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## Communication in IT adoption:

### The use of infographics in the case of Citizen Observatories

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#### Abstract

In this communication we explore the potential of infographics as a communication tool to increase awareness and citizen participation in Citizen Observatories (COs). We present and discuss a project developed through the use of infographics, aiming to contribute to the dissemination of this novel concept and fostering its adoption, as developed and funded by the European Commission. In a first section the concept is presented and the relevance of communication and citizen engagement in the adoption of COs is argued. In a second section the concept of infographics is discussed, as a relevant resource for communication and citizen engagement. In the third section the infographics project developed by the team, with desktop and mobile versions, is presented and explained. In a fourth section the results from a survey assessing the user experience with the infographic, with a sample of journalism and communication students from 9 different nationalities, are presented.

**Keywords:** Citizen Observatories; Infographics; Visual Communication; Human-Computer Interaction; European Commission, IT adoption

#### 1. COs AND THE RELEVANCE OF COMMUNICATION AND CITIZEN ENGAGEMENT

The concept of citizen-enabled observatories of the environment and of natural resources through the use of information and communication technologies (ICT), usually referred to as Citizen Observatories (COs), has assumed public visibility mostly over this decade, since the 2010s.

The development of Community-Based Environmental Monitoring (CBM) (MSH and UNICEF 1998, McKenzie et al. 2000, Bliss et al. 2001, Connors et al. 2001) and, later, of Volunteered Geographic Information (VGI), that allows private individuals to participate directly in the collection of geographic information through the use of equipment and sensors, replacing (at least partially) data collection performed by public agencies (Goodchild 2007, Craglia 2007) are milestones of this process, paving the way for the appearance of COs.

The concept of CO can be considered to have two central features, according to the existing literature, corresponding to (i) an open and shared information system dedicated to the collection of data on the environment and on natural resources, using ICT; and (ii) the volunteer participation and involvement of individuals in data collection (Montargil & Santos, 2017). The EU has adopted, however, a more specific concept, where COs should also complement existing earth observation systems, including the European Copernicus satellite programme, contributing with *in situ* information.

Besides information gathered through satellites, earth observation systems can also use and integrate *in situ* information, such as ground-based, airborne and ship or buoy-based observations and measurements. *In situ* data are essential in these systems, being integrated into forecasting models, contributing to the calibration and validation of space-based information and contributing to fill gaps in information from satellites (*idem*).

In the concept adopted by the EU a CO is, therefore, a subsystem that uses devices (mostly smartphones) operated by citizens to gather information used as *in situ* input for an earth observation system. A CO relies, therefore, according to this concept, mostly on information gathered by citizens, essentially through a mobile crowdsensing strategy (Ganti et al. 2011; Angelopoulos et al. 2015), but it is also intended that these data “should complement those from existing systems (e.g. the Copernicus Land Service) and surveys, including national surveys”. For this reason, COs funded by the EU are required to cooperate with the global repository of information from earth information systems, the Global Earth Observation System of Systems (GEOSS), and “data should be made available through the GEOSS without any restriction” (European Commission 2014: 3).

One of the critical issues regarding earth observatories is, naturally, financing the initial and ongoing operating costs. Copernicus cost between 1998 and 2020 is estimated at 8.4 billion euros. A part of this cost relates to the in-situ information. Creating and maintaining a network of ground stations, for instance, covering all the extension of the European territory is logistically demanding and expensive. A citizen-enabled earth observatory represents an opportunity to lower these costs. The European Commission has, for this reason, financed demonstrating projects through its I&D programmes, first with FP7, in the 2012-2016 period (with CITI-SENSE, Citclops, COBWEB, OMNISCIENTIS and WeSenseIt) and now with Horizon 2020, between 2016 and 2020 (with Ground Truth 2.0, GROW Observatory, LandSense and SCENT), representing a total investment of around 40 million euros.

If a relevant number of citizens is mobilized to gather and share information with an earth observation system, through practical and affordable sensors owned by citizens, connected through devices they use in their daily life (such as smartphones, tablets or laptops), we can have a reliable network with lowered costs.

Communication and participation are, therefore, key dimensions for the development of COs. For a specific kind of sensor, if the goal is to establish a reliable network with good coverage of the territory (with high granularity), we are probably considering a dimension of thousands of users, for each country. Considering several types of sensors and measurements, at the European level, probably a network of dozens or hundreds of thousands of participants will be required.

