

# VIRTUAL HANDS-ON WORKSHOPS TO BRING TEENAGE GIRLS TO COMPUTER SCIENCE IN URUGUAY: AN EXPERIENCE

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## ABSTRACT

During the last decades the presence of women in the area of Computer Science has decreased in most countries. In the last years, at the Facultad de Ingeniería (School of Engineering), Universidad de la República, Uruguay, we have carried out several activities with the goal of bringing girls closer to Computer Science area, on the occasion of Girls in ICT Day. Through these activities, we intend to eliminate certain preconceived ideas and negative stereotypes that promote girls' distancing from careers of this area. This paper presents the experience of the three virtual workshops carried out during 2021 (in virtual modality, due to the COVID-19 pandemic), which focused on programming, data, and geographic information systems, and the analysis of a set of virtual platforms considered for each workshop.

**KEYWORDS:** Computer Science, gender gap, teenage girls high school, virtual hands-on workshops.

TALLERES VIRTUALES PRÁCTICOS PARA ACERCAR CHICAS ADOLESCENTES  
A LAS CIENCIAS DE LA COMPUTACIÓN EN URUGUAY: UNA EXPERIENCIA

## RESUMEN

Durante las últimas décadas la presencia de la mujer en las Ciencias de la Computación ha ido en decrecimiento en la mayoría de los países. En los últimos años, en la Facultad de Ingeniería de la Universidad de la República, Uruguay, hemos realizado actividades para acercar a las adolescentes mujeres al área de Ciencias de la Computación, con motivo del Día de las Niñas en las TIC. A través de estas actividades se intenta derribar ideas preconcebidas y estereotipos negativos que distancian a las niñas de las carreras de esta área. En este artículo se presenta la experiencia de los tres talleres que se realizaron durante 2021 (en forma virtual debido a la pandemia de COVID-19), los cuales se enfocaron en programación, datos y sistemas de información geográfica, junto con el análisis de un conjunto de plataformas virtuales que se consideraron para cada taller.

**PALABRAS CLAVE:** Ciencias de la Computación, brecha de género, adolescentes mujeres de secundaria, talleres virtuales prácticos.



## 1. INTRODUCTION

The decreasing presence of women in the Computer Science area is a well-known issue that has been occurring for nearly the last three decades. Several international studies and Ibero and Latin American studies show this reality in different countries (Ricket, 2001; Quesenberry, Frieze, Lewis, 2015, Marín et al., 2015; Bello, 2020). The analysis of the causes of this phenomenon has identified certain negative stereotypes that promote girls' distancing from careers in science, technology, engineering, and mathematics (STEM), mainly computer science (Tomassini, Urquhart 2011, Moreira et al 2019, MIMCIT 2020). Elements such as the belief that these careers are only for men or that women are not good at mathematics and science lead girls to doubt their abilities. Likewise, the lack of encouragement at school and in the family to pursue these careers and the lack of role models discourage girls from choosing STEM careers. Finally, in the particular case of computer science, the false idea of programmers working in basements, eating only pizza, and with little social interaction are not attractive to most young girls.

Universities, enterprises, and institutions in several countries of all continents (Ricket 2001; Quesenberry, Frieze, Lewis 2015, Marín *et al.* 2015) are carrying out activities to fight these stereotypes and false beliefs and bring more girls to this area. In particular, the International Telecommunication Union (ITU) has organized since 2011 the International Girls in ICT Day to “build awareness about the gender digital divide and encourage more girls and young women to pursue careers in STEM actively” (<https://www.itu.int/women-and-girls/girls-in-ict/>). During this day, universities, companies, and institutions are encouraged to open their doors and invite girls to see what these careers offer, talk and interact with women in these fields, and get first-hand exposure to different aspects of ICT.

Facultad de Ingeniería (Engineering School) from Universidad de la República (UdelaR) in Uruguay, has participated in Girls in ICT Day since 2011 focusing on the organization of activities for teenage girls. Starting with the 2017 edition, we added hands-on workshops with the slogan “doing instead of watching” to bring high school teenage girls closer to the University and engage them in STEM-related activities. These workshops follow a role model approach, delivered exclusively by female teachers and advanced students from the majors involved (Ref 1, Ref 2). All these activities were part of the project “Promoting ICT careers within teenage girls from high school in Uruguay”, which received the award in the gender category

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Year	W	M	Total	%W
1990	120	358	478	25%
1991	151	385	536	28%
1992	147	335	482	30%
1993	141	274	415	34%
1994	141	293	434	32%
1995	142	264	406	35%
1996	94	278	372	25%
1997	125	292	417	30%
1998	135	332	467	29%
1999	89	283	372	24%
2000	130	351	481	27%
2001	79	327	406	19%
2002	80	374	454	18%
2003	113	431	544	21%
2004	101	431	532	19%
2005	90	373	463	19%
2006	83	417	500	17%
2007	100	419	519	19%
2008	92	462	554	17%
2009	103	442	545	19%
2010	118	546	664	18%
2011	108	543	651	17%
2012	104	486	590	18%
2013	107	551	658	16%
2014	82	570	652	13%
2015	97	524	621	16%
2016	99	557	656	15%
2017	99	629	728	14%
2018	144	694	838	17%
2019	158	747	905	17%

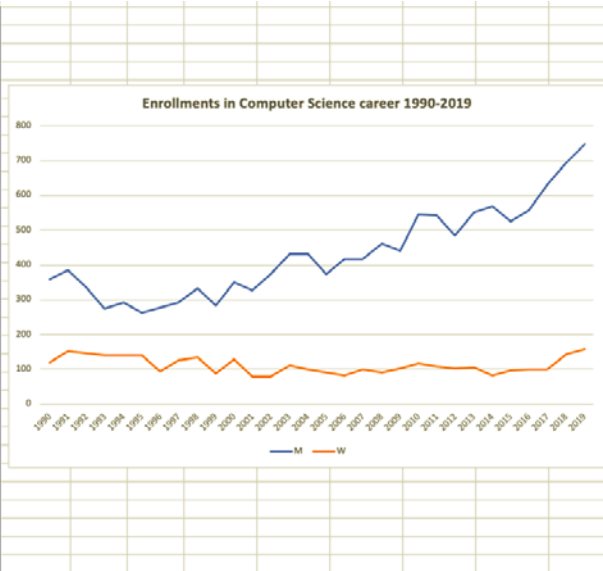


Figure 1. Enrollments in Computer Science career, organization, 1990-2019  
(Data from <https://planeamiento.udelar.edu.uy/publicaciones/estadisticas-basicas/>).

of the “Regional Fund for Digital Innovation in Latin America and the Caribbean (FRIDA)” in the 2018 edition. The Instituto de Computación (Computer Science institute, InCo), which is in charge of the Computer Science careers in FING, Udelar, has been working on the gender gap in the area, promoting this kind of activities within teenage girls from the beginning of the project, and within other projects (FING, FCS, CSIC, Udelar, 2018).

