Entrepreneurial skills
for young social innovators
in an open digital world

Workshop Description

MEASURING OUR ENVIRONMENT

Institute for advanced architecture of Catalonia

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 770063

Measuring our environment (Iaac)

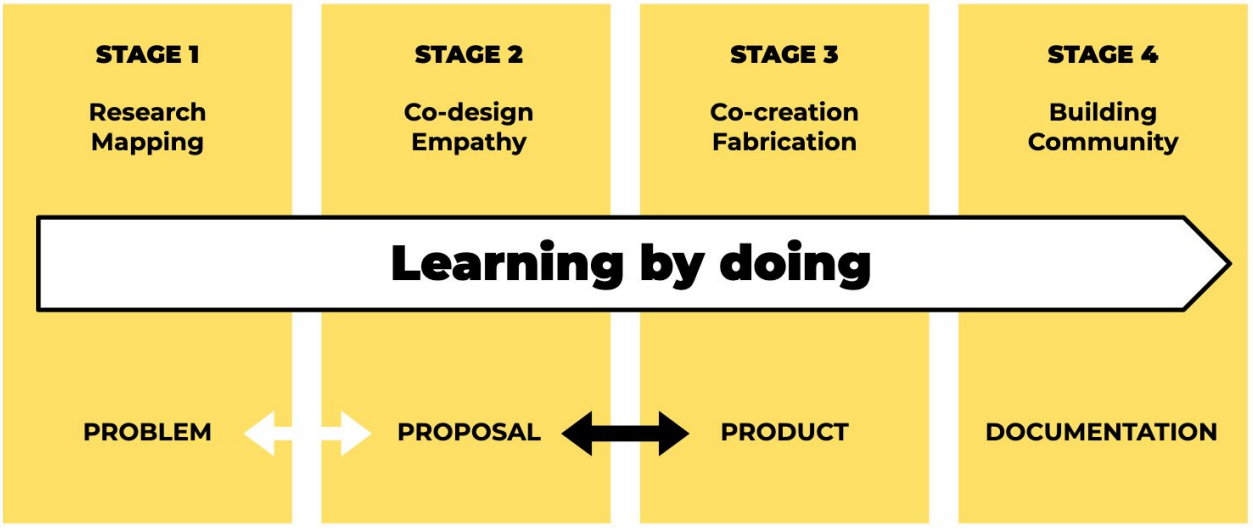
The proposal seeks to provide imaginative solutions, based on a co-creative design and digital technologies, to local problems. The idea is to create a community that shares the knowledge generated and is the beginning of a sustainable ecosystem for formal and non-formal environments.

The pilot was divided into 4 stages with clear differentiated objectives.

Stage 1 and 2 consist of explaining, understanding, measuring and defining possible customized solutions based on the cross-cutting theme of the DOIT Action. We count on the participation of external agents from the educational community, such as neighbourhood associations, social organisations or partners (such as Making Sense and Smartcitizen). This helps us to present, understand and co-define possible issues on the theme of the action.

Stage 3, in which the group of participants work in a digital fabrication space such as the Fab Lab Barcelona and prototype the solutions designed in stage 2. Participants are exposed to other students from totally different disciplines, languages and ages, giving them the chance to explain and validate their ideas, as well as to get inspired by other projects.

Stage 4, in which we encourage each group to test their proposals in situ with the educational ecosystem (parents, school group or external guests) to obtain real feedback that will help them during the communication process. We end with a final act in front of the school management, representatives of the Town Hall and external collaborators who support the children during the action, such as Itinerary, Making Sense, etc.



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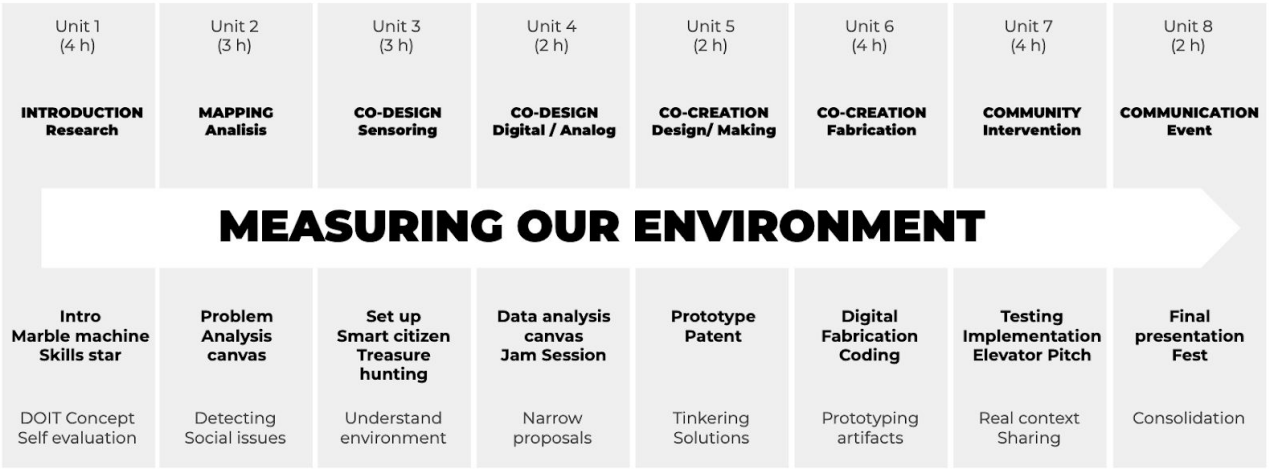
"Measuring our environment" is part of a training and support programme that allows the development of key skills and competences in the educational ecosystem by facilitating its transition to 4.0 education within the framework of the UN Sustainable Development Goals.

It is an educational proposal with which we invite the whole educational community to actively participate and reflect on how open source technologies, "maker" education practices and open design can be used by local communities to collect data and use it as a transforming lever for their immediate environment.



The educational units and processes described below are a summary of the Pilot that was conducted in the “col.legi Sant Andreu de Badalona” during the first quarter of the year 2019, in collaboration and full coordination with the subject of "Entrepreneurship" of 4rt of the ESO. With the aim of living an active learning experience to understand the data around us through computer thinking, critical thinking and the use of effective technology as a means and not as an end.

Duration: 28hr - 8 units
Setting: Inside School
Group size: 23 children, 9 girls & 14 boys
Age: 14-15 year
Location: Col.legi Sant Andreu / Fablabbcn

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Unit 1 - Introduction

2:30 hours approx.

- [30min] Welcome, Introduction
- [30min] Social Entrepreneurial skill stars
- [90min] Decision Marbel Machine

The main objective of this unit is to present all the actors of the Fablab or Makerspace project, the DOIT research project, the educational community (students and teachers), and different partners in the process. It is important to create a climate of trust between the parties in order to build a solid foundation for the best ideas to flourish.
Te unit is divided into 3 different activities, which can be carried out consecutively or on different days.

Welcome - 30 min

Aim
Introduce the general concepts of Fablab Barcelona, DOIT project, it's methodology and the different phases of the research project.

Materials
- Presentation
- TV or Projector

Prompt
Present your institution, introduce the DOIT project, its objectives and the different phases of the research project. What do you expect from them and how will it help them.

Facilitator instructions
- Smile and introduce yourself, and the institution
- Ask if they know what a research project is and if they have been told what they are going to do.

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- Prepare a presentation that talks about the following topics:
    - Introduction of a Fablab, makerspace and/or your institution
    - Explain some projects that could motivate them (related to digital manufacturing for example)
    - The objective of the project: To use environmental data to detect problems and propose local solutions.
    - Explain the stages/units of the project and its duration.
    - Explain the working methodology.

NOTE: Usually this small introduction is done with the support of a presentation, but it is not necessary to do so. It will depend on the location and age of the participants.

Social Entrepreneurial skill star - 30 min

Aim

This activity is designed to understand and self-evaluate based on the 7 most important skills of a "Social Entrepreneur" that are totally linked to the learning objectives of the DOIT project.

Materials

- Dina4 papers
- Pens or markers
- Print template (toolkit)

Prompt

Draw a profile based on 7 entrepreneurial skills for social innovation. And use that to form more compensated teams possible among the participants.

Preparation

You can do this activity in almost any space, class with tables, open rooms, free spaces. It will depend primarily on the medium in which you have printed the template.

Note: For the group's formation, it is advisable to have a clear area where participants can stand and move freely.

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Facilitator Instructions

- Explain the 7 most relevant skills for social entrepreneurship. An exact definition is not necessary, especially depending on age. Look for everyday situations to explain the most abstract concepts
    - Creativity
    - Self-sufficient, Ability to plan, manage resources (planning skills).
    - Teamwork, collaboration skills.
    - Perseverance
    - Empathy, Awareness of the needs of others
    - Be motivated, sense of initiative.
    - Risk, Embracing new things (entrepreneurial identities)
- Print the graph on DinA4 papers and distribute one to each participant
- Ask the participants to self-evaluate from 1 to 7 each skill of the star. Unable to repeat any of the scores.
- Connect the points between them forming a star of your profile.
- List the skills, one by one, and ask the participants to be distributed in the room, based on the highest rated skill. (try that the space is large, and that the participants can see each other).

