use of a video conference tool allowed to record all the participants simultaneously from the same perspective.

The second case, the **communicability evaluation**, was entirely planned to be conducted online. At the time of the first step, the study planning, social restrictions were already recommended. This situation required adjustments in the research protocol once it had to consider the participants' agreement to use their equipment

and install specific software for the online conference and internet browsing.

The last case, the **observation study**, suffered changes in all steps. The unexpected situations of exploring an AR application in a physical location cannot be fulfilled entirely in an online setting. So, before each session, the users were provided with all information about all available interactions in the virtual environment.

4.2 Interaction flow

The social restrictions defined to limit the spread of the virus have required a redesign of the researches' stages and implied the adoption of tools to make them practicable. Also, the stakeholder's role, especially the study mediator, has taken different perspectives. Figure 4 shows the interaction flow adopted in each case study and the role of the mediator.

The arrows in Figure 4 indicate the communication flow between the mediators, participants, and the application. The eye icon represents situations in which mediators or participants have assumed a passive stance, i.e., observers of the study' interactions. It is important to say that Figure 4 presents a perspective of interaction based on the intent of performing the tasks by interacting with the application. Thus, by considering the mediator as an observer of users in the communicability evaluation, we are aware that the user must communicate with the mediator when the task is done.

In the **focus group**, the participants observed the dashboard shared on the screen and guided the mediator in solving the proposed tasks. So, by interpreting the task, they discussed which steps should be taken to reach the desired result. From this perspective, the users are in charge once the mediator cannot interfere in the users' decisions.

For the **communicability evaluation**, the mediator's role was witnessing the user's actions while specific tasks were performed. So, the user is in charge, and the mediator takes notes of comments, doubts, or other situations during the session.

In the **user observation**, both mediator and users interact with the application. In this case, the mediator plays the system's role by changing the information on the screen. The user, in turn, interacts with the application to perform the tasks proposed.

Table 2 summarizes information about the three case studies regarding (i) the number of participants; (ii) who was in charge during the study session; (iii) the mediator role; and, (iv) the session characteristic that can be *collective* when all participants are connected in the same session or *individual* when just the mediator and the participant are connected simultaneously.

4.3 Difficulties

The redesign of the research projects has brought challenges and difficulties to researchers. During the studies, they had to circumvent situations related to connection, communication, and configure the environment.

A shared difficulty between the three case studies is that remote settings, despite the tools employed, lack the possibility of observing users' body language, which could suggest discomfort, impatience, or other reactions [7].

During the **focus group** session, the participants did not integrate so easily at first. To handle this situation and break the ice

Table 2: Case Studies characteristics

| Case Study	Number of participants	Who was in charge?	Mediator role	Sessions characteristic
Focus group	5	users	perform the tasks according to the participants guidance	collective
Communication evaluation	5	user	observe the users interactions and take notes about their performance	individual
User observation study	10	the mediator and the user	observe the user interactions and perform actions to update the information shown in the interface	individual
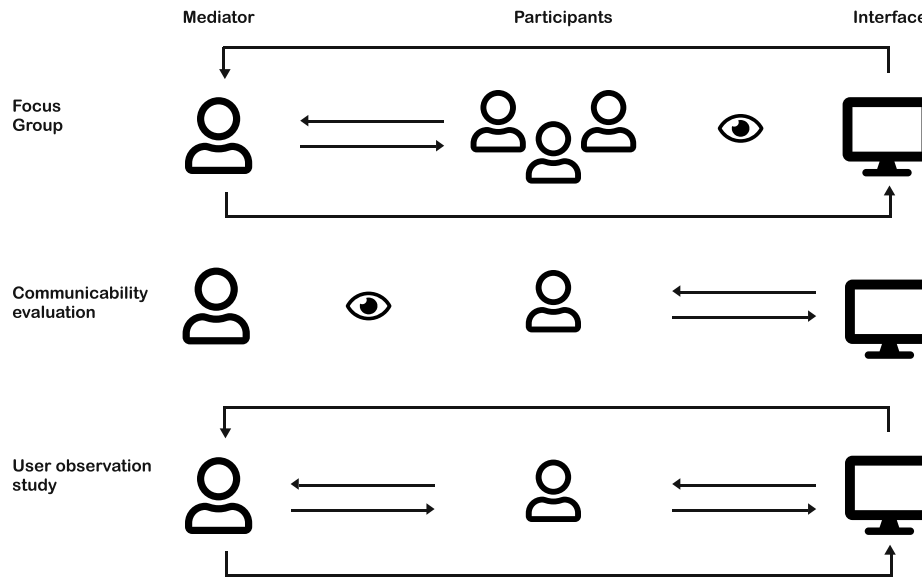
Figure 4: Case studies interaction flow

between all participants, an introduction round were performed in which each participant and the mediator could present themselves.

In **communicability evaluation**, once the experiment was designed as an online activity, the main challenge was to ensure the minimum requirements for remote setup configuration for both participants and mediators. For the participant, the requirement was Google Chrome or Mozilla Firefox browsers because the application was tested using their engine.