Since participation in citizen observatories is naturally voluntary, depending on the citizens' decision and willingness to gather and share information, citizen-enabled earth observatories become a very relevant challenge, in terms of communication and IT adoption. Considering citizen engagement and participation is still very limited in the CO experiences (Montargil & Santos, 2017), we explored infographics as a relevant resource for communication and participation, in this project.

## **2. INFOGRAPHICS AS A RESOURCE FOR COMMUNICATION AND ENGAGEMENT**

From journalism to design, infographics have been used in so many different contexts that it is difficult to get one single definition. Since infographics were mainly popularized in the journalistic context, (i) most definitions emphasize the journalistic use and (ii) there is no consensus on the best word(s) to refer to “infographics”, with “data visualization”, “graphic information”, “information visualization” or “visual storytelling” being considered as some of the alternatives.

Just like technology has evolved through times, so have infographics. Depending on the format, on the platform and on the communication goal, different perspectives on what infographics are will emerge. For some people, it will be a simple graph. For others, it will be a set of elements that combine to inform a given message. And for others, it will be the story and narrative that those elements will tell, all together.

For de Pablos (1999), for example, an infographic implies the use of the binomial image and text (I+T) in any communication. For this author, infographics have always existed. However, they must be distinguished from the draws of cave men because these had no support in a real medium of communication, as today's have in a newspaper, for example. Furthermore, to de Pablos, “infographics” is not the same as “graphic information” because journalism has always included graphics, diagrams, maps, illustrations and images in their articles, and infographics allow to explain, through images and small texts, details that would be unnoticed otherwise. This made the author distinguish general infographics from journalistic infographics, a product of info journalism.

Cairo uses “information visualization” as a synonym to “infographics” and defines it as “any information presented as a diagram that shows the relationship between all parts of a system” (2008: 21), used with communicational purposes. In concordance with this definition of Cairo is also the definition of the Oxford Dictionary, which indicates that an infographic is “a visual representation of information or data, e.g. as a chart or diagram”. However, for Figueiras, “information

visualization is much more than the visual representation of data. It is rather the process of dissecting raw data, which by itself has little meaning and presenting it in a way that it is no longer complex” (2014: 19).

Other terms have also appeared in some “how-to” books such as *Infographics: The Power of Visual Storytelling* by Lankow et al. (2012), or *The Power of Visual Storytelling: How to Use Visuals, Videos, and Social Media to Market Your Brand* by Walter & Gioglio (2014). On the former, the authors distinguish data visualization (a visual representation of data or the practice of visualizing data, using pie charts, bar graphs, line charts, etc. (Lankow et al., 2012)) from infographic (an abbreviation of information graphics) and also from editorial infographic (“an infographic for use in print, an online publication or a blog” (Lankow et al., 2012)). On the latter, Walter and Gioglio define infographic as visual representations of information, bringing together the data and visuals to tell a story; but they also introduce the concept of visual storytelling: “defined as the use of images, videos, infographics, presentations, and other visuals on social media platforms to craft a graphical story around key brand values and offerings” (Walter & Gioglio, 2014).

Having all these different definitions to the same word and having all these terms can be confusing, especially when there is scarce academic work on the subject. As we can see, all these different authors stand by their own definitions of infographics, some of them even giving it a different word. However, we can also see that they all agree in one thing: infographics are a little more than the visual representation of information.

It is the dissection of raw data and information into something simpler and easier to understand for the regular public, like diagrams, charts, schematics, images and little pieces of text. For authors like de Pablos (1999), Tufte (2001 and 2006), Figueiras (2014 and 2015) and even Cairo (2008 and 2013), for whom infographics and information visualization are the same, this is what infographics are all about, as long as the connections between all data and information can be perceived by anyone who reads and interprets the infographics. Lankow et al. (2012) and Walter & Gioglio (2014) go a little further, introducing a narrative component to the infographics. The latter authors stand for a more editorial and aesthetic approach of infographics while the former stand for a more scientific approach.

Whichever type of infographic we speak about, they all share the same structure: a good infographic should have a title, a small introductory description of the theme, the illustration itself (with subtitles, preferably), conclusions (if necessary) and the sources. These items provide guidance on how to read the infographic, contextualizing the reader on the theme. The sources are relevant to give credibility to the information.