  TIP! Try that the groups have the same number of people. If not, compensate the teams based on the second most valued skills.

- Once divided into groups. Explain to the participants that to develop social entrepreneurship projects, the group has to be made up of a representative of each of the skills and the maximum possible diversity (men / women, etc).
- Leave 5-10 min for the participants to talk to each other and reorganize the final teams.
- Finally, ask them to present themselves as a group and explain why they believe that their team is compensated and how these different skills can help them face the different challenges of the future.

Variations

Another interesting version is to incorporate it as a welcome activity.
To do this, instead of printing on paper, we manufacture a cardboard accreditation with the laser cutter. With the engraved drawing as a support to draw the star.

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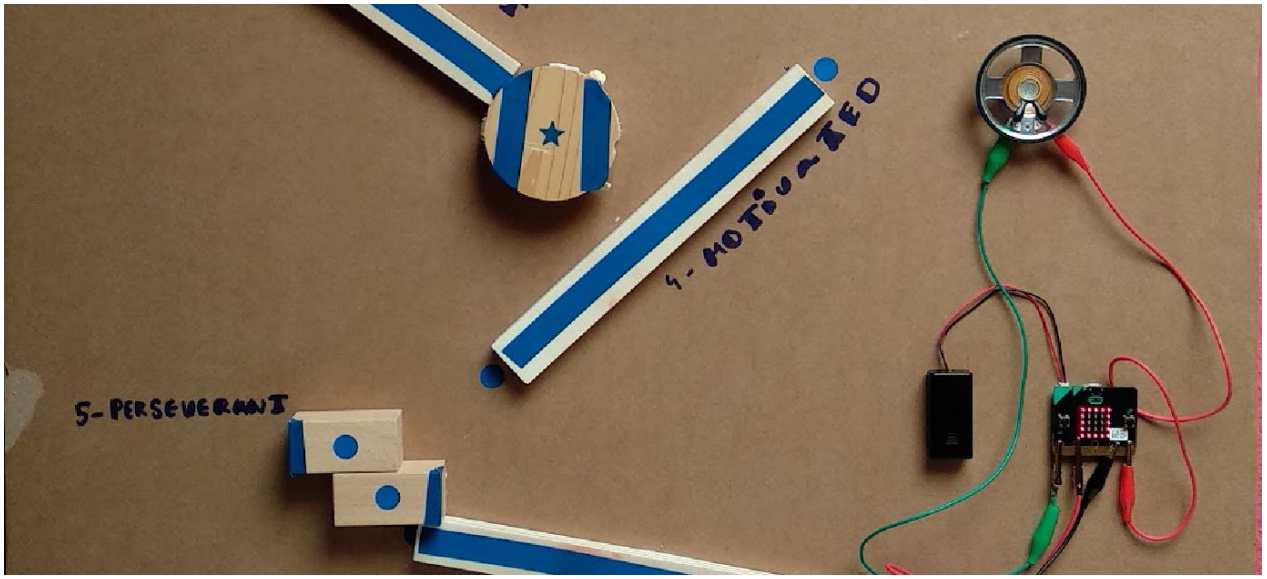
Decision Marble Machine - 90 min



Aim

Building a Marble Machine is a playfull platform for the learner to investigate concepts at the intersection of art, science, and technology. The process of testing, questioning, and occasionally failing is as significant as the final construction.
We will reinforce the concepts of entrepreneurship and social innovation worked on in the previous activity. Making them reflect on which ones they find more relevant and exemplifying the need for all to be an essential part of achieving the final goal.

Materials

- Cardboard sheets
- Recycle wood peces or other construction kits (lego, etc..)
- Double side tape,
- hot glue gun
- Cutter and scissors
- Electronics kits (microbits or similar)

Prompt

It manufactures a marble machine with a maximum of 7 elements, which allows it to take the marble from the initial point to the end, passing through all the elements.
Identify each Skill with one of the elements and order them from more to less relevance according to their perception of value.

Preparation

Before you do the activity, make sure you collect all the necessary materials. You can ask participants to bring items from home beforehand. This will make the machines more personal and will probably increase their level of participation.
Try to leave enough space between the tables, so that each group works comfortably and can move freely around the space. If you are in a school classroom, you can remove all the chairs, to force them to work standing up, this way they will still have a more active attitude.

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Prepare different tables with all the material, depending on the number of participants you may have to duplicate them, so that not everyone concentrates on the same table and the materials are always visible.

NOTE: Prepare different constructive solutions as examples to motivate and encourage the creation of imaginative solutions. This will help the less advanced or self-confident groups a basis to start.

Facilitator Instructions

- Hand out all the material to the groups. Ask if anyone has brought anything from home they want incorporated into their machine. Ask one of the participants for help with this task.
- Explain the objective of the activity and how much time they have to do it.
- Show a practical example of the activity and explain the different constructions they can do. (you can do this in a presentation or better still with real examples)
- The first part of the activity is for them to explore the materials and their different construction possibilities. No pressure or objective, just explore. (remind them that it takes 30 min)
- After 30 minutes, stop the activity and do a feedback round. Each group can explain what has worked and what has not. Which composition you liked best. How they felt.

  NOTE: In case you want to incorporate electronics in the activity, it is recommended during this time, divide the groups into subgroups to make a demo of how microbit works.

- Remember the 7 skills for social entrepreneurship (see previous activity)
- Emphasizes the importance that this activity tries to explain in a visual way the need that to achieve the final objective they need to work in a team and use all the skills together.
- Now ask them to think of a final composition. With the following objectives:
  - Make a marble machine with a maximum of 7 elements, which will allow to take the marble from the starting point to the end, going through all the elements.
  - Identify each Skill with one of the elements and order them from more to less relevance according to their perception of value.
- Leave 40 minutes to work on their final compositions. During the activity, reinforce the idea that there are no good or bad solutions. The aim is to learn as they are doing and to start working as a team.

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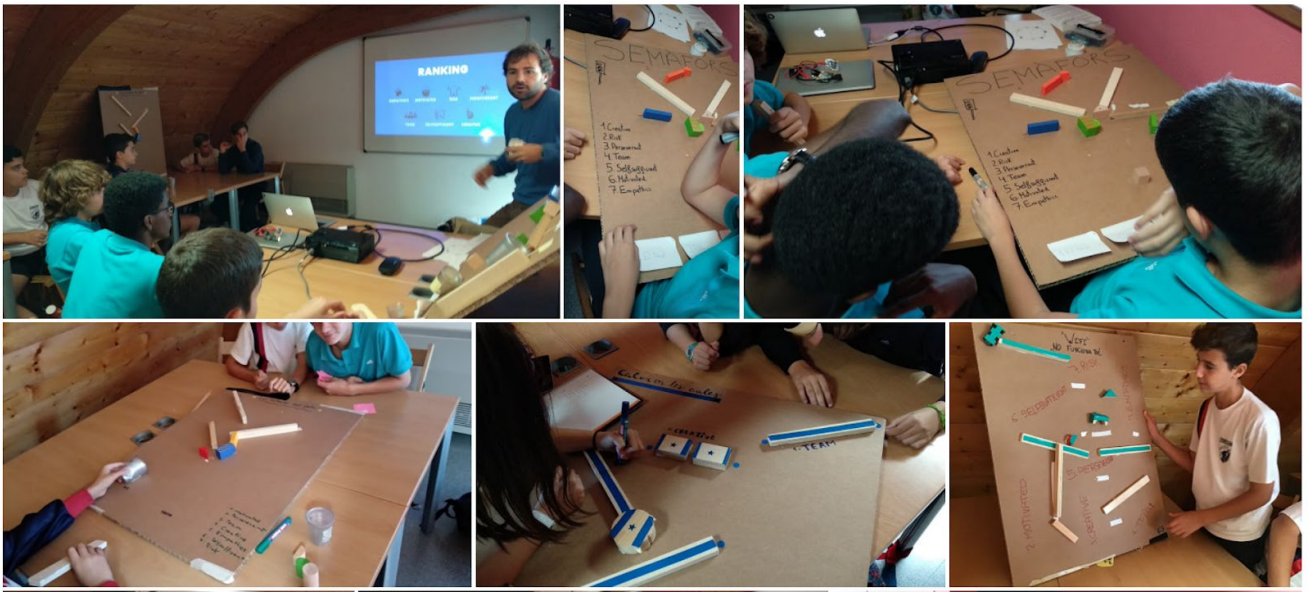

