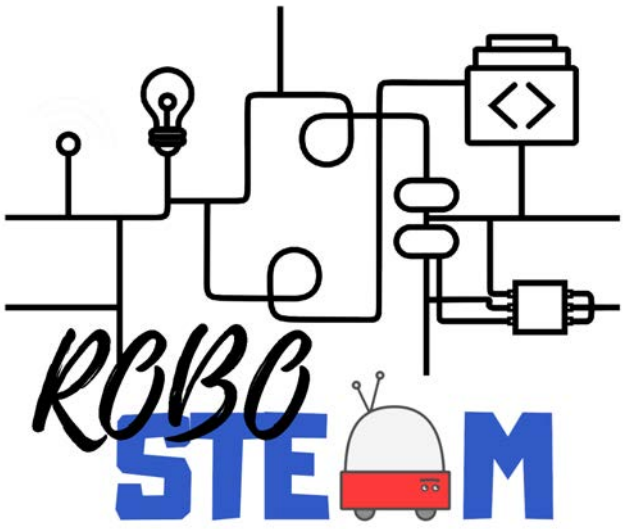
Design of Open Hardware Kits – O2.A4



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Version History

Version	Date	Comments
0.1	01/06/2019	Definition of challenges
0.2	01/07/2019	Template definition
1.0	01/08/2019	Gathering possible kits and challenges

Table of Contents

1. O2.A4

This document describes part of the work of the RoboSTEAM project [1-3] Output 2 - Guides for designing Open Hardware PD&R. The output aims to define guides that allow designing learning challenges for the development of STEAM [4] competencies [5] and computational thinking [6-9] by using PD&R. An important part of this output is to define challenges and kits to be tested in the identified context selected from the gathered in section O2.A4. The activity is described in the proposal as follows:

> "*Definition of some PD&R kits taking into account the competencies that students should acquire and the best way to facilitate this acquisition taking into account the socioeconomical contexts where challenges take place*".

2. THE PROCESS

The process followed was first the definition of what the project understands as Challenge and how can be applied in different contexts. This led to the definition of Challenge, Mini Challenge and Nano Challenge. After that a template was defined to gather Challenges and Kits. Later, the partners should provide at least a challenge, and those with a technological background a kit.

2.1. The challenge definition

What is Challenge Based Learning

Challenge Based Learning (CBL) is an educational paradigm that encourages students to leverage the technology they use in their daily lives to solve real-world problems [10]. CBL is collaborative and involves not only students or teachers, but also other experts in specific fields.

- **Challenge:** It works posing to students a big idea, they should discuss about it