Infographics may have other features that make them more appealing and engaging, especially when used in an editorial and aesthetic approach. Animations, for example, can contribute to catching the

users' attention. Buttons, search engines, actions giving the opportunity for the user to change, insert, select, choose, reveal or hide information, can also do such work. These features allow the user to interact with the infographics but also to engage with it, at the same time they give the user an opportunity to explore more freely the data at his/her own pace.

Those interactive features are a result of the evolution of infographics. Linear infographics (mostly static images for print purposes) and some multimedia infographics (animations and videos) only require the viewer to see and absorb the information that is being presented. This is a linear (or one-way) form of communication and the user is passive towards it. Nowadays, database infographics and some multimedia infographics allow the user to be active towards it, by clicking, inserting data, changing the dynamics of the infographics, and so on.

An infographic may (and should) have interactive features to increase participation, to enhance elaboration and retention and to increase motivation, while simultaneously urges the user, who seeks for clarification of understanding, to discover and explore the contents of the infographic.

Interactivity has been used in information visualization mostly to make data more engaging or playful. It gives infographics, in this case, a more engaging way to absorb knowledge and to learn. If an infographic has interactivity displays and allows interaction with the user, it becomes an even more powerful tool. Like Figueiras claims, employing interactive techniques gives “users the ability to properly explore the data and find appropriate answers to their questions” (2015: 140), turning visualization into an *exploratory* (rather than *explanatory*) activity. If an infographic really takes advantage of this technique, it should not be considered as a linear form of communication, but as a non-linear (or bidirectional) one.

As we have seen, infographics can be a powerful tool to communicate data, a subject, an idea or even a concept. As Cairo claims, “an infographic is a tool for the designer to *communicate* with readers, and a tool for readers to *analyse* what’s being presented to them” (2013). Having that, infographics bring important benefits when it comes to the learning processes: enhances the ability to think critically and to develop and organize ideas; improves comprehension, retention, and recall of information and helps to reduce the cognitive load, leaving space to learn new material.

They have the power to amuse the viewer at the same time as it informs, teaches and even raises awareness. With that power, it contributes to solve analysis and comprehension problems.

This project presented here consists of an infographic presenting and explaining the concept of Citizen Observatories (COs), that may be published in a specific website or shared online. And for this reason, we will be using infographics with an editorial and aesthetic approach in this project.

### **3. THE PROJECT**

#### **3.1. Goals**

CO projects run on a voluntary basis and we have seen that for it to be successful, citizens' engagement is crucial. There are several reasons why someone would want to participate in these projects. Whether it is because someone has a problem which solution can be found in a CO project, or just because he/she enjoys science and wants to be part of a scientific project in his/her spare time, anyone can participate in these projects.

To recruit volunteers, it is very important to make information accessible. All ongoing CO projects have their own websites (and a few have their own mobile apps) and general information on the concept can be found at the European Commission website. However, we explore the hypothesis that there could be a way to make the core information even more accessible and relatable.

Our main goal with this project is to build an infographic to communicate the CO concept in a simple way. Considering the benefits of infographics for communication - including the use of images, interactive features, and its shareability - we will use this tool to make CO's information more easily available to the public.

With this project, we also hope to contribute to the field of infographics. As we have mentioned before, infographics are widely explored in journalism, so bringing it to multimedia and science will hopefully bring a new perspective on its usability and advantages.

Finally, we hope that this project will increase awareness both to infographics and, especially, to COs. We expect the final result of this project to be used to spread information on that concept and, hopefully, to raise the willingness of citizens to engage in CO projects.

#### **3.2. Methodology**

The CO concept is not easy to explain in a simple and straightforward way. Because one of our goals is to simplify and make this concept more accessible, we chose to use personas to build a relatable narrative around the concept.

A persona is a fictional character, made up for the purpose of helping people understand a given concept, idea or product. They are used mostly in marketing and publicity to help designers understand the behaviour and motivations of the target audience. They also help designers maintaining focus and attention on the relevant details. Personas represent a certain type of characters and standardize the approach of a group, which is why they become so relatable with the audience, and especially when built accordingly.