In Uruguay’s engineering and technological areas, the gender gap is present in the scientific, academic, and professional areas. Several diagnoses on the situation of women in STEM were carried out in the last decade to account for the gender gap based on evidence, such as the gender report (ANII, 2015) of the Sistema Nacional de Investigadores (National System of Researchers, SNI <https://sni.org.uy/>), the Udelar’s teachers census (DGPlan, Udelar, 2015) for Udelar, the industry, and recently the national report of Uruguay (MIMCIT, 2020) for the SAGA project of UNESCO, in which Uruguay participated.

Regarding women’s participation in the Computer Science degree in FING, Udelar, it is interesting to analyze the history of enrollments from early in the 90s until today. Figure 1 presents the evolution of this indicator, showing that the women: men enrollment ratio was almost 1:2 and 1:3 in the 90s, reaching its maximum value in 2014 (1:7) and oscillating between 1:5 and 1:6 thenceforth. This fact is in line with what happened in the world. Also, from 2000 the total enrollment in the Computer Science degree presents a sustained growth with small oscillations.



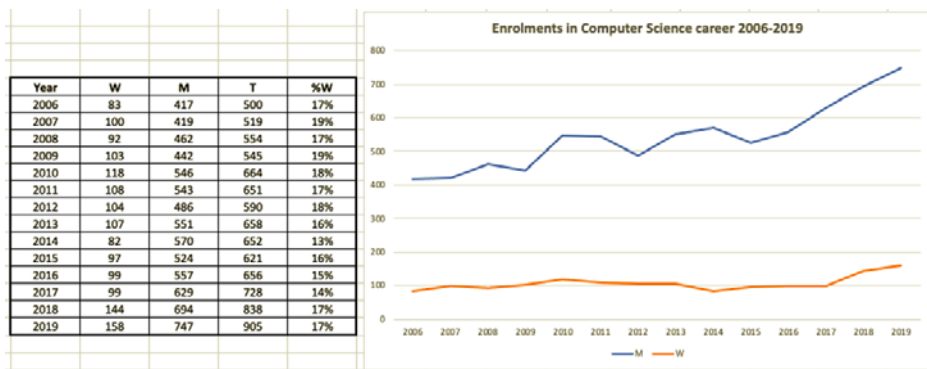


Figure 2. A zoom on the 2006-2019 enrollment data in Computer Science degree, organization, (Data from <https://planeamiento.udelar.edu.uy/publicaciones/estadisticas-basicas/>).

If we zoom in on the last 14 years (2006-2019), we observe that the total enrollment has grown since 2015, reaching its historical maximum with 900 enrollments in 2019 (see Figure 2). Thus, women’s enrollment has shown a slight growth in the last two years. Unfortunately, we still do not have the 2020 and 2021 data, so we cannot confirm the tendency.

In 2020 the pandemic situation in Uruguay started in March, so we had to suspend in-person classes and go virtually with all courses and exams within a short period to ensure that students at the university could continue their studies. In particular, the activities for the Girls in ICT Day to take place in April had to be suspended. So we launched the website (deleted due to double-blind review), where we uploaded photos and videos of previous editions and other materials. For the Girls in ICT day of this year 2021, we decided to organize virtual workshops to carry out the activity in virtual format, creating new workshops from scratch and adapting some existing ones.

This article extends (Ref 3), where we presented two workshops in the Computer Science area and the virtual experience carried out with teenage girls from high school, showing and discussing the challenges of turning to a virtual modality and the results of the workshops. We extend previous work by adding entirely new content, as follows: i) a new section that includes the virtual platform’s review performed during workshops preparation, presenting the main characteristics we took into account to select the ones we finally used, and ii) a new subsection with the description of a workshop on geographical information systems, which was not previously described.

The rest of the document is organized as follows. First, in Section 2, we present the review on virtual platforms. Then, in Section 3, we describe the virtual workshops and activities, while in Section 4, we describe and discuss our experience with the virtual workshops, comparing it with the in-person workshops we carried out in previous editions. Next, in Section 5, we present related work, and finally, in Section 6, we draw some conclusions and future work.



## 2. VIRTUAL PLATFORMS REVIEW

This section reviews existing programming and data platforms we considered to be used in the virtual workshops. We also briefly describe the geographic information systems platform we used for the workshop.

### 2.1. PROGRAMMING PLATFORMS

We searched and compared several online web programming platforms, checking the provision of the Spanish language as the essential characteristic for interaction with the graphical user interface (GUI) and coding. We also looked for programming with code blocks in which each instruction is mapped as a block, putting concepts within reach of children, based on the experience of “Butia” project (<https://www.fing.edu.uy/inco/proyectos/butia>) with TortugArte (Sugar activity inspired by Logo), which was the one we used in the in-person activities. Although several coding platforms are around, most are only in English and do not always allow free use. Among the ones that we looked at are Scratch (<https://scratch.mit.edu/>), Blockly (<https://developers.google.com/blockly/>), Code.org (<https://code.org>), Snap (<https://snap.berkeley.edu/>), and Gobstones (<http://gobstones.github.io/>). Also, the Uruguayan governmental Plan Ceibal (<https://www.ceibal.edu.uy/es/plataformas-inicio>) provides platforms and open educational resources (OER) for Uruguayan elementary schools and high schools, which are used within the school activities with children and teenagers, but with no gender focus.

#### 2.1.1. *Blockly*

Blockly is an open-source developer library developed by Google to build block-based coding applications and provides examples in Blockly games (<https://blockly.games/?lang=es>). It provides a block editor UI and facilitates generating code with out-of-the-box generators for JavaScript, Lua, PHP, Dart, and Python. Since we were looking for already existing block-based coding applications, we focused on Blockly games that provide exercises for learning programming.

There are eight games, each with a specific learning objective, e.g., Maze for loops and conditions, Music for functions, etc., with different difficulty levels to be traversed from basic to advanced. Both the GUI and the coding blocks are provided in Spanish, and girls can use the GUI online or offline by downloading it from Github (<https://github.com/google/blockly-games/wiki/Offline>). In Figure 3, the Maze game is shown in the programming environment.

Google also provides other materials, tutorials, and applications for teaching Computer Science at different levels, in Code with Google (<https://edu.google.com/code-with-google>), including CS First (<https://csfirst.withgoogle.com/s/en/home>) and Grasshopper (<https://grasshopper.app/>) for JavaScript, not block-based.





Figure 3. Blockly games Maze example to work with loops and conditions.

### 2.1.2. Scratch

The Scratch tool (<https://scratch.mit.edu>) was created in 2002 by the MIT Media Lab and is currently maintained by the Scratch Foundation. It is a collaborative programming platform with a large community of users translated into more than 60 languages, including Spanish. In 2019, version 3.0 of the platform was released, and more than 20 million young people created projects on the platform (48% increase over the previous year) (<https://scratch.mit.edu/annual-report>).

The platform was designed for young students from 8 to 16 years old. Students can create stories, animations, and games, select or create images as characters or objects that participate in the story, and define sequences of instructions using a block-based coding style. Figure 4 shows the general working environment and a simple program consisting of a number guessing game.

The Scratch site offers an extensive gallery of projects classified into different categories, such as animations, arts, games, music, stories, and several tutorials. The platform also allows the creation of user accounts. In particular, teachers can keep track of the projects created by their students.