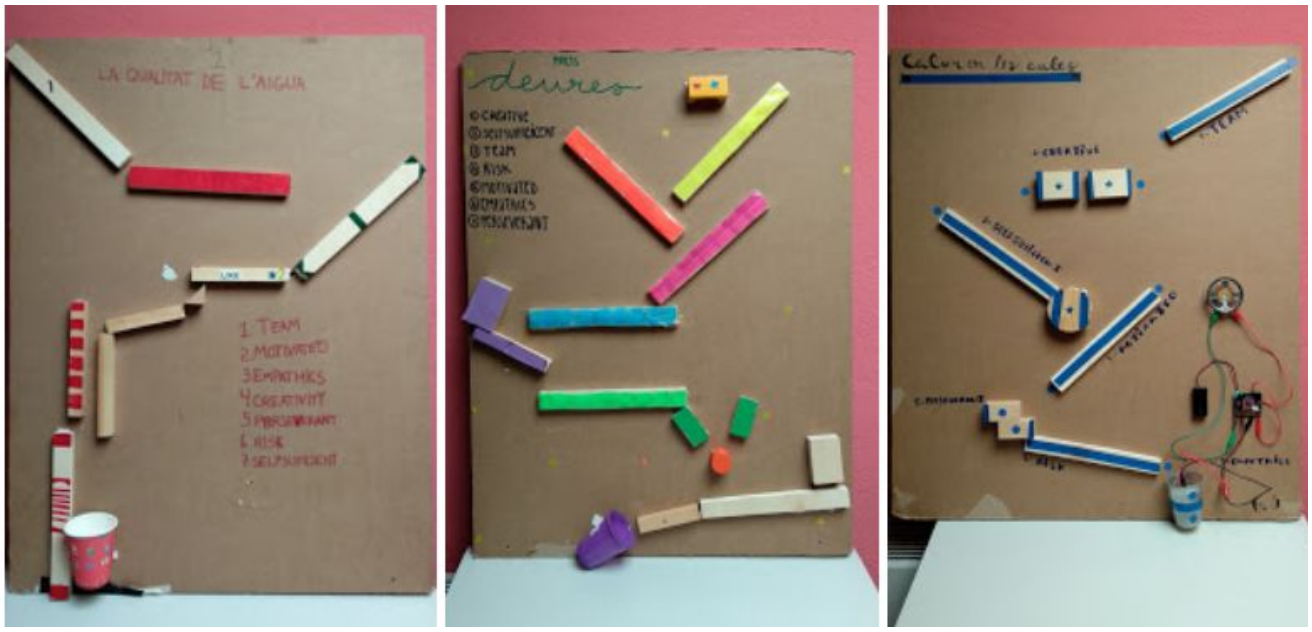

- Finally make a round of 20 minute presentations, where each group explains their work, how they have arranged the skills and why. Make sure that there is time left so that everyone can play with each other's machines!

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Unit 2 - Mapping

2:40 hours approx.

- [40min] Mapping local problems
- [120min] Problem analysis canvas

The main objective of this unit is to detect and classify the different local problems that most affect the educational community. For this purpose, we propose an activity to identify and group them in clusters.
Once the problem has been defined, an activity is proposed to work on it in more depth, analysing the evidence, the impact of its causes and possible recommendations.

Mapping Local problems - 40 min

Aim
Identificar, listar y agrupar las problemáticas locales, que más interesan al colectivo.

Materials
- Post-it
- Pens or markers

Prompt
Build a mural of local issues that reflects the different interests of all participants.

Preparation
Draw on a large blackboard, wall, or cardboard a scale of horizontal lines from 1 to 9, with 1 being the bottom and 9 the top.

NOTE: The distance between the lines must be at least the size of the post-its used.

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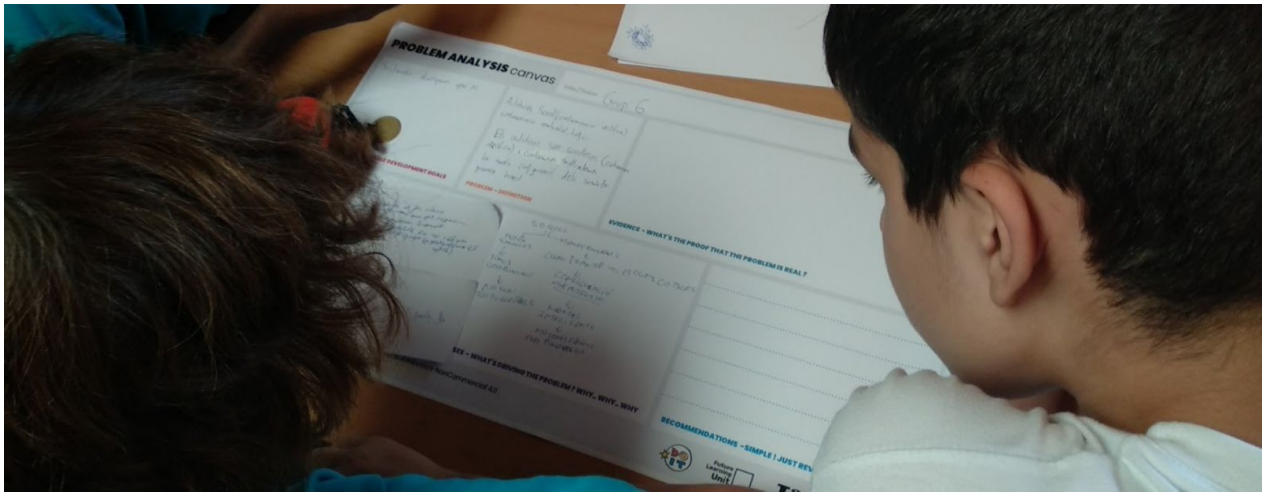
Facilitator Instructions

- Ask each participant to write down a minimum of 3 local issues they have identified. Insist on the different scales of problems: Personal, Class, School, Neighborhood.
- Ask them to share with their group the different problems and try to group them if they have coincided.
- Once each group has put together all the options, share it with the others. For them, use the mural we have prepared in advance. One representative per group will explain the different problems they have listed. The idea is that once they have explained them, they will paste them on the mural. The position in the mural is indicated by the number of posits in the cluster.
- Continue until all the groups are finished. As the groups share their problems, some of them coincide and can be grouped in clusters and in this way we will increase them in the graphic scale that we have drawn in the mural.

NOTE: It's okay if there are posits that are not grouped together, that indicates that only one person has thought of that possibility, but it doesn't make it any less important.

Problem analysis Canvas- 120 min



Aim

Working on a problem in a transversal way and based on the scientific method. To have the maximum of information to be able to propose optimal and effective solutions to our possibilities

Materials

- Computer/tablet/phone
- Pens or markers
- Print template (toolkit)

Prompt

Complete the canvas model with images, texts, videos and/or any document needed to complete all sections.

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Preparation

If you do not have an internet connection, it is better to have printed information about the ODS as well as documentation related to the different problems that have been previously defined.
It is also interesting to have made a previous search of the citizen initiatives, collectives or organizations that already work in these fields, to show as an example.

Facilitator Instructions

NOTE: For this activity you need a minimum of 30 min and there is no maximum time. It will depend on how deep you want to go in each of the areas. In the Pilot we did it during 2 sessions of 1 hour each, in an interval of one week between them. This way we give time to the different groups to work on the evidence, document themselves correctly and prepare a small summary presentation.

Introduce the different sections that make up the canvas:

- **TITLE:** Choose a title that is attractive to the whole group and that illustrates the problem to be analyzed.
- **SDG:** Identify which Sustainable Development Objectives proposed by the United Nations are most aligned with the problem they want to solve. Many of the problems are represented by more than one SDG, so there is probably more than one. Encourage students to identify them and explain why.
- **DEFINITION:** Define in one sentence what the problem is to be addressed. It has to be simple and at the same time explanatory, so that anyone can understand it at first.
- **EVIDENCE:** Find evidence that demonstrates the problem. This part will require some research such as looking for diary notes, making a visual documentation (photos etc). Do some consumer surveys. Depending on the problem it will require empirical and contrasting evidence that it exists.
- **IMPACT:** List of consequences that cause this problem. This helps to dimension the magnitude of the problem and in the future it will also help us to understand how we can provide solutions.
- **CAUSES:** List of the things, which cause the problem. Here we can suggest the exercise Five whys is an iterative interrogative technique used to explore the cause-and-effect relationships underlying a particular problem.
- **RECOMMENDATIONS:** Simply a list of possible solutions to the causes detected.

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Unit 3 - Sensing

2 hours approx.

- [60 min] Smart Citizen Onboarding
- [60 min] Treasure Hunting

After detecting, analyzing and choosing the problem we identify with. This unit focuses on explaining and understanding the value of data as a tool to better understand the world around us, to be more efficient in how we relate to it.

We will explore various tools for capturing data and also learn how to interpret their values.

Smartcitizen Onboarding - 60 min

Aim

Introduce the concept of citizen empowerment through free data platforms such as the Smart Citizen project focused on environmental parameters. Demonstrate practically how it could be applied in a case like your school.

Materials

- Smartcitizen kit
- laptops or computer

Prompt

Explain the SmartCitizen project as an example of technology applied to social innovation.
Configuration and installation of 6 kits in different locations of the school. Analyze the data.