We decided to use three different personas, each one representing different scenarios: two with specific problems and one interested in citizen science. Inspired and based on the persona already

sketched and proposed by Montargil & Santos (2017), we adapted and developed three personas for this project:

- Ralf is a German amateur fisher, 35 years old, living in the Berlin area. He is a fishing enthusiast and fishes regularly in the many lakes and rivers surrounding Berlin but also, occasionally, in the sea. He is concerned about the water quality in his fishing locations because it will affect the quality of the fishes he catches. Therefore, Ralf has decided to buy a handheld sensor to monitor water quality. This monitor can be connected to his mobile phone and, through an app, his measurements will be registered online. Ralf has shared publicly his sensor's information and enrolled in a citizens' observatory monitoring water quality. Ralf also has access to water quality measurements made by a public environmental agency and by a network of professional fishers, through a network of fishing associations and professional institutions;
- Lisa is a Spanish entrepreneur, 24 years old, living in Barcelona. She has always been interested in nature, especially birds. Lisa is a birdwatch enthusiast and that is why she takes advantage of weekends and holidays to go outside the city and make observations. While birdwatching, Lisa can take photos with her mobile phone and upload in a specific app for bird specialists and amateurs. The app uses the mobile phone GPS and the information provided by the users to associate the observations to a specific location. The users share publicly their observations' data and are able to discuss them in an online forum, with other users and bird specialists;
- Nohr is a Danish contractor, 62, living in Aarhus. He suffers from pollen allergies and other breathing conditions. Due to his job, he must travel frequently so he bought a small sensor that measures air quality. He can connect his smartphone to the sensor and measure the air quality on a regular basis. Besides, Nohr enrolled in a citizen observatory related to the air quality and pollution monitoring which allows him to share publicly and access his measurements and his own evaluation of the air, as well as get alerts through his phone and email.

Our infographic was built around these three personas and, step by step, we explained how these three citizens could engage in CO projects and either solve their problems or satisfy their curiosity.

The design process began with the research of information and data on the different projects. To better understand the whole process of building a CO project and, especially, of connecting with the

public (i.e., recruiting volunteers), we contacted the principal investigators of CO projects funded by the EU (both finished and ongoing). We received answers from three of these projects (SCENT, CitiSense and GROW). Their feedback, combined with the information provided through all the CO websites allowed us to gather relevant information, in order to conceive the infographic.

The infographic was designed for two versions, desktop and mobile, using Adobe Illustrator. After a process of sketching on paper that took several weeks, we decided the type of icons and images to use. To make the process of designing faster, we used an online icons and images bank. When the infographics were complete, on Illustrator, Adobe XD was used to simulate the interactions and the infographic behavior.

As mentioned before, it was decided to take this project one step further by making our prototype a functional online infographic. In order to do so the infographic was developed using HTML5, CSS and JavaScript, and made available online by hosting it on a personal web server. We also used a domain service which forwards the information to the web server.

When the infographic was finished, we decided to test it with the contribution of two classes, at the School of Communication and Media Studies (ESCS - Escola Superior de Comunicação Social), in Lisbon. We built two versions of the questionnaire, one for the mobile version and the other for the desktop version. Both versions were identical, only the link to access the infographics was different. The questionnaire was organized in two main sections: one to assess the experience with the infographics (any previous knowledge on the topic, how easy it was to understand the concept, if it was visually appealing...) and another with socio-demographic questions.

At the first class, with 15 Erasmus international mobility students, we tested the mobile version. Because not all of them had computers, we gave these students access to the mobile version and let them explore it at their own pace.

To test the desktop version, we used a Journalism class at the same school, with 13 students, held in a computer lab. The methodology was the same: we gave the students access to the desktop version and distributed the questionnaire. For both groups of students, they took about 15 minutes to go over the whole process.

#### **4. RESULTS & FINDINGS**

The mockups for the infographics were developed, both for desktop and mobile versions (Figure 1 to Figure 5).