### 2.1.3. Code.org

Code.org (<https://code.org>) is a nonprofit platform created in 2013 by Hadi and Ali Partovi to encourage students to learn computer science, seeking to increase the participation of young women and students from other underrepresented



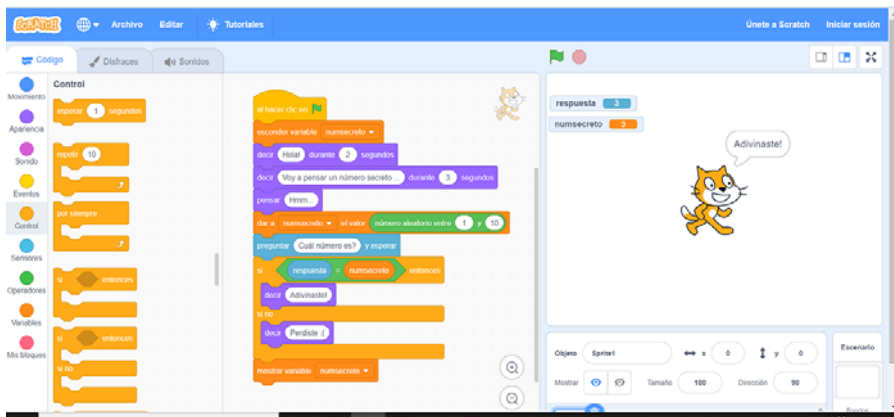


Figure 4. Simple example of a Scratch project.



Figure 5: Example of a Code.org project.

groups. The platform provides mini-lessons, including videos, tutorials, and projects, available in over 45 languages to learn programming in a fun way. Complete courses are divided into elementary, middle, or high school. In addition, students can make their games, apps, computer drawing, websites using blocks, JavaScript, CSS, HTML, and more. Figure 5 shows an example of a lesson.





Figure 6. Snap! screenshot.

The platform also has a one-hour tutorial designed for all ages to show that anybody can learn the basics of code in a short time, getting people to write short snippets of code to achieve pre-specified goals using Blockly (<https://snap.berkeley.edu/>), and Gobstones (<http://gobstones.github.io/>). In addition, the Hour of Code website has over 500 computer science activities for all ages and experience levels.

#### 2.1.4. Snap

Snap! (<https://snap.berkeley.edu/snap/help/SnapManual.pdf>) was developed by the University of California Berkeley and is a reimplementing of Scratch, with different extensions that make it suitable for deeper programming learning. As shown in Figure 6, the various block categories are similar to Scratch's.

Snap! allows the programmers to create their blocks, and one of the main extensions is the use of lists to implement data collections.

Although it is a handy platform for teaching programming skills, it is designed to go deeper into programming, so it is not the most appropriate tool for an introductory workshop like the one we conducted on this occasion.

#### 2.1.5. Gobstones

The Gobstones platform provides a web environment easy to learn and use, with a GUI and programming blocks in Spanish, including predefined exercises (<https://gobstones.github.io/gobstones-jr/?course=program-ar/proyectos-gobstones-jr>) and teacher materials (Martínez López, 2019) provided within the Argentinian program.AR (<https://program.ar/material-didactico/>) initiative. The Gobstones



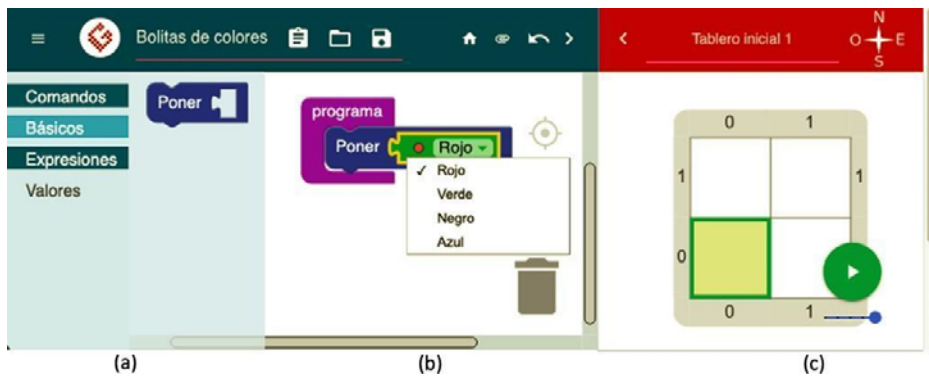


Figure 7. Gobstones platform general view with the basic marbles exercise.

platform was designed by the Universidad de Quilmes, Argentina, and takes its name from Harry Potter’s magical game of marbles since marbles are a key element in the language. In Figure 7, the general view of the Gobstones platform is shown with the basic marbles exercise.

The web environment is organized in three main spaces: it uses an initial board (c) to show the problem to solve and the execution environment along with a green arrow for running the program, and using the code blocks provided (a) the program code is defined (b).

When executed over the board (using the green arrow), the final board with the execution result is shown (when there are no errors). It also provides a compass on the superior right corner to be able to move the program head across the board. The example exercise in Figure 3 asks to build a program to put four marbles, one of each provided color, in the (0,0) cell of the board. The program must change the state of the board, i.e., from the initial board we have to go to a final board. It can be seen that in this trivial example, there is one primitive (procedure) provided in the command option, which is “Poner” (“Put”), with one argument, and in the expressions option, the values to choose from: red, green, black, blue. There is also an option to show the program code in text form.

Another very similar platform is called Pilas Bloques (<https://pilasbloques.program.ar/>) from the Argentinian program. AR initiative, which we did not evaluate in-depth since we first found Gobstones, provides mainly the same elements and exercises we have already tried in Gobstones.

### 2.1.6. Other platforms

Although we reviewed several other platforms that provide elements and activities to learn how to code, we focused on presenting the ones we evaluated more profoundly, since they offered the main elements that we were looking for in the

workshops, with the Spanish option for GUI and block programming. Most of the platforms we found are block-based. Still, others provide direct textual language programming, with diverse age targets, and different language options, for solving problems or creating computer games, among others. Although they only provide the English language for programming, it is worth mentioning Alice (<http://www.alice.org/>), which is also block-based and allows to create animations, build interactive narratives and simple games in 3D; CodeCombat (<https://codecombat.com/>) and Flowlab (<https://flowlab.io/education/teachers>), which also provides support for creating games; MakeCode (<https://www.microsoft.com/en-us/makecode>) from Microsoft, which provides block-based and other languages and materials for learning programming; Tynker (<https://www.tynker.com/>), which is also block-based.

## 2.2. DATA LITERACY TOOLS AND PLATFORMS

Data literacy has gained prominence in recent decades. This concept, which describes the ability to read, work, analyze and argue with data, requires training in specific skills (D'Ignazio 2016). Our data workshop's main goal was to provide girls with a simple hands-on experience analyzing data. Few platforms focus on training all these skills by providing exercises and activities, but several general-purpose platforms can be used for this goal. In the following, we summarize the reviewed tools.