Preparation

Adquirir unos kits de medición de parámetros ambientales. En este piloto se usaron los kits del propio proyecto, ya que es una tecnología Open Hardware desarrollada en el Fab Lab Barcelona. You can find here: https://smartcitizen.me/

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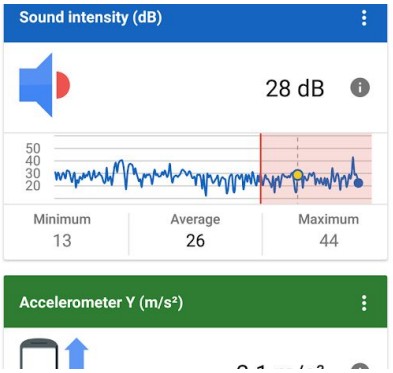
Otras alternativas al kit de ciudadano inteligente serian:

Smart Citizen kit	micro:bit smart science IoT kit	App Science Journal
		

NOTE: It is important to mention that a minimum of 1 or 2 days should pass between this session and the next one, so that the kits have taken enough data to be able to do a complete study of all the hours of the day.

Although for this activity it is good to have as many sensors as possible. If this is the first time working in this field, we recommend focusing on noise, temperature, light and suspended particulate pollution.

Facilitator Instructions

- Start with a short introduction to the Smarcitizen project, as a practical example of how to design technology to empower citizens. Explain the different sensors it has.(10 min)
- We continue with a Data discussion (20 min), an open question and answer session about the world of data. In our case we did it through a presentation that served as a guide to moderate the conversation.
  Below are some examples of areas to be discussed:

  AWARENESS, In order to act on information, you have to be able to understand it. Often, things we physically cannot sense by ourselves are more difficult to grasp. By relating measurements to tangible impacts, these become actionable, which helps to make sense of these complexities, like the relationship between actors and expectations about responsibilities.

  OPEN HARDWARE, If you cannot open it up, you do not own it. Open hardware allows you to find and use cheap and versatile sensing equipment. You can inspect its inner workings, change and extend its functionality, and share your own tweaks freely with others.

  DATA JOURNALS, Sensors can be very effective at capturing hard, quantitative data. But to truly make sense of data, we often need context that even sensors cannot detect.

  DATA OWNERSHEET, Discuss about the technology used, the data collected, data ownership and privacy concerns, and what other data they would like to collect. It helps to articulate concerns and fosters opportunities for data awareness and decision-making.

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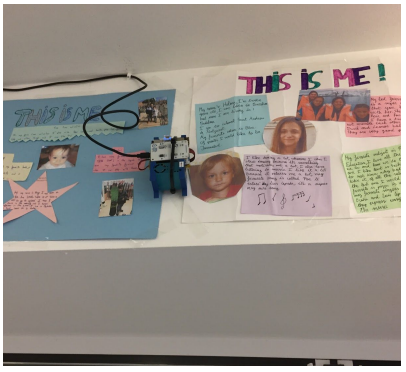
NOTE: You will find more information, tools and reference on how to use the sensors and data, you can visit the documentation of this research project: Making-Sense

- Onboarding (20min). Recognition, activation and configuration of the kits. Step by step activity of how to configure the kit, register it to the platform, connect it to the school wifi network and start taking the first samples. For more information visit the documentation here: https://docs.smartcitizen.me/
- Location (10min). Decide together which are the best places to install the kits for 1 or 2 days. Take into account the chosen problems and the possibility of having contrasted data. Interior-exterior, North-South facade, places of high concurrence, etc.
- Installation (outside school hours). The installation process of the kits will be carried out during the most appropriate hours according to their location.



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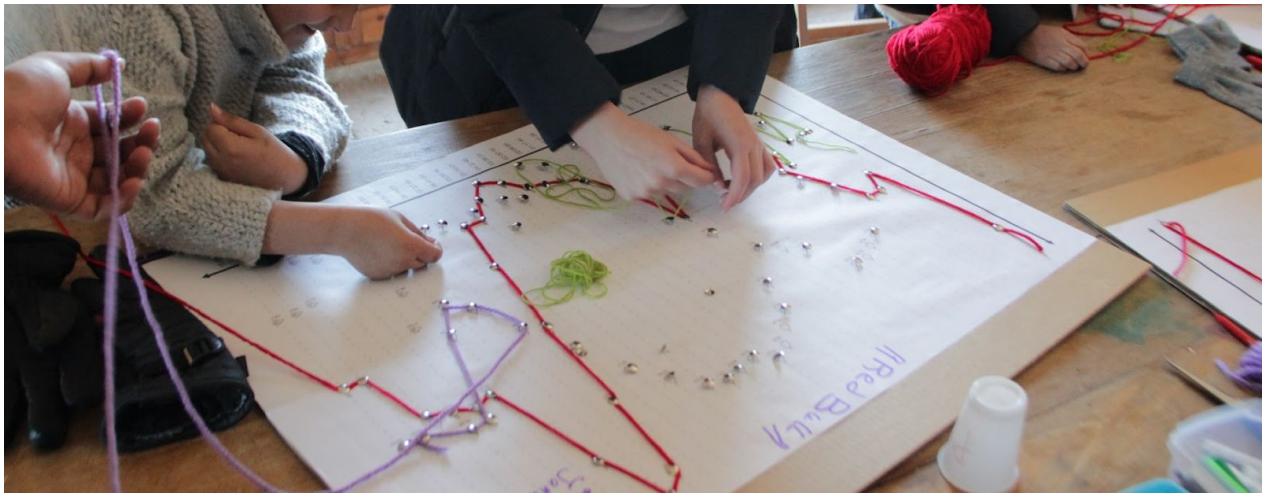
Treasure Hunting - 60 min



Aim

Understand and interpret the data in the graph to associate them with one of the hidden kits. Using sensors to Geolocate kits. Recognize space and surrender. Match data with environment

Materials

- Pens or markers
- Print template

Prompt

Find the hidden treasures (SmartCitizen Kits) in the school building with the only clue of a map and a graph with environmental data: light, temperature and noise.

Preparation

Download and build the graph on the template. Print in a DINA2 format. Un formato grande para favorecer el trabajo en equipo. No imprima la curva sinó los puntos que la conforman, para que parte de la actividad sea la de reconstruir la gráfica manualmente.

NOTE: Although there is now software that automatically draws number arrays. On the contrary, the act of drawing or reconstructing the graph is carried out as a dynamic, participatory and interactive process of the subject, so that knowledge is a real construction operated by the person learning.

Design and print a map of the building or location to help during the challenge.

Facilitator Instructions

The activity is divided into two parts:

- Reconstruct, identify and understand the data:
    - Ask each group to draw the graphs
    - Try to understand the data graphs
    - Find relations between sensors: noise, light, temperature

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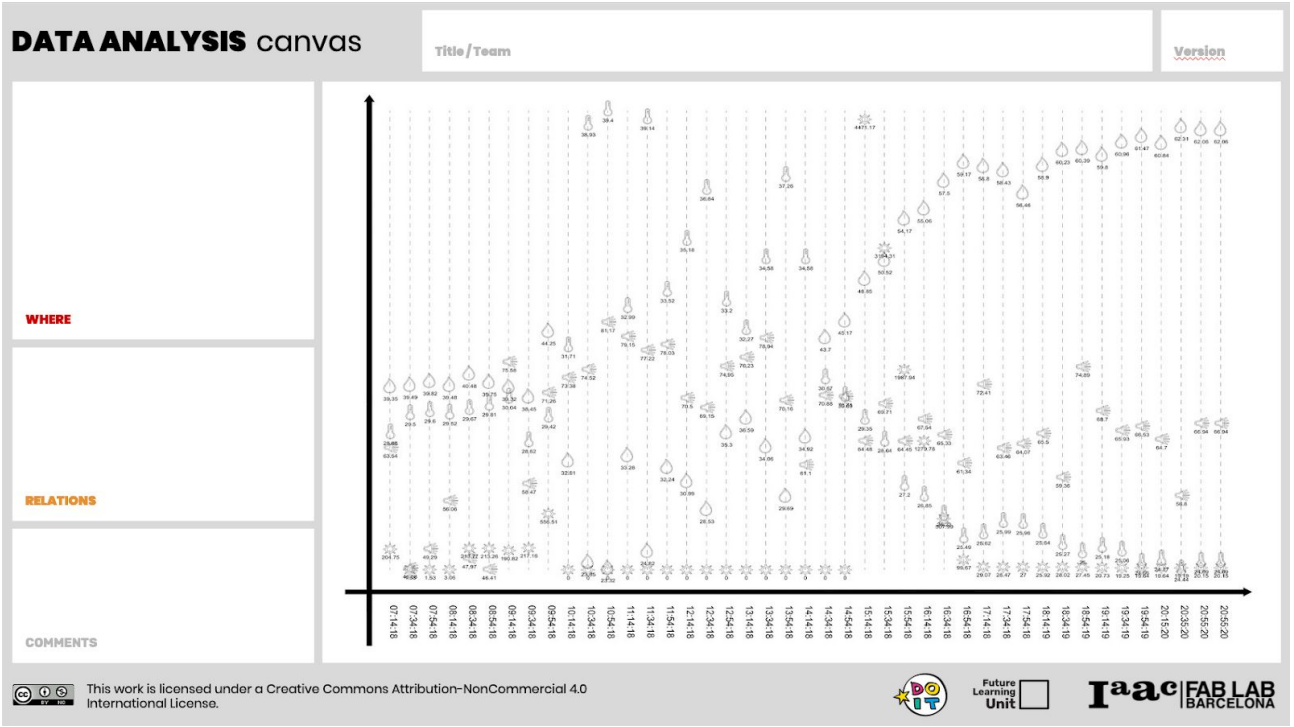
- Ask your questions: indoor or outdoor?
- Check with other teams
- How loud is the noise? Compare-o-meter
- Choose the location of your smart citizen kit

- Feel, contextualise and rescale the data
  - Visit the location and get your data
  - How is the light ?
  - Is it noisy ?
  - It's cold ? It's warm ?
  - What do you see ?
  - Write in two_three lines how do you feel in your location

After completing the two parts of the activity make one round of presentations per location, you can use the template as a guide to explain your experience. Ask them if the numerical values match their sensory perception of the location. Compare the same numerical values from any sensor with the perceptions of the participants. Why? It opens a reflection on how our body perceives the same atmospheric value in different ways. Thus, what for some is sound, for others noise. Where some are cold, others are comfortable, etc..