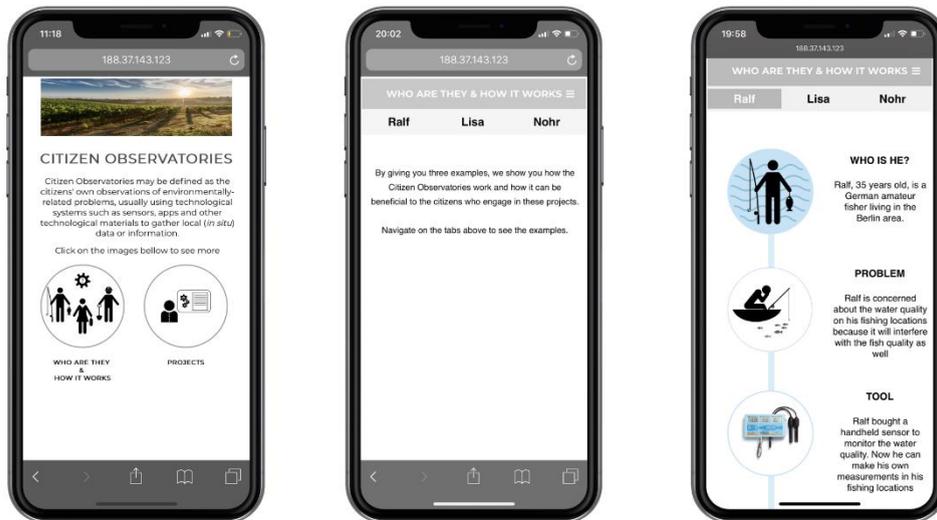


Figure 1 – Mockups of the mobile version: homepage, personas front page, example of a persona