### 2.2.1. *Airtable*

Airtable (<https://www.airtable.com/>) is an online platform for storage, visualization, and cross information of small data loads. One of its main advantages is that multiple users can work simultaneously, adding data and generating new information. Moreover, it is adequate to introduce people to databases as it shares the simplicity of spreadsheets applied to database features. Users can load data from CSV files, assign different data types to each column and obtain crossed data from multiple spreadsheets. The tool also allows users to filter data according to specific conditions and show the result in different kinds of charts. For our purposes, the main drawback is that it is only available in English, making it difficult to use for non-English speakers.

### 2.2.2. *Datawrapper*

Datawrapper (<https://www.datawrapper.de/>) is a tool for managing and visualizing data. It allows the user to upload data in different formats and make minor changes such as changing data types or adding columns. It has several chart types to visualize data and has a wide range of customizable options, for example, the position of a specific column in the chart. Finally, it allows the user to download



the created chart. Even though it is a powerful tool for exploring data through different chart views, it does not have the possibility of choosing different files and crossing their information, which is one of the most interesting aspects to explore when starting to work with data.

### 2.2.3. *DataBasic*

DataBasic (<https://databasic.io/es/>) is a tool that makes it easier to understand textual and tabular data. It consists of four main tools: *wordCounter*, *sameDiff*, *WTFcsv*, and *Connect the dots*.

*WordCounter* shows the most used words and/or phrases in a document, summarizing text. *SameDiff* lets the user compare two documents in order to see the differences between them, this kind of comparison allows the user to learn about quantitative analysis of a text. *WTFcsv* provides an overview of the uploaded CSV file. It is a suitable tool for people who don't know how to deal with a spreadsheet and provides a simple analysis of word frequencies. Finally, *Connect the dots* analyzes data as a network showing how it is connected. It spots the most related entities and the most popular relations among data.

Even though all of these tools help to better understand the structure and content of data, the procedure itself is hidden from the user, which is a drawback in this case.

## 2.3. GEOGRAPHIC INFORMATION SYSTEM PLATFORM

In the Geographic Information Systems workshop, data is one of the most important things. In Uruguay, the Spatial Data Infrastructure (IDEuy, <https://www.gub.uy/infraestructura-datos-espaciales/>) is the official reference for spatial open data and is coordinated by the President's Office. IDEuy is composed of all the government Ministries, some Local Governments, and several public enterprises: Water, Telecommunications, Postal Service, and Energy.

The IDEuy coordinated a photogrammetric flight in 2017-2018 that generated aerial images for the entire territory of Uruguay. New versions of some national vector layers have been generated from these images. Some of these new vector layers are competence of different Government Ministries, but all of them are published on the main website of IDEUY. Besides that, the IDEuy has the official and most actual dataset on geographic data, and it has several interesting tools. For the purpose of the workshop, we focus on the Map Viewer. The Map Viewer allows us to activate and deactivate the different layers, allowing us to focus on one at a time. It has a coordinate calculator that shows the actual coordinates of the pointer and can find a point by its coordinates or change the coordinate reference system. Figure 8 shows the IDEUY website's main page.



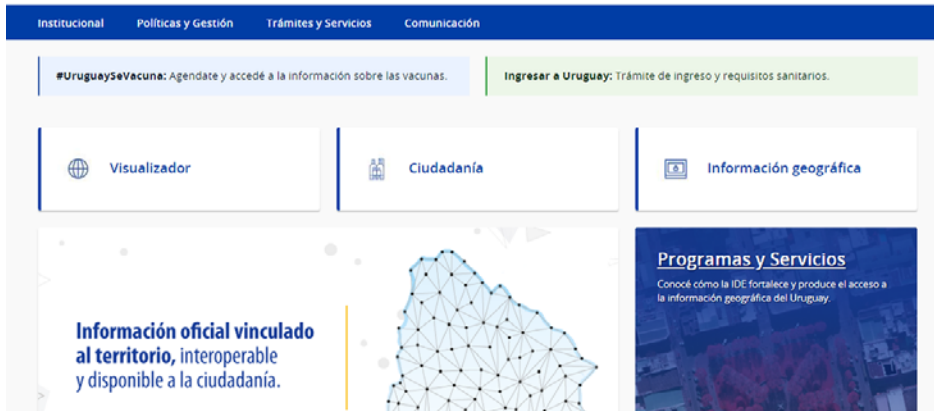


Figure 8. Spatial Data Infrastructure IDE Uruguay website.

### 3. VIRTUAL WORKSHOPS

In this section, we present the definition of the new virtual workshops.

#### 3.1. PROGRAMMING WORKSHOP

The programming workshop was named “¡A programar!” (“Let’s code!”) to try to motivate girls to participate. This workshop was defined from scratch for the virtual format since, in the in-person format, the main workshop for programming was the “Butia” robot (<https://www.fing.edu.uy/inco/proyectos/butia/>) workshop (Ref 1, Ref 2). We designed this virtual workshop with a focus on giving the girls motivating activities to have fun coding online and, at the same time, learning a few key concepts about programming. We selected the Gobstones web platform since we found it very easy to learn and use, with a GUI and programming blocks in Spanish, that provide predefined exercises and materials for teachers that meet the objectives we had for the virtual workshop.

At the beginning of the workshop, we introduced some basic programming concepts: program, algorithm, sequence of instructions, selection, and repetition. We worked with an algorithm for brushing teeth, starting from an elementary version and adding complexity by introducing conditions and repetition.

After this introduction, we presented the Globstones platform and the first exercise.



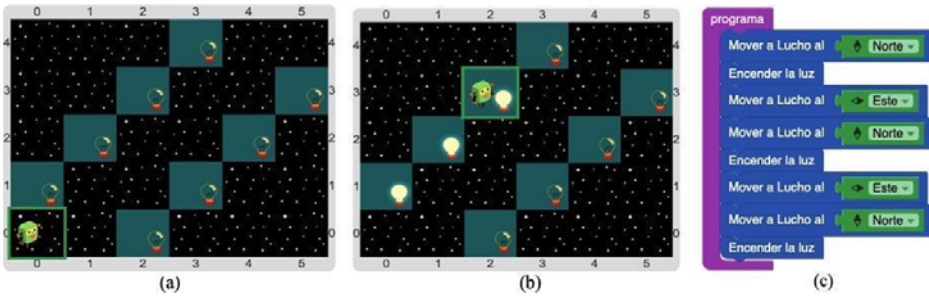


Figure 9. Lucho turns on the lights exercise: a) initial board, b) partial solution board, c) block code.

### 3.1.1. Programming activities

We selected three exercises from the Gobstones platform, providing a logical path from the first basic exercise to the third, building knowledge upon the previous one. The first exercise focuses on using primitives and variables to solve a problem step by step; the second exercise adds repetition to the first one, and the third exercise adds conditionals to the second one. We also considered how attractive the proposal would be for the girls, including the clothing for the board (i.e., adding visual elements to provide a user-friendly experience).

*Exercise 1 - Lucho turns on the lights.* The first exercise takes us to the space, where the robot Louie (Lucho, as they affectionately call it, which means Lou) has to go through the cells containing lightning bulbs to turn them on. Two procedures are provided: “Move Lou to:” (in Spanish “Mover a Lucho a:”) to move the robot through the board, and “Turn on the light” (in Spanish, “Encender la luz”). In this exercise, the idea is to find the best way to move the robot through the cells that have light bulbs to be turned on, using the best strategy to travel the board without extra movements using the primitives provided. We also prepared questions to discuss the solution: What can they say about the robot movements within the board? What is the effect of such movement blocks regarding program length and readability? Could we have a basic block of movements and repeat the block instead of repeating movements every time? Figure 9 shows a) the initial board, b) a partial solution board showing the first three movements of the robot to achieve the task, and c) the corresponding block code.