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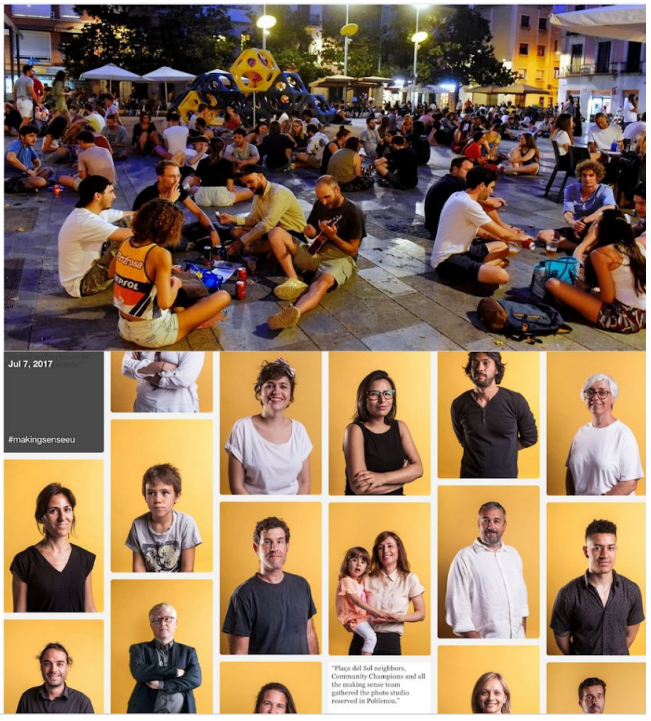
Unit 4 - Abstract to Concrete

1:30 hours approx.

- [60 min] Inspiration case
- [30 min] Jam Session

So far we have analyzed, detected, and studied the local problems in an empirical and analytical way, using sensors, surveys, etc. But in order to provide an honest, cross-cutting and sustainable solution, it is necessary to empathize with the communities as well as to get involved in the solution. That is why the objective of this unit is to be inspired by real cases in order to decide which actions and proposals we are going to implement.

Inspiration case - 60 min



Aim

Inspire and motivate with a real case. That will help us understand and co-define possible issues on the subject of the action.

Materials

- Presentation

Preparation

Add the participation of external agents of the educational community, such as neighborhood associations, social organizations or partners, related to the different problems.

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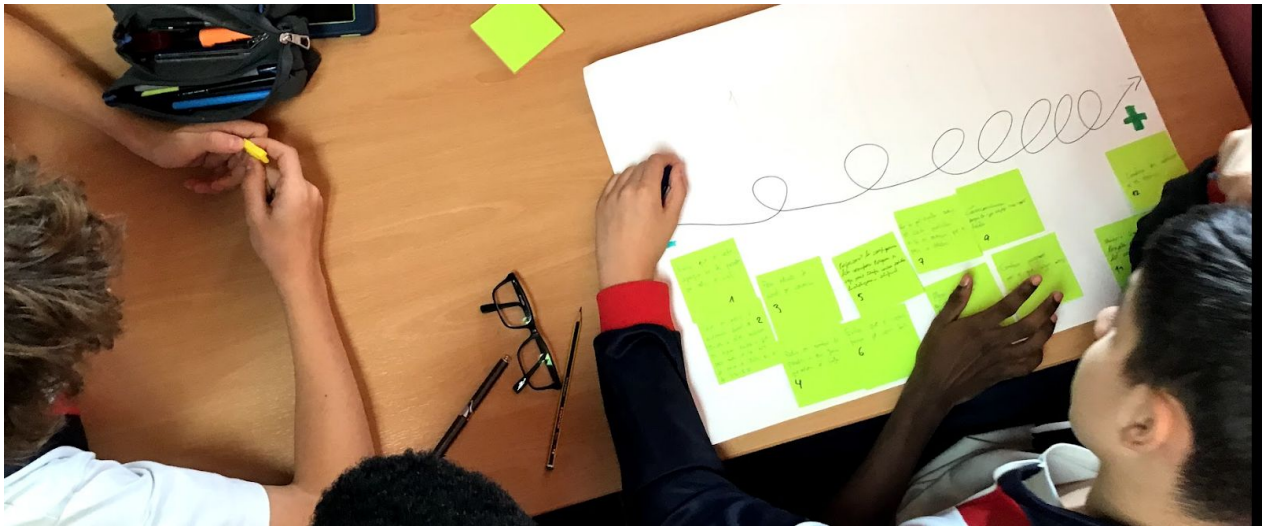
In our case we ask Matias Verderau, who was part of the team that led the Making Sense project.

The Making Sense project created an award-winning methodology which enables communities to appropriate their own sensing tools in order to understand their environment. This, therefore, encourages action to address environmental problems – e.g. air pollution, noise and nuclear radiation. Making Sense has combined open source software, open source hardware, digital maker practices and design, meaning it can be effectively used and implemented by communities. Making Sense has created impact through three steps of transformative change: strongly defining smart citizens as the point of reference for the 'smart city'; giving core stakeholders knowledge, technology and experience to collect and analyse data and finally, providing a framework to design change e.g. through action and policy-making.

You can see more about the project here: http://making-sense.eu/

Jam Session - 30 min



Aim

The main objective is to provide a structured dynamic, so each individual of a group can propose and discuss as many ideas as possible on a specific topic.

Materials

- Dina4 papers
- Pens or markers
- Print template

Prompt

Propose as many ideas as possible to solve the problem, share them with your colleagues and choose the one that will be developed in the next phase.

Preparation

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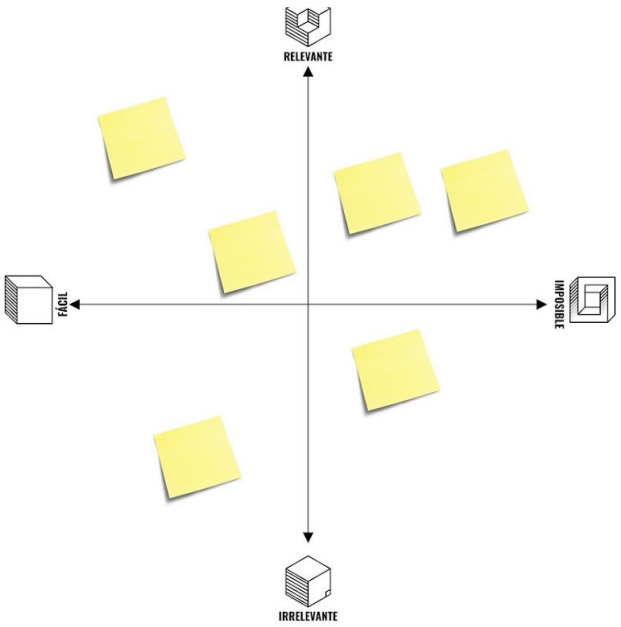
Distribute a post-it notepad to each group and markers
Distribute dinA2 sheets per group
Ask the participants to draw two cross-shaped arrows that go from side to side of the paper

- The X axis will indicate from easy to impossible.
- The Y axis will indicate from relevant to irrelevant.



10-15 ideas ordenadas

Selección de 5

Eje motivación - 2

Decidir

Facilitator Instructions

- Ask the students to write, individually, 10 ideas to solve a problem (15-20min)
- Each participant will explain the idea to the rest of the group and all will classify and delight according to the axes. (10 minutes)
- Divide the group into two and ask them to select, by subgroup, the 5 that have most attracted attention.(it does not matter in which position of the cross they are) (5 min)t
- Each subgroup will work on 2 new ideas, related to the 5 selected ones (they can be combinations of these 5 or new ideas). (10 minutes)
- Share with the other subgroup the 2 new ideas and choose 1 final of the 4 (10min)

NOTE: This session is especially useful for those groups where there are very dominant profiles that inadvertently do not allow all the members of the group to contribute their vision of the project.