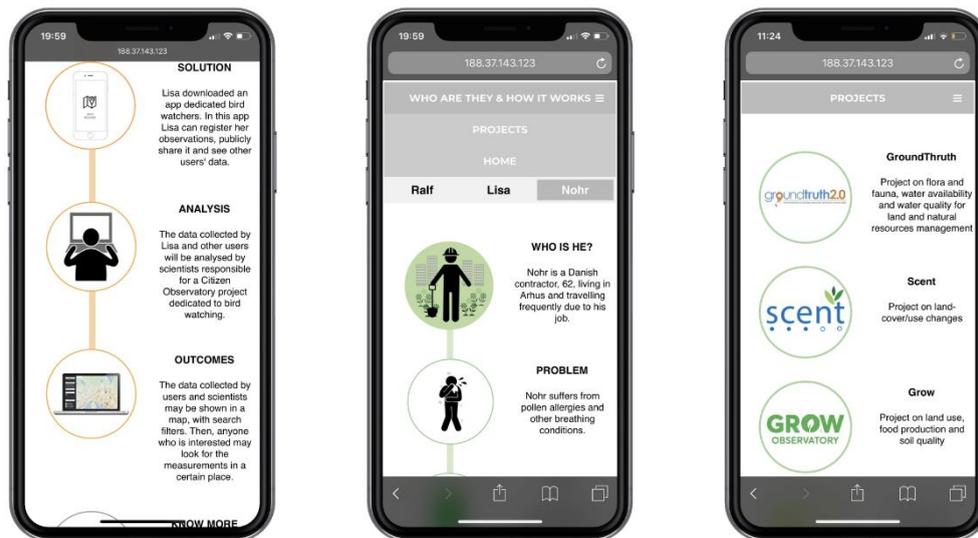


Figure 2 – Mockups of the mobile version: persona page, drop menu, projects page

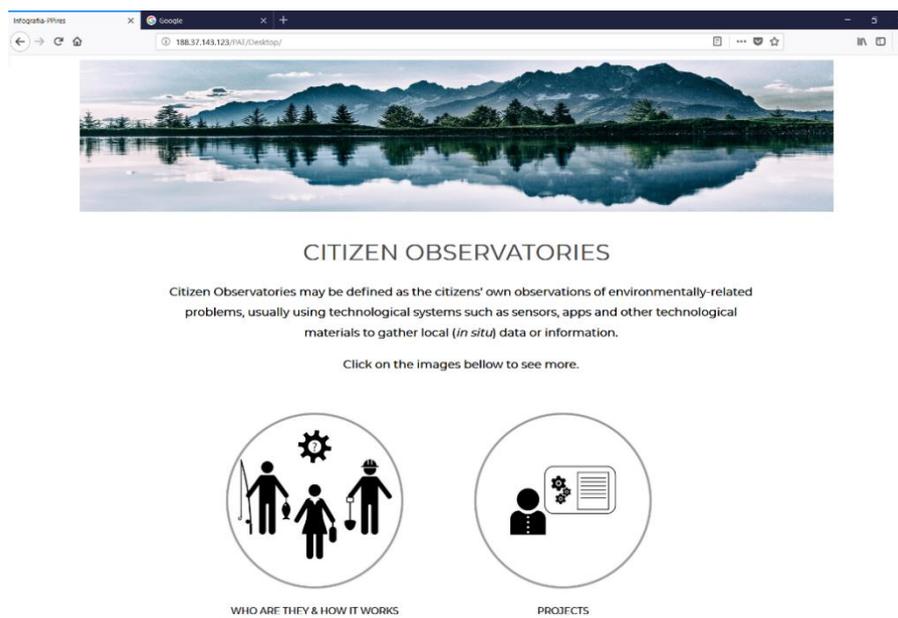


Figure 3 – Print screen of the desktop homepage

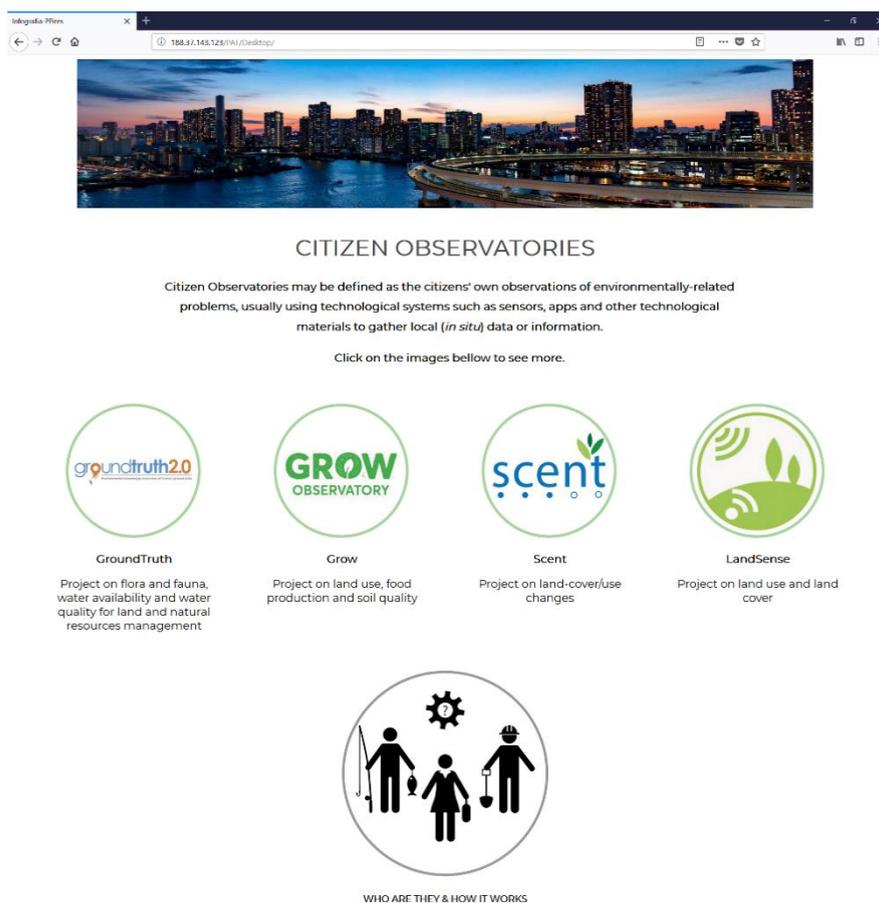


Figure 4 – Projects page on the desktop version

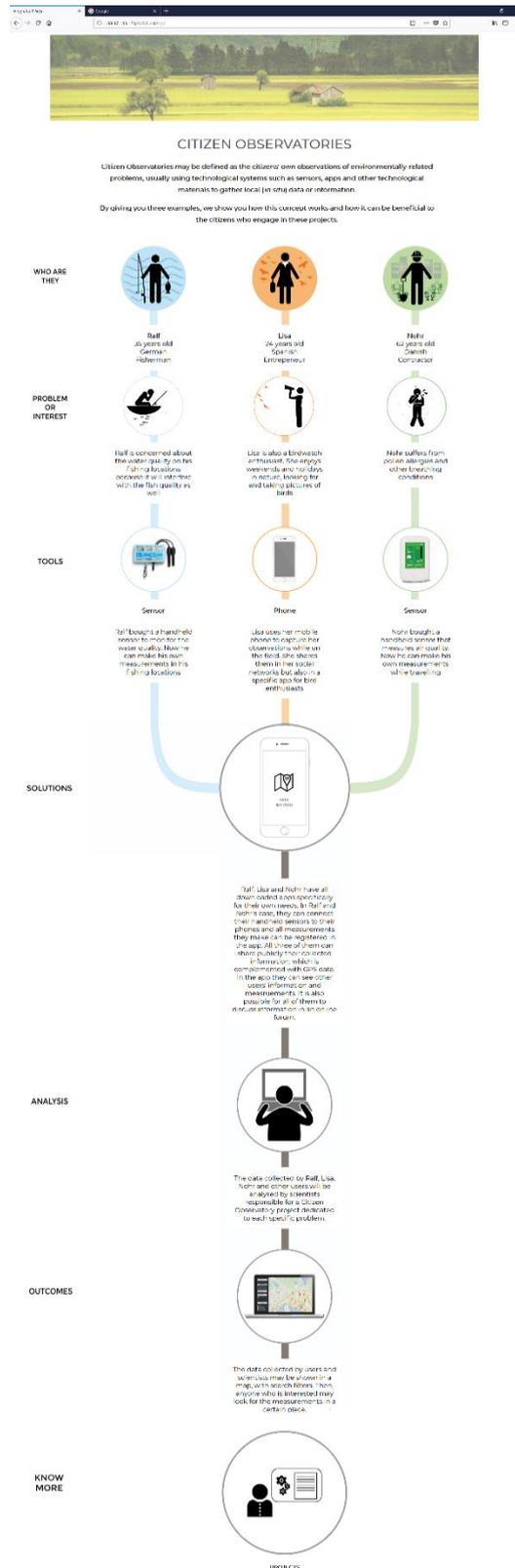


Figure 5 – Personas page on the desktop version

Final and functional versions can be found here:

- Desktop version: <http://desktopinfographics.ddns.net/>
- Mobile version: <http://mobileinfographics.ddns.net/>

Regarding the survey, a total sample of 28 valid questionnaires was obtained (15 Erasmus students, evaluating the mobile version, and 13 Portuguese students, evaluating the desktop version). Even though the sample is small, it is considered adequate for exploratory analysis.

The first group, that analyzed the mobile version of the infographic, was very diverse in terms of nationalities: Estonian (1), Polish (3), Romanian (2), Danish (2), Italian (1), Spanish (2), Belgian (2), French (1) and one user that did not identify the nationality. In terms of gender, however, they were very equally distributed, with 8 women, 7 men and one not identified, all in their early twenties. Their academic background is in journalism and communication.

Of all respondents, only one claimed to be familiar with the CO concept, prior to the survey. We then asked them to evaluate, from 0 (Not easy at all) to 7 (Very easy), how easy it was to understand the concept of CO through the infographic and how easy it was for them to navigate in the infographic. The results show us it was easy in both cases, being the navigation a little easier (average score: 6,13) than the understanding of the concept (5,53).

These results agree with the information the respondents gave us when asked if they found every information they looked for. Only two out of the sample of 15 answered “No”. One of them explained that he/she wasn’t looking for any information, and the second considered that the infographic should have “more information about why it is useful and how I can use it and why should I”.