*Exercise 2 - SuperLucho 1.* The second exercise changes the setting of the initial board, so Lucho has to go through an unknown number of cells in the space to get to the finish line, turning on the bulbs in each cell. In this exercise, the robot has to move East, and several initial boards are provided, over which the code is executed randomly. This helps ensure that no fixed repetitions



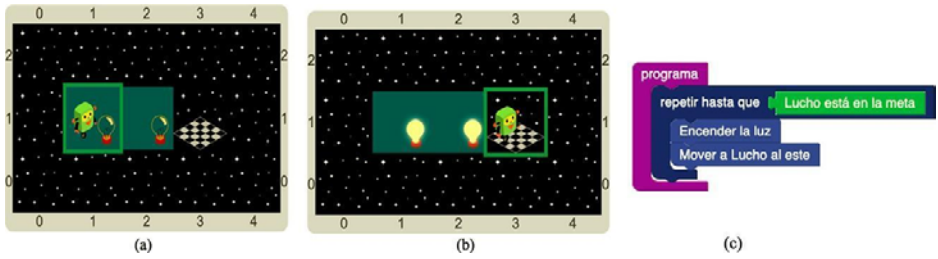


Figure 10. SuperLucho 1 exercise: a) initial board, b) final board, c) blocks code.

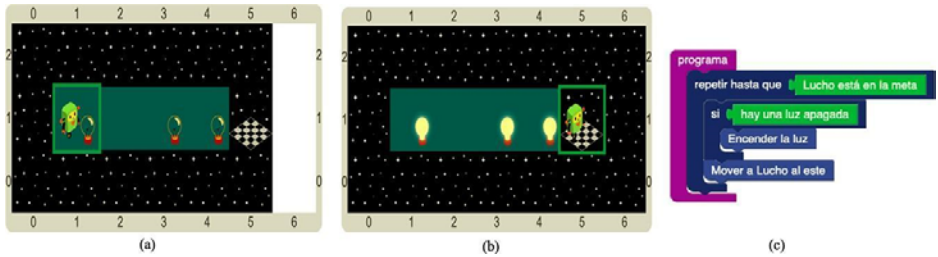


Figure 11. SuperLucho 2 exercise: a) initial board, b) final board, c) blocks code

can solve the problem since each initial board has a different number of cells. The goals of this exercise are twofold: i) add a repetition block code to solve the problem detected in the previous exercise and ii) add a conditional in the repetition block code to end the loop, as opposed to counting the cells to do it. Figure 10 shows a) the initial board, b) the solution board, and c) the corresponding block code. We also prepared questions to discuss: Why is it not possible to repeat the code block a fixed amount of times as in the previous exercise? Why do we need to check if Lucho reached the finish line and not something else?

*Exercise 3 - SuperLucho 2.* The third exercise changes again the assumptions of the initial board, so Lucho still has to go again through the unknown number of cells in the space to the East, until it gets to the finish line turning on the bulbs as in the previous exercise, but now some cells are empty i.e., there are no bulbs in each cell but in some cells. Again several initial boards are randomly executed with the solution code. In this exercise the goal is to add a conditional block to check whether there is a lightning bulb to turn on in each of the visited cells. Figure 11 shows a) the initial board, b) the solution board, and c) the corresponding block code. We also prepared some questions to discuss with the girls: Why do you have to check if there is a lightning bulb in the cell? What if they don't check it? Did it happen to them?

## 3.2. DATA WORKSHOP

As well as the Programming workshop, the data workshop was defined for this edition. Moreover, it was the first time that an activity focusing on data was included. The workshop was named “Taller de datos” which is translated to “Data workshop”, and its main purpose was to introduce the girls to the importance and value of data. Our objective was to perform the hands-on activities using a platform that allows loading, managing, and viewing data. The chosen platform had to enable loading a csv file, showing it in a table format, filtering data, and generating charts. With all these features in mind, we decided to work with *Airtable*<sup>1</sup>. With *Airtable* you can create an account and load data for free, for a trial, and access the data afterward. We created a database called “Chicas TICs”, in which the girls would perform the activity. The main page shows the grid view (initially empty) and allows selecting different forms of presenting data and adding an application that adds charts. The web page is in English, which was one of the main concerns before doing the activity.

### 3.2.1. Data Activities

The workshop was structured in three activities with incremental complexity, each of them depending on the previous one.

*Exercise 1 - Loading Data.* In this exercise, the aim was to show the girls how using an appropriate tool can completely change the way data is presented. First of all, they had to open a raw csv file, with covid-19 Uruguayan data, in any data editor. We showed them the difficulties of reading such a file to motivate the use of additional tools. The csv file is shown in Figure 12 a). After that, the girls were guided into loading the file into an *airtable* table, called *covid19*. The tables obtained are shown in Figure 12 b). When this was finished they were able to compare both data structures.

With the data loaded into the application, the second step was to link more than one table. To do so, one of the columns of the *covid19* table is changed to a lookup value in a second table. The table chosen to interact with was one including population per department, so we could calculate the average amount of infected people. To conclude this step, after generating the lookup to the other table, they had to add a column containing the average. The average step is shown in Figure 13.

*Exercise 2 - Adding Chart.* One of the main advantages of using tools to manage data is the capacity of visualization. Using *Airtable*, we helped them construct a

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<sup>1</sup> <https://airtable.com/>.



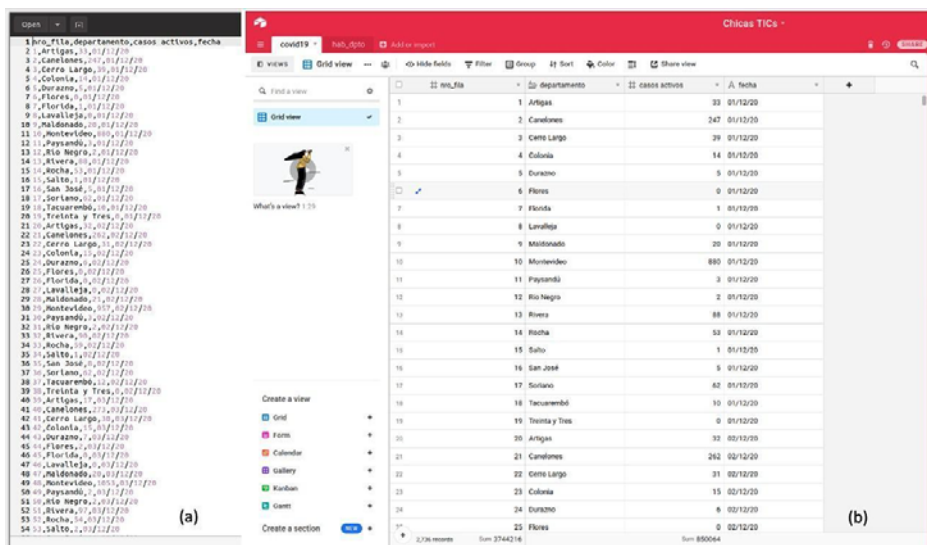


Figure 12. COVID-19 data to analyze: a) csv file format, b) airtable table format.

pie chart showing the average number of active cases per department. After this first step, we gave the girls some freedom to explore what other types of charts could be done. We also asked them what additional interesting information they would like to obtain from a chart and helped them construct the different options.