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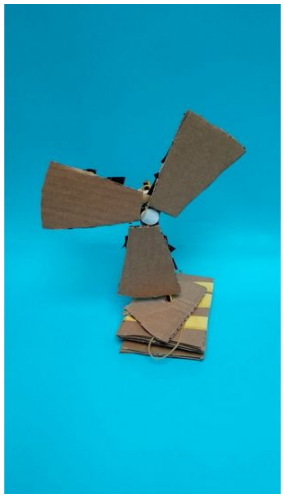
Unit 5 - Design & Making

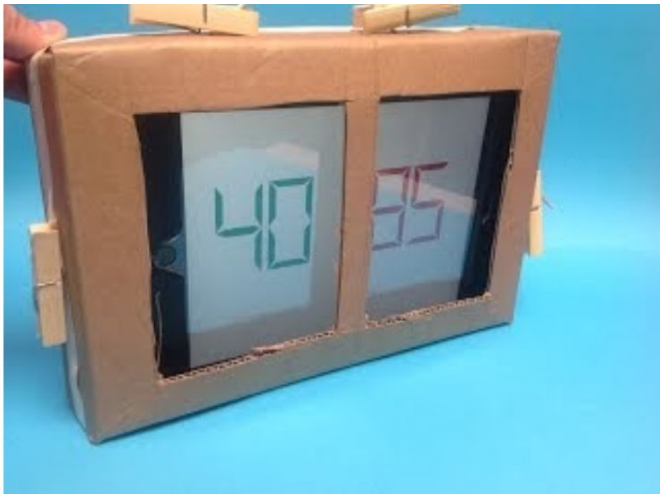
2:00 hours approx.

- [60 min] Rapid Prototyping
- [45 min] Design patent

A prototype is a working model of a product that is used for testing before it is manufactured. Prototypes help designers learn about the manufacturing process, and they help understand how people will use it.
Later we will use the drawing as part of the process as it provides a good framework for understanding the design in 2D and 3D.

Rapid Prototyping - 60 min





Aim

Hands On activity to tinker and design a prototype of the solution. With the idea to test out new ideas, representing basic functions, proportions, materials and manufacturing processes

Materials

- Cartó, material reciclat
- Cúter i Estisores
- Pistola Silicona
- Cinta adhesiva / Doble cara
- Regles, Retoladors,...

Prompt

Explore, design and manufacture a prototype that represents all or part of the idea/solution of the problem.

Preparation

Collect various materials and tools that students can use to construct prototypes.

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Facilitator Instructions

- This activity is specially designed to be carried out in a standard school classroom. That is why both the materials and the technology used try to be as accessible as possible.
- Explain to students the purpose of building prototypes. Mention that several types of prototypes exist, but we will focus on creating prototypes for the purpose of testing different working aspects of a product.
- Show students the available building materials (or allow them to bring in their own if this was established in advance).
- Give students "free time" to experiment with the materials and begin construction. Answer questions as they arise.
- If students become frustrated with the way their initial prototypes look, remind them that prototypes are used to test out new ideas and are not meant to look perfect!

Peer review method

NOTE: Many times we find it difficult to do a feedback session where each member of a large group can express their opinion in an orderly and quick manner.

- Have each team show the class their initial prototype, explain its purpose, and describe any challenges they have encountered during the build process, and next steps.
- During the presentations, ask each group member and each teacher to write down the following ratings in 3 post-it. After the group presentation each person pasted the posit on a board.
    - Something they liked
    - Something to improve
    - A new idea to be implemented in the future
- Ecah group reflects on the feedback received by summarizing the feedback and what changes they intend to make in the next iteration of their designs.

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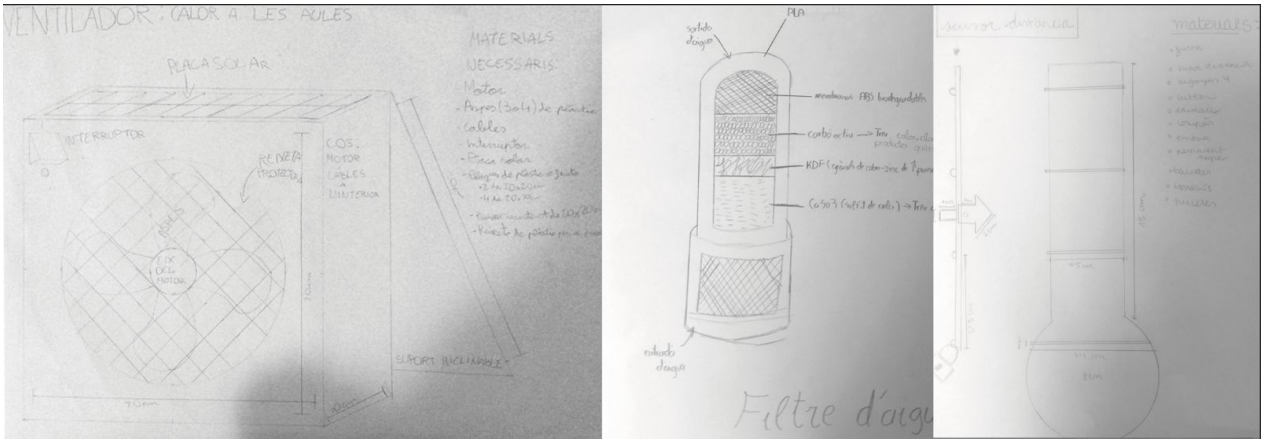
Design Patent - 45 min



Aim

The objective of this activity is to have as many details as possible of the designs to be fabricated with digital manufacturing tools.

Materials

- Dina4 papers
- Pens or markers

Prompt

Draw a detailed sketch of your envisioned prototype, labeling them with dimensions and materials.

Preparation

Take a look of the toolkit F076: Patent exploration

Facilitator Instructions

Three main sets of patent drawings include the following:

- Identification of drawings: includes the title of the invention, inventor's name, and application number...
- Views. The drawing must contain as many views as necessary to show the invention. The views may be plan, elevation, section, or perspective views.
- Detail of each non-standard part on a drawing sheet
- Assembly drawing showing all parts on one sheet
- A Bill of materials (BOM), essentially of each part

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Unit 6 - Dig. Fabrication

4:00 hours approx.

- [240 min] Wing Sessions

The main objective of a Wing Session is to take projects to the next level of prototyping, to maximize the impact on the intervention.
At the same time, will be to involve participants in the fabrication process of a product or intervention, so that they get a general look at these technologies, and mainly understand the technical possibilities that provide what technologies can be used, the design processes and associated times.

Wing Sessions - 3 hours

Aim

The main objective is to provide an enriching experience for the day-to-day students of the lab, while meeting the machines, learn how to operate them and be introduced to the knowledge that will allow them to "work" comfortably within technology.

Materials

- Wood panels
- Acrylic
- Electronics
- Consumables
- Digital fabrication tools

Prompt

Design and manufacture a prototype that is part or all of your intervention.

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Overall Objectives

- Provide tools and skills to rethink and redesign your project ideas in a cross-cutting and interdisciplinary manner.
- To provide an immersive experience of the centre. Become familiar with the staff and the house.
- Inspire new ways to use technology.
- Acquire resources for self-learning
- Create a strong group capable of helping each other.

Project objectives

- If you have defined the problem but do not have a clear idea of how to solve it, end the day with an idea and a prototype that explains it to validate it with possible users.
- If you have the problem, the idea validated with final users, have a first prototype to test.
- If you have already tested it, iterate to have the prototype with the changes suggested by the users.

Preparation

Get the team together beforehand, make sure you go over the timings, the objectives of the activity and review the groups, the projects and their evolution.
Review the blueprints the students made to anticipate the materials. Discuss the different fabrication options and agree on a plan of action for each of the projects.
Prepare small examples of each of the technologies that will be shown during the tour. Often a small demo or example is better than an explanation.

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Preparation of the space

- Prepare a space with a table for each group. With enough space between them to be able to work comfortably and allow for circulation between them.
- Place a piece of paper along the table. It will act as a protection and offer a canvas for participants to use as a sketchbook during the session, ideas, planning, drawings, texts. It will be their documentation notebook.
- Prepare "design thinking" material for each table. Postitits, markers, stickers, etc.
- Add basic prototyping material and tools such as scissors, cutters, glue, tape, rulers, etc.
- Make sure that each table has at least one electrical point. To be able to connect, ipads, computers, power supplies.
- Leave material on each table to make the accreditations.

Facilitator Instructions

- The entire unit 6 could be performed in a single session. But we have divided it in 2, to make it even easier for schools to go to the FabLab.
- Instructor-student ratio of 1-6: Our express methodology is designed to achieve maximum productivity in the shortest possible time. That is why the objective of the session is not that the participants understand the most advanced concepts of digital manufacturing but rather that they understand the possibilities and limitations they offer us.
- Each group will be assigned an instructor "mentor", who will accompany, guide and facilitate everything necessary for them to be the maximum operative in the lab.

  NOTE: Reducing the number of instructors/mentors per participant means lowering the final expectations of the unit, or increasing the number of hours of the activity.

- Below is a list of the different technologies available during the pilot:
  - Laser cutting
  - Vinyl cutter
  - 3D printing
  - Computer Control Machine
  - Power hand tools
- All knowledge transfer will be done in a practical and applied way to the project. This implies that each software and technical particularities of each technology will be explained by groups and when necessary.