We also asked the students if they thought the infographic was visually appealing. Three answered “No”, two did not answer and 10 answered “Yes”. To complement this information, we also asked them if they thought the icons and the images used on the infographic were adequate to communicate the concept. Except for one person that did not answer, all other respondents answered “Yes”.

To understand if the infographic was effective, we asked the students to write a little definition or description of COs, based on the interaction they had. Here are a few examples of those answers:

*A process for the collection of data done by regular people in their field of interest that can be used by scientists to make more valid and trustworthy conclusions about the subject.*

Estonian student, 20 years old, no previous knowledge about COs

*People who are looking for solutions to some problems.*

Romanian student, 19 years old, no previous knowledge about COs

*Platforms that help to improve our lives.*

Spanish student, 23 years old, no previous knowledge about COs

*Normal people who track daily habits/activities and share that data with others through apps/websites.*

Belgian student, 20 years old, no previous knowledge about COs

*Observations everybody can cooperate with to help scientists (and people who are interested) to know more about what is observed.*

Belgian student, 22 years old, no previous knowledge about COs

Finally, we asked the respondents to tell us about what they enjoyed the most and the least about the infographic. Nine out of the 14 students that answered to the former question told us that the simple visualization and iconography were the best part of it because it made the information very easy to understand. Three respondents told us that the navigation and interaction on the infographic was very good and two referred the examples as the feature they liked the most out of the infographic.