*Exercise 3 - Adding Filter.* Finally, we explored the possibility of adding a filter and obtaining data of interest. For this step, we asked them what simple question they would like to answer and helped them to add it. They mainly asked for the number of cases where they lived, so we filtered data by department. In Figure 14, an example of a filter by department is shown. After adding the filter, the changes could be observed in the table and the chart.

### 3.3. GEOGRAPHIC INFORMATION SYSTEMS WORKSHOP

The Geographic Information Systems workshop was called “Mapping your world” (Mapea tu mundo). This workshop was redefined entirely for the virtual edition, since the previous editions of the workshop relied on the computer lab infrastructure (Ref 1, Ref 2). The workshop’s main goal is to use geographic information technologies, specifically online map viewers. The workshop starts with an introduction to the history of cartography, the representation of the Earth on a plane, and the technologies that support digital maps. To explore and work with spatial data we choose the Map Viewer (Visualizador) of the Spatial Data Infrastructure of Uruguay IDEuy.



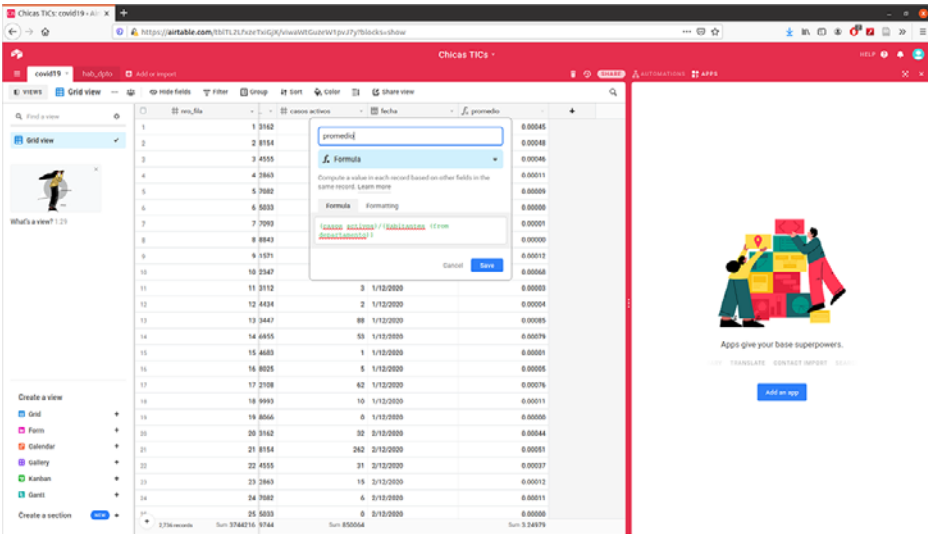


Figure 13. Airtable average calculation of infected people.

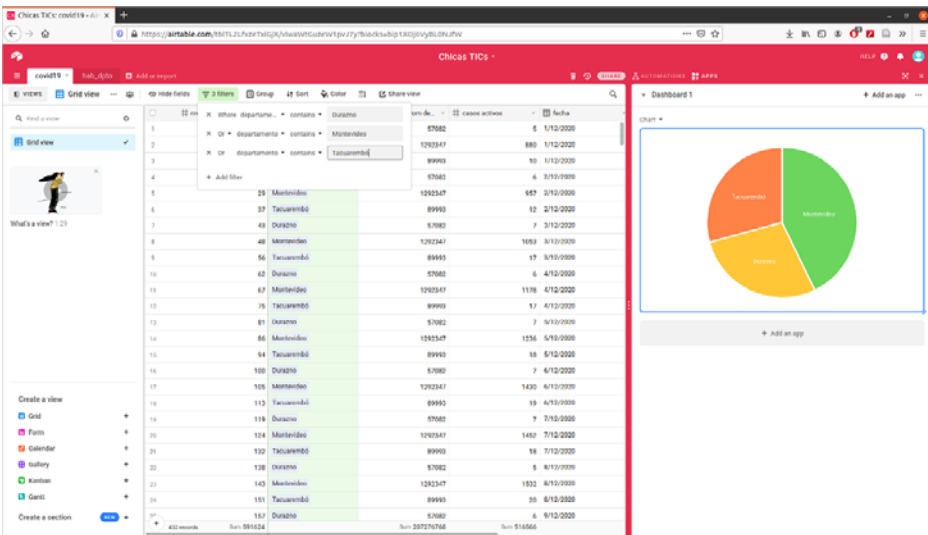


Figure 14. Filter by department.

The workshop methodology was planned to work with initial questions to start from the girl's previous knowledge and get to the concepts together. For example, starting with "What is an aerial image?" "What are satellites?" As we go

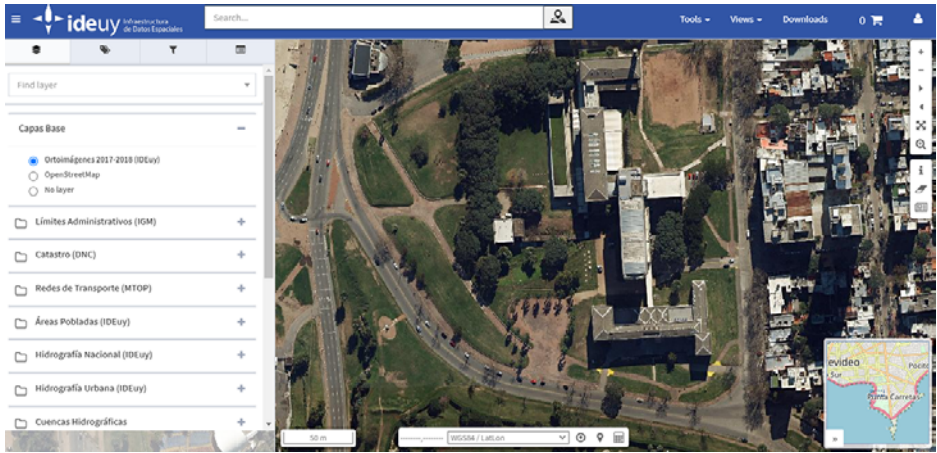


Figure 15. Orthoimages of FING (2017-2018).

through the map viewer, we discuss different concepts about spatial data and its generation.