Schedule

- **INTRO**, To welcome, start with a small explanation of the place that will include a presentation of the fab lab universe, and a brief story of the facilities. Introduce the fablab team.
- **ACCREDITATION**, Ask each participant (including mentors, instructors and fablab staff) to produce a badge with their name on it. After the tour, ask them to write or draw on the back of the badge what technology and project has most impressed them.

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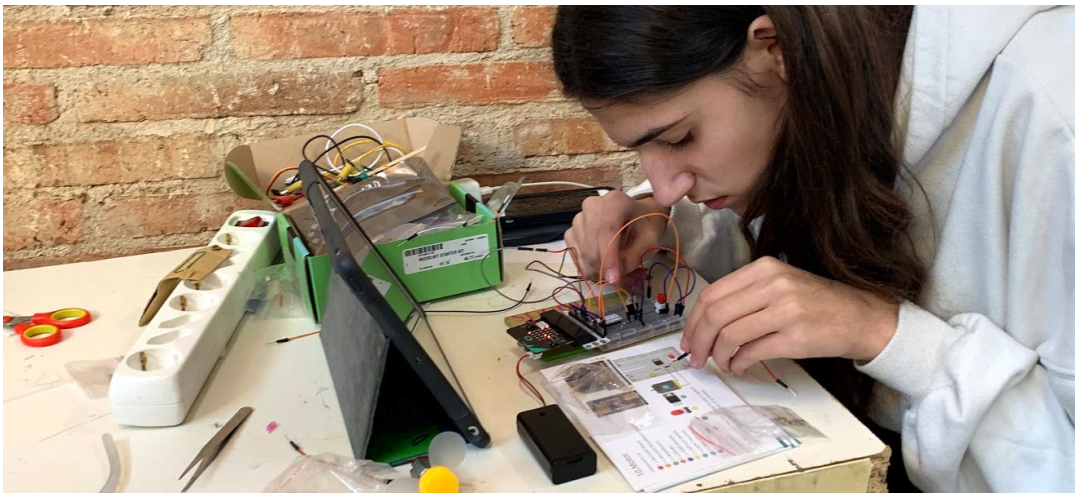
- **TOUR(Meet the technology)** To begin to understand the fablab universe, there is nothing better than to find out and explain it through a tour of the Fablabbcn. Divide the group into smaller groups and
- **PLANNING**, Before starting, spend 15-20 minutes on an activity so that each team lists the tasks they want to do and organize them in DOING/TODO/DONE. With the help of the mentors/instructors, assign responsibilities, divide the team (if necessary) and set priorities.
- **WORKING SESSION,** Group work
    - **Electronics,** As we have seen in previous phases of the project, electronics provides vital information to better understand the environment around us. Each group of participants will receive a kit of electronics and will develop the following activities. Identify all the parts. Do a small exercise following a manual. Detect which input and output they want to use in their Prototype.



    - **Design & Fabrication,** Each project will need different technologies and materials, but we recommend. Start working in 2D, as this is all that is needed to start with some of the simpler machines in the lab, such as lasers and vinyl cutters. It's also one of the fastest digital manufacturing techniques, so you can validate your designs first. Later, depending on each project, 3D design and manufacturing will be included.

- **FEEDBACK,** Round of presentations of the results. Questions: What did you like and what didn't you like? What are the next steps?

NOTE: If the session is divided into more than one day, it is recommended to start on day 2 by reviewing the task schedule, to adjust it based on experience.

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Some digital manufacturing concepts to work on during the session

Principles and practices
Knowing the different documentation platforms is important when it comes to reproducing, modifying or innovating on existing work. Explore libraries and resources to distribute knowledge and learn some protocols for design and project management in digital manufacturing and to transmit it to others.

2D & 3D Design
A fundamental skill required for Fablabs and digital manufacturing is the ability to transfer design intentions into a CAD environment, either in 3D (ideally) or in 2D. We recommend using as many Opensource applications as possible.

Subtractive processes
Fabrication objects by removal and/or cutting of material Similarly, when mixed with digital production tools, higher accuracies are obtained than could be obtained using conventional (manual) methods.

Additive processes
Successive superposition of micrometric layers of material until the desired object is achieved. This is increasingly a very important aspect of digital manufacturing, as it allows the customization and manipulation of existing objects.

Physical Computing & Electronics
Basic concepts of physical computing to understand the interaction between the physical and electronic worlds. The use of Microbit is recommended as a hardware tool, because it is a versatile platform that offers a lot of information, support and plugins available online. Other hardware platforms such as Arduino or Smart Citizen are also recommended.

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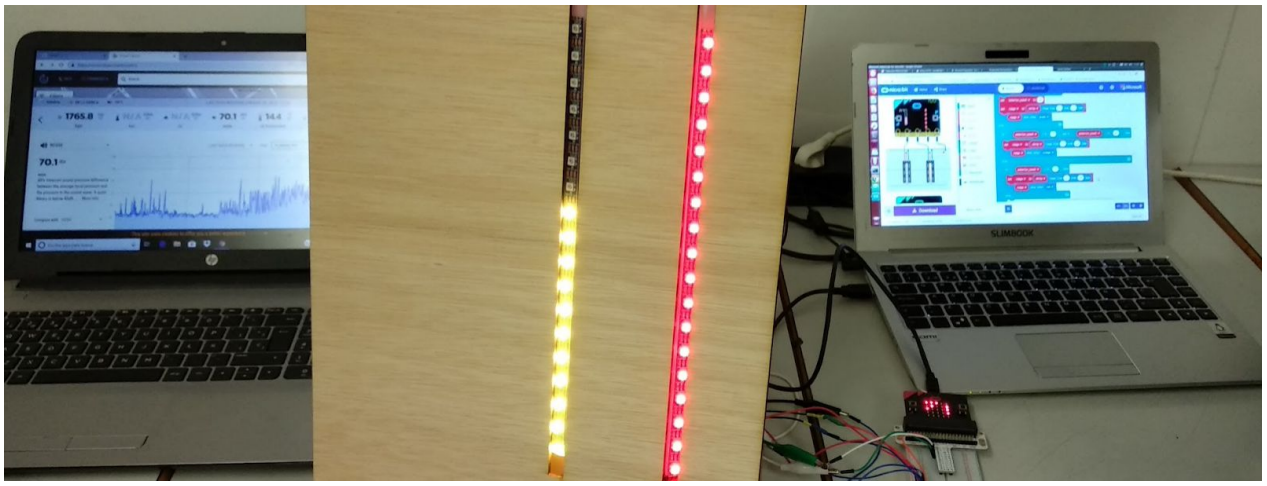
Unit 7 - Community

2:00 hours approx.

- [60 min] Implementation
- [60 min] Elevator Pitch

El objetivo de esta unidad es la de diseñar e implementar una intervención para probar y medir el impacto que nuestra solución tiene en un ámbito de actuación real.
Sin embargo, lo que es particularmente importante de las intervenciones es lo que hacen. Las intervenciones se centran en el comportamiento de las personas, y en cómo los cambios en el entorno pueden apoyar esos comportamientos.

Implementation - 60 min



Aim

The objective is to present the designs of the prototypes and their projects in real contexts, to evaluate both their effectiveness and their impact on the community.

Materials

- tbd

Prompt

Plans, designs and implements interventions (action plans) that allow testing and measuring the impact of the proposals in real contexts.

Preparation

Most of the activity in this unit will take place outside of class time as we will be asking students/participants to present their projects with the community in real contexts.
Use the class time to prepare these actions.

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Facilitator Instructions:

Each action step or change to be sought should include the following information:

- What actions or changes will occur
- Who will carry out these changes
- By when they will take place, and for how long
- What resources (i.e., money, staff) are needed to carry out these changes
- Communication (who should know what?)

Some recommendations to take into account during the design of the action

- Try to involve as many people in the community as possible in the action. Involve potential clients or end users of the intervention
- Learn what others have done before. Look for references of other similar actions to inspire you.
- Identify the issues or problems you may have during the action
- Think about what impact you want to have and how we measure it. This will help you think about how to document the experience.

GO AND TEST!

Elevator Pitch - 60 min

Aim

Is a way to share the expertise and credentials quickly and effectively with people who don't know you. Prepare the explanation for the day of the final presentation.

Materials

- Papers and pens

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Prompt

Prepare a 1-minute talk that summarizes the project and explains the experience made during the Pilot.

Preparation

Try to recreate the conditions on the day of the final event. It can be a party, market, presentation, fair conference, etc.

Facilitator Instructions

- Explain what the idea of elevator pitch is, because that's what it's called and what the main function is.

  NOTE: Elevator Pitch it's typically about 30 seconds, the time it takes people to ride from the top to the bottom of a building in an elevator. (The idea behind having an elevator speech is that you are prepared to share this information with anyone, at any time, even in an elevator.