Regarding the last question, on what they liked the least about the infographic, five out of the 12 respondents mentioned a lack of information, both on numbers or percentages, and reasons why COs are important and why people should adhere to it. Two respondents talked about how similar the examples were, and four mentioned a few technicalities such as a lack of background color or a long loading time. Last but not least, one student told there was nothing she didn't like about it.

The desktop version was tested amongst a class of 13 Portuguese students of journalism. The survey was exactly the same as the mobile one except for the link the students had to run on their computers.

The class was mainly composed by women (11 out of 13) in their early twenties, and similarly to what happened in the previous class, only one of the students knew about COs prior to this interaction. These students also claimed the concept was quite easy to understand (average score: 5,92) and to navigate in the infographic (6,54). Unlike foreign students, in this class they all claimed to have found all the information they looked for in the infographic.

Twelve out of thirteen students told us they found the infographic visually appealing, and all 13 students claimed the iconography was adequate to communicate the information. These answers are in agreement with the descriptions the students supplied:

*These are the observations made by citizens about environmental problems, usually made through applications or other platforms.*

19 years old, no previous knowledge about COs

*These are people looking for solutions for environmental problems they face every day. For this they use the most efficient and updated technology.*

20 years old, no previous knowledge about COs

*They consist of observations that people can make and communicate through apps about certain issues. These observations rely on relevant data gathered with technological devices and people's considerations.*

21 years old, no previous knowledge about COs

*Tools that collect and aggregate data related to certain environmental factors.*

20 years old, no previous knowledge about COs

*A project whose aim is to study the environmental problems observed by citizens themselves.*

20 years old, no previous knowledge about COs

Finally, we also asked these students what they liked the most and the least about the infographic. Regarding the former, five respondents claimed that the examples were the one thing they liked the most, five mentioned the simplicity and easiness of understanding the information, and three students added to it the fact that it had components of interactivity. Regarding what they enjoyed the least, seven respondents mentioned they felt there was a lack of information regarding either the personas or the projects, in the sense they ended their analysis and wanted to know more about the projects and the personas situations. Two students told us the infographics should have been a little more interactive, one did not like the initial page and three said there was nothing they did not like about the infographic.

As we will see in the following section, these results were very important for us, in order to get some insight on the project.

## **5. CONCLUDING REMARKS**

Even though the sample for this survey is small, it is very diverse and provides a good preliminary insight into the work developed throughout the project. It is also particularly interesting to have feedback from journalism and communication students, considering their specific background. Furthermore, we believe it was an advantage for this project to have foreign students analyzing the infographic, since COs are funded by the European Commission, taking action in several European countries.

As we can see by the results, both groups of students had rather similar answers to the survey questions. Overall, they considered the concept was easy to understand and the infographic was easy to navigate. Most of them also considered the infographic was visually appealing and the iconography was adequate. This is in agreement with the fact that most of them also told us that one of the things they enjoyed the most about this infographic was the fact that it was simple and easy to understand.

The comments and critiques are probably even more useful and actionable than positive evaluations. A few comments considered it could be richer in information, especially because by the end of the interaction the students were left curious about the subject and wanted to know more. This was actually considered as a positive comment since it demonstrated the students understood the concept (by the other answers) but also wanted to have more information about it and about the EU funded projects. This also means that the goal of increasing the interest on COs was achieved, through this project.

In fact, all comments and answers were relevant, in order to improve the infographic. We acknowledge that this survey should have been done ideally at an earlier stage. However, this is a preliminary overview on how the user would perceive the infographic. In order to know in more detail what should be improved and how, we propose a more extensive survey, including people from a wider range of ages, nationalities and backgrounds.

With this project, we were able to develop a functional infographic that presents and explains the concept of COs. Our goal was to explore the potential of infographics to increase awareness for this concept. As we have seen through the evaluation, we were able to raise the interest of a short group of people for this subject, and we believe that with further improvements and by spreading the infographic it would be possible to reach a wider audience.

To conclude, we believe that COs could benefit with the usage of infographics as a communication tool. Its versatility, adaptability, and variety of formats make it an adequate way to increase awareness. The fact that it can be spread online makes it even more appealing. Even if so far it has been discreet, infographics have more potential for IT adoption and use than meets the eye.

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