### 3.3.1. GIS activities

*Exercise 1 - Aerial and Satellite Images.* After opening the IDEuy Map Viewer, the first exercise was to explore the layer called “Ortoimágenes 2017-2018.” We introduced how these images were generated through a photogrammetric flight covering all the Uruguayan territory. The aerial images have different precision on urban areas and countryside areas. We showed the Facultad de Ingeniería area, as shown in Figure 15. After that, the participants had to look after their cities, neighborhoods, high schools, and homes. We proposed to discuss if there were changes in their familiar zones between the 2017-2018 images and the 2021 reality. As a second part, we explored the layer called “Montevideo Marzo 2020” in the group of Satellite Images. Focusing on the Facultad de Ingeniería area, we compared this image with the previous aerial image. As shown in Figure 16, the image quality is different and we can see some differences in reality: Facultad de Ingeniería has a new building.

*Exercise 2 - Map Tools.* The second exercise is about recognizing and using the tools that the map viewer has. On the bottom-right area of the screen, we can see a reference map that shows where we are exploring the map. It brings context showing a larger area. The map viewer also has a scale reference and a coordinate area. The coordinate area shows the actual coordinate where the cursor is pointing and has some advanced functions such as transforming coordinates between different Coordinate Reference Systems (CRS). The



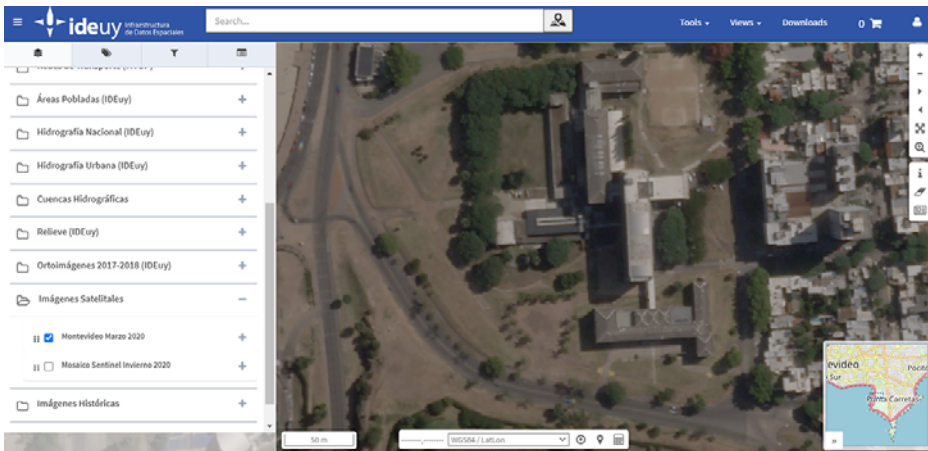


Figure 16. Satellite image of FING (March 2020).

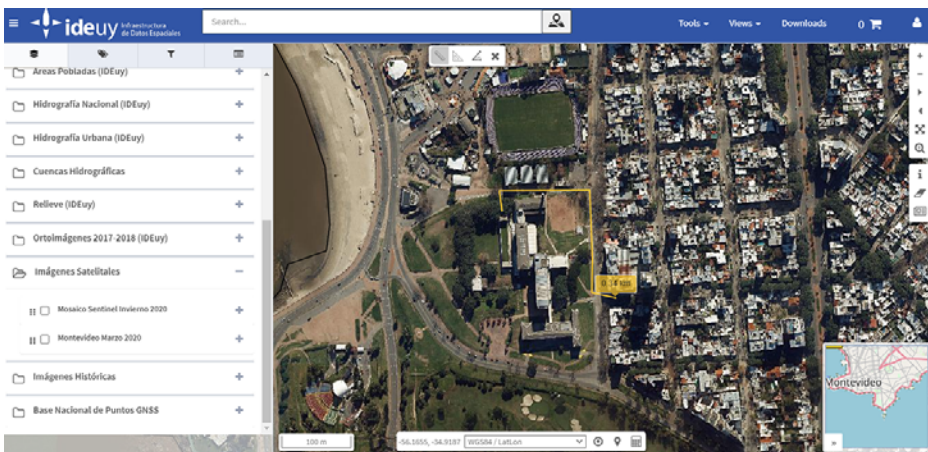


Figure 17. Measure of distance.

last tools used are the measurement tools that measure distances, perimeter, or areas. Figure 17 shows the distance tool used to measure a route from the Computer Institute to a nearby bakery.

Figure 18 shows the area and perimeter measurements of the main area of Facultad de Ingeniería.

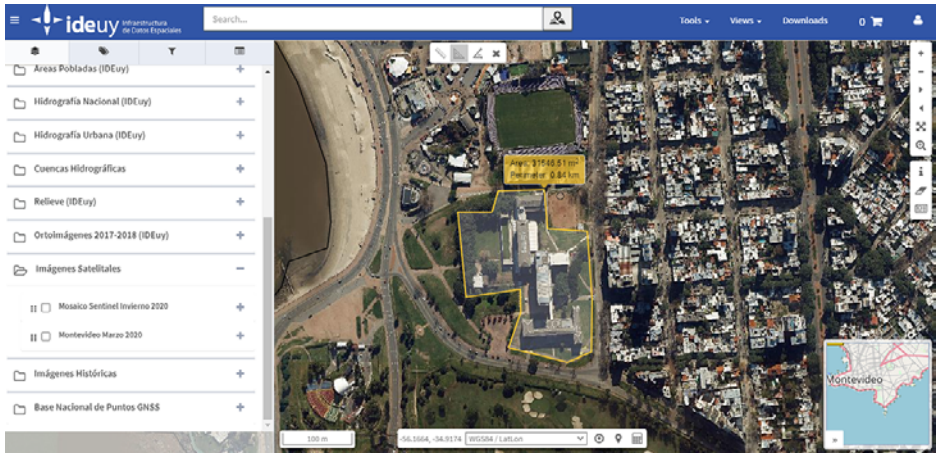


Figure 18. Measure of an area.

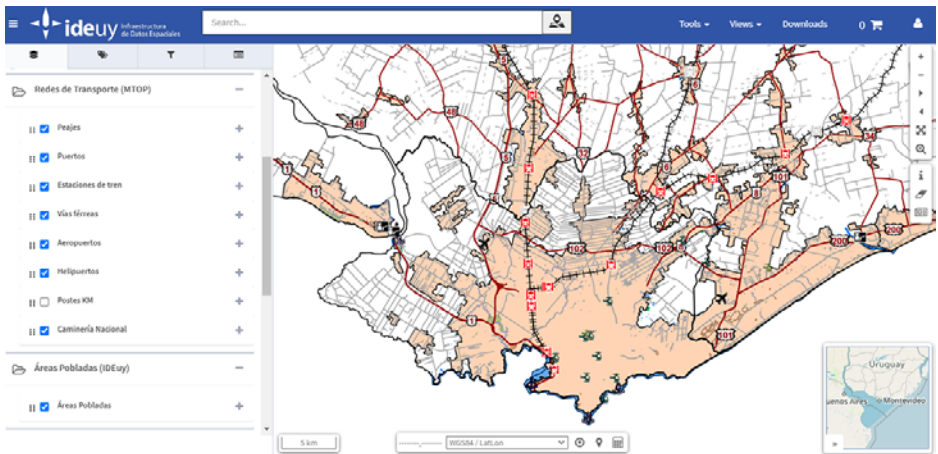


Figure 19. Example of vector map.