Two points needed attention to executing the **user observation** study. The first is related to the setup configuration. Once not all the participants were familiar with the tool for simulating the AR environment, additional instructions were provided to ensure the experiment's correctness for the use test. The second is concerned with simulating a 3D environment in real-time. Generally, reproducing low-fidelity AR applications presents some challenges. However, through a remote experiment, the participants were required to understand the physical environment, a hypothetical example, considered for the test. This situation would not represent a challenge if the experiment were applied in a physical location.

4.4 Advantages

Although the limitations imposed by the pandemic on research, it is possible to list opportunities that researchers leveraged from their works in this new context.

All researchers agreed that using video conference software, such as Zoom, could reach specific achievements. For instance, in the case of the focus group, it was possible to - easily - verify users' expressions during the session once they appeared simultaneously on the screen. The same task would require more equipment, such as multiple cameras and audio recovery devices, and consequently would be more expensive on an in-person focus group. The recordings also make it possible to review key points, comments, and criticism without requiring extra time-consuming tasks, such as multiple video editions.

This remote scenario also allowed the researchers to recruit people from distant places, such as other states, cities, or even countries, which is an unfeasible possibility considering on-site studies.

Another shared vision from the researchers is related to scheduling flexibility. Also, conducting online studies prevent time-wasting actions, as driving to the local of the study, for instance.

4.5 Participants feedback

The environment is an important aspect when conducting user-based studies. The researchers always try to avoid users' distractions while they are performing the task. Thus, the participants were observed and asked to give their opinion about attending a study in a remote setting.

At first, during the **focus group**, as cited before, the participants did not integrate easily. However, after everyone introduced themselves and why they wanted to join the group, some participants started to interact, and the group finally integrated. Regarding their feedback in the tasks, they did not report problems related to the remote environment. The participants presented difficulties caused by the task complexity or their lack of familiarity with visualizations, not by the format of the study itself.

In the **communicability evaluation**, the participants did not complain about any questions regarding the remote setup. At the beginning of the test, they were introduced to some relevant aspects of the tool they had to use. The explanations were enough to let them perform the tasks.

The participants were asked to report their understanding of the tool employed to reproduce a 3D environment in the **user observation** study. It was done once it had to be entirely redesigned for an online setup. Regarding the answers, just one participant answered that he was not familiar with the tool. After some time, this participant could accomplish the task without any problem. According to the participants, the prototype communicates objects appropriately from the real world, although it did not provide all the visualizations.

4.6 Lessons learned for the post-pandemic research

The studies performed through the pandemic period forced researchers to adopt alternative approaches to their researches' success. Concerning our experience acquired from the three case studies, we identified lessons and approaches that may be helpful and remain or must pave user-based research projects path in a post-pandemic world. In the following, we present them. Of course, we are far beyond to cover all possibilities.

- Conversely to we may think, the switch of in-person study to an online format did not drop the user engagement in performing the tasks from each study.
- Interviews and practices, such as user observations, communicability evaluation when conducted remotely, offer scheduling flexibility and low cost to be performed without limit the results. Also, the participants felt more comfortable being home. This fact also made them express feelings and opinions freely like they were not under observation. We claim that future studies can blend online activities with in-person ones for those situations in which cost and distance matter. Also, the diversity of people that can attend research is broadened in such settings.
- A finding from remote studies was that Zoom's facilities helped us record all the users at the same time or pin a user screen if needed. Also, the users could share their screens to tackle doubts about computer configuration to perform the tasks.

- Simulating an AR environment in remote setups challenged us to support the participants in understanding the simulated application. Although we reached good results, further investigations on how to support the users in performing tasks in such an environment are required.

5 CONCLUSION

The coronavirus pandemic had a significant impact on our society. Attempting to control the spread of the virus, governments from many countries adopted measures to restrict the movement of people. Social distance became mandatory, which forced activities such as human-based research to moved to remote setups. In this new scenario, some researchers modified their projects with adjustments that vary from redesigning part of the project plan or redesigning the entire research. In other situations, the projects had stopped while the social restrictions are maintained.

We sought to present an overview from our experience in conduction user-based research under social distance restrictions in this work. In this pursuit, we presented three case studies addressing human participation in researches practices. For each case, we showed the adaptations taken to make them feasible. Also, we presented difficulties, advantages, and users' feedback regarding the activities performed remotely.

Although we believe that in-person research practices are essential [11], especially those requiring user participation, a usual approach for HCI research, we realized that, with some adjustments, our studies could be performed without significant constraints in an online format. Of course, our work does not exhaust the subject.

As long as the pandemic remains, researchers from user-based or lab-based studies, such as Virtual Reality (VR) and Augmented Reality (AR) [12], are publishing their results and experiences of conducting remote studies. The situation also influenced the rhythm of publications. The urgency to gain knowledge about the virus made the researchers share and make their outcomes open for public access, as Porter and Hook reported [9].

To sum up, the online format brought advantages for researchers, such as flexible scheduling and the possibility of recording all users simultaneously and from the same angle, making it worth discussing which practices from this remote scenario will remain when our regular and in-person routine returns. As future actions, we envision seeking other HCI community contributions regarded studies in remote settings, not only for the methods analyzed here but also for user-based studies in general. Another interest relies on reviewing tools and their facilities in supporting such studies and providing users and researchers, which may have a disability or not, with richer interaction possibilities.

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