- For 15 minutes ask each member of the group to work individually on a text that summarizes the following points:
  - **About the group.** Tell who you are: describe you and your group.3. Tell what you do and show enthusiasm. Define the group goals
  - **What do you offer.** Tell what problems have been solved or contributions you have made.
  - **What are the benefits.** Tell what very special solutions your group is working on. What are the advantages? What it makes different.
  - **What do you do it.** Give a concrete example or tell a short story, show your uniqueness and provide illustrations on how you work.
  - **How much it cost.** Think about how much it would cost to implement the solution and estimate a rough cost

- For the next 15 minutes, ask each group to share the notes and texts among its members, with the aim of rewriting a final text with a maximum duration of 1 minute.
- Make a round of presentations where each group will have 5 minutes to make their speech.
- Feedback
  - Like most of their classmates, they have followed the evolution of the other groups in the class. They will be perfectly capable of helping and giving advice on how to better explain the objectives and the work done by the group.
  - After each presentation, open a dialogue with the class to give advice (always positive) on how to improve or better explain some of the parts.

- End the activity by asking the participants to repeat the speech with a family member, and write down their comments, which will be very valuable for the final presentation.

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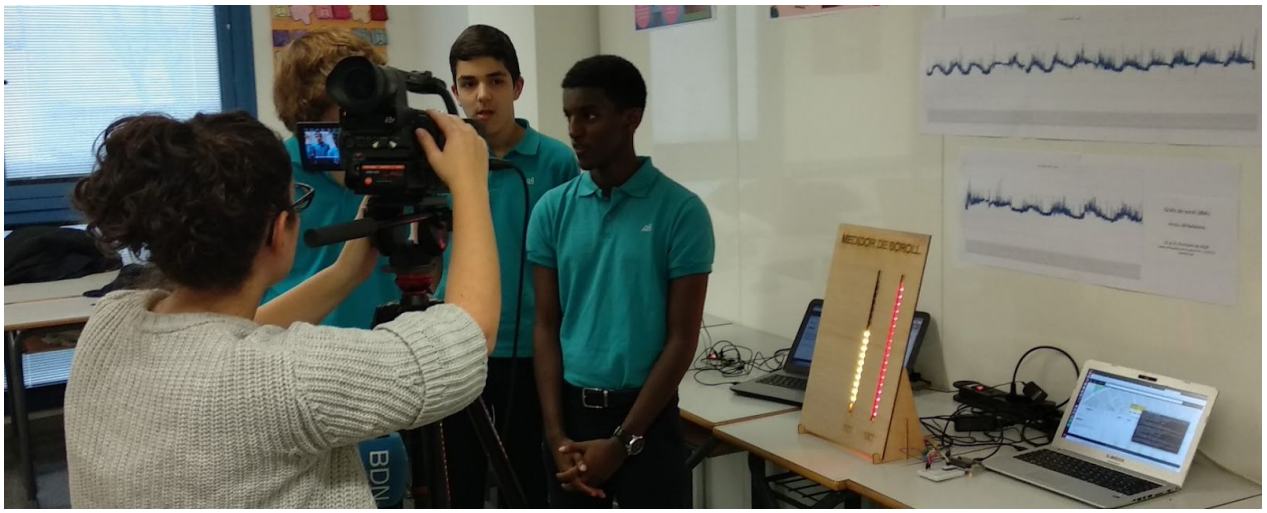
Unit 8 - Communication

1:00 hours approx.

- [60 min] Final event, fest

We ended with a final act before the entire educational community, social entities, representatives of the City Council and external collaborators who have supported the groups throughout the process.

Fest, Final Event - 60 min



Aim

Share the results of the projects with the community, with the aim of generating the maximum positive impact so that the proposals have continuity.

Materials

- Group presentations
- Prototypes

Prompt

Organize a final event with the community to share the experience made during the whole process.

Preparation:

Decide what type of event best fits the theme and projects you have worked on. It can be a fair, a party, a presentation, workshops.
Evaluate the size of the event and look for a suitable space.
Prepare and send formal invitations for the event to:

- To members of the educational community, representatives of local institutions, administration
- All the people who have participated in the different stages of the project, teachers
- Family representatives.
- Press

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NOTE: Do not limit yourself to the school setting. Many times you can attract more people if it is done in a public space.

Plan the activities and make a schedule for the day. This will help participants and special guests to plan better.
Explain to each group what they have to prepare for that day. Presentations, prototypes, etc.
Prepare an activity for feedback. If the event is very big you may have to structure it beforehand so that the guidelines are clear from the beginning. (See Peer review method in unit 5).

Facilitator Instructions:

- Gather the students/participants 10 minutes before the start, and review the day's schedule.

  NOTE: Everyone may be a little nervous. It is a day to enjoy the work done. Try to convey to them that the work is done and that today is just about showing how hard they have worked.

- Master of ceremonies: Prepare a small presentation with the following contents.
  - The objective of the project
  - Summary of groups and projects
  - introduction to special guests, organizations, etc.
  - Explain the dynamics of the day.
  - Feedback
- Document the event (photos, videos, interviews, etc...)




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SUCCESS STORY

As part of Fab Lab Barcelona's contribution, we implemented the pilot in the second year of the DOIT project. We did Weekly sessions of one or two hours, or one several days long session to go from start to finish.

We worked with 25 middle school children aged 14 to 15 at the "col.legi Sant Andreu de Badalona" during the first quarter of the year 2019, in collaboration and full coordination with the subject of "Entrepreneurship".

The weekly sessions were held from October to January. There were definitely advantages to seeing the same children week after week, but this approach did also have its challenges. Time management becomes crucial, as does an ability to create interest before anybody can really see where the journey will take them.

At first there were some participants with less than enthusiastic attitudes, probably because all the things that excite so many of us about digital fabrication are quite abstract, but everything changed when the class visited Fab Lab Barcelona and saw for themselves some examples of what they could do. It just goes to show, you could have the most fascinating space, but something still has to click to turn "OK fine, more homework..." into "Wow, I can actually do some things here!"

Luckily, these bits and atoms did click and the students were divided into groups, each tackling a different task. They proposed an issue, carried out interviews and tests to see if it actually was an issue, decided on how to approach the issue and then to develop a solution

WATER FILTER

Pol, Pablo, Dani, Javi

NOISE VISUALIZATOR

Martí, Cesc, Albert

HOMEWORK METER

Clàudia, Kate, Paula, Lucia, Ainhoa

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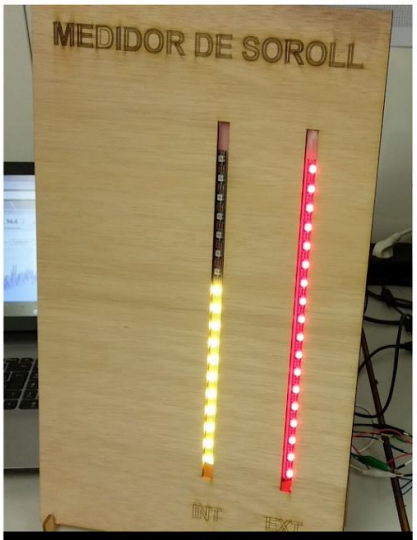
One of the groups chose to work on a homework-meter after interviewing the rest of the school. The physical prototype they developed visualizes the amount of homework assigned in each class, and has feedback mechanisms for when it gets too much. There were a lot of motors and sensors involved in this beautiful machine.

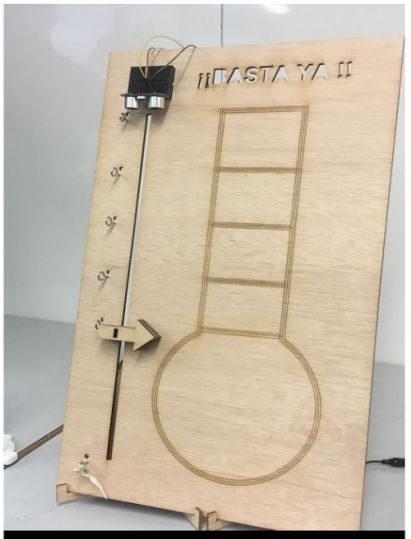
Another group thought there were too many birds on the rooftop garden the students use during recess. The birds made it unsafe for them to play as they liked, and nobody was happy about it. After thinking long and hard to find a solution that doesn't harm the birds, they came up with a tech-y scarecrow that uses a combination of active and passive non-invasive techniques used to keep birds away, like noise, movement and reflective materials.

There was one group who used a prized project developed in Fab Lab Barcelona. Some classrooms in the school were always too noisy, because the school itself is close to a noisy street. Using the Smart Citizen kit, they recorded and visualized the noise levels and presented their findings to the City Council, who later decided to replace buses that pass near the school with electric buses, which helped keep the noise levels down. Talk about civic engagement and affecting change!

WATER FILTER



NOISE VISUALIZATOR



HOMEWORK METER

Regarding the impact of the DOIT project on the school, we not only highlight the successes and evidence of the students' projects, but also the "oil stain" effect that spreads to all sectors of the school, teachers, management, families. Proof of this is that in the second term of the entrepreneurship course, the pilot was repeated, this time guided exclusively by the teacher of the course. Subsequently and seeing the results in the subject, the school management and the fab lab Barcelona, have begun a process of reflection that allows the development of skills and key competencies in the educational ecosystem facilitating their transition to a 4.0 education in the framework of the UN Sustainable Development Goals.

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