*Exercise 3 - Vector Data.* The third exercise proposes to explore the layers area at the left of the screen, activating and deactivating different thematic vector layers. The task for this exercise is to design a map with vector layers for the girls' area and show it to the group by sharing their screens.

Figure 19 shows one example of a vector map with transport information: roads, railroads tracks, railroad stations, ports, helipads, airports, tolls, and urban areas in the Montevideo department zone.

TABLE 1. NUMBER OF REGISTRATIONS TO THE WORKSHOPS BY INSTITUTION AND DEPARTMENT

DEPARTMENT	# INSTITUTIONS	REGISTRATIONS
Montevideo	10	27
Canelones	2	16
Paysandú	3	24
Soriano	2	10
Durazno	2	20
Florida	1	1
Salto	1	2
Total registrations	21	102

#### 4. VIRTUAL EXPERIENCE

For this edition, we defined two shifts for the workshops, one in the morning and one in the afternoon. As in previous editions, we prepared a poster to disseminate the call between high schools, institutions, FING and UdelaR, and the general public. We opened registrations two weeks before the event. The final number of inscriptions for this edition was nearly a hundred girls from both Montevideo and the countryside. In Table 1, the number of registrations is presented along with the institution, origin department, and type of institution.

It can be seen that most participants correspond to countryside institutions with a total of 75 registrations, while from Montevideo the registrations were 27. This is the opposite of previous years when workshops were in person, due to transportation costs and time needed for countryside institutions to go to the Engineering School. Also, most registrations came from public institutions, 14 of them corresponding to 61 registrations, and 7 private institutions corresponding to 41 registrations.

##### 4.1. CARRYING OUT THE WORKSHOPS

When defining the logistics of the workshops, we faced several challenges related to the virtual format. One was how to manage the zoom link, which would not be made public for security reasons, and how to work with the girls in subgroups, which the zoom provides, but only on one level without nesting the breakout rooms. Other challenges referred to assuring that at least one girl for each subgroup could connect with a computer to access the web platforms and share screen with the rest, and also the need for a responsible adult (either parent or teacher, with no gender restriction) to stay with them during the event. We decided to provide the zoom link in the confirmation email we sent for the girls' registration with the shift



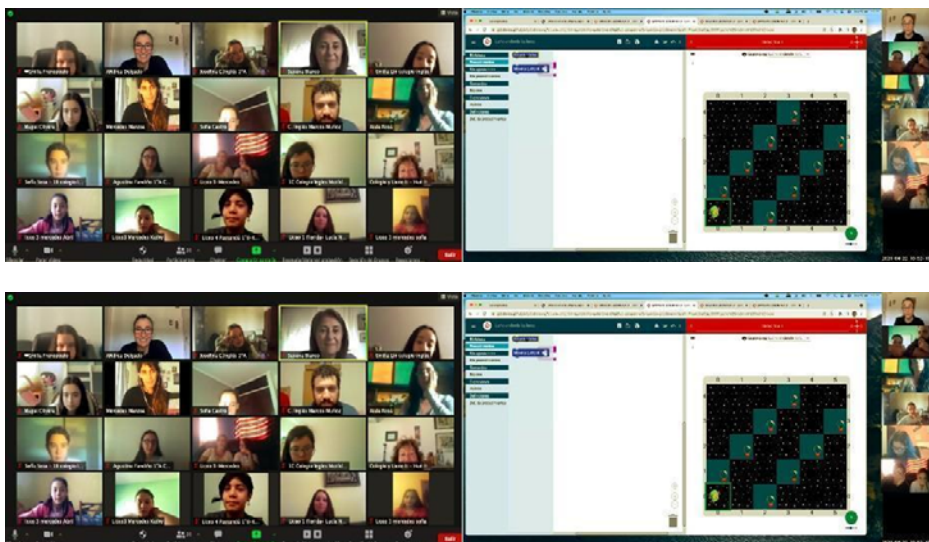


Figure 20. Virtual workshops experience zoom rooms: a) general room, b) sub-room with Gobstones.

assignment, asking that a responsible adult connect with them and stay during the workshops, and the need for a computer. This link was the initial room to welcome the participants and, afterward, one workshop stayed in this room and the other moved to another link.

After the welcoming message, each workshop followed a similar script for activities, by first introducing concepts and the problems to tackle, and for each exercise dividing the room into sub-rooms where sub-groups of four/five girls worked together. Teachers visited a couple of sub-rooms to see what the girls were discussing and helped them to think and solve the problems. After each exercise, we returned to the main room and discussed with all the girls what things they analyzed, how they solved the activity, and the problems they had, if any, reasoning over the questions we prepared. Figure 20 shows zoom breakout rooms screenshots of the programming workshop.

In previous editions, after the workshops, the girls were asked to complete a form evaluating the activities. For this edition, it was not possible to update and make it available online, but it will be added in the editions to come.

## 5. RELATED WORK

There are several international, Ibero, and Latin American initiatives to encourage girls into STEM careers that also work with girls in hands-on workshops and courses mostly in person as we did in previous years. It is worth mentioning

analysis and initiatives from MIT (Ricket 2001), Carnegie Mellon (Quesenberry, Frieze, Lewis 2015), Spain (Marín et. al 2015), and Meninas Digitais from Brazil (Maciel, Bim, da Silva 2018). Regarding Data Literacy resources, one outstanding effort is the YouCubed project from Stanford University which provides teachers with activities designed for kids at the primary school level (<https://www.youcubed.org/data-big-ideas/>) In recent years, most Ibero and Latin American countries have shown similar realities and presented several studies and initiatives in the Latin American Women in Computing Conference (LAWCC) [14], such as Argentina, Bolivia, Brasil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, España, Panamá, Paraguay, Uruguay, and Venezuela. Most virtual experiences, platforms, and initiatives offer videos and exercises on demand, which are different from our proposal.

## 6. CONCLUSIONS

Although creating new workshops in virtual format for the event was a challenging task, we believe the final result was successful both for participating girls as well as for teachers. Working in sub-rooms, with groups of few girls, was a good approach that allowed us to closely interact with them in the reasoning to solve the problems. The organization of this activity gave us the opportunity to review online platforms available to work on the different topics covered in the workshops, allowing us to learn about a variety of tools that will surely be useful in future activities. The tools we chose (Globstones, Airtable and IDEuy) proved to be adequate to introduce the basic concepts of programming, data use, and geographic information also were easy to use for most of the girls. The experience was very rich, not only from the perspective of the technical aspects the girls were able to contact with, but also from the perspective of their questions and concerns with respect to their future careers, experiences as engineer students, and professional lives. We could give them a place and a moment, where they felt comfortable expressing their feelings with respect to the possibility of studying engineering and technology-related careers. Also, the virtual format allowed girls from institutions in the countryside to participate for the first time in the activities. Although the experience of participating in “in person” activities was valued in previous years, the virtual experience was also welcomed as a way to make contact with the area.

We believe that it is important for girls to know that there is room for them in the Computer Science area if they like it and want to pursue a career in the area, so they do not walk away for the wrong reasons. Too many talents are being lost that could make contributions to our discipline, enriching their lives, the scientific academic, professional areas, and the society.

RECIBIDO: 15-11-21; ACEPTADO: 17-3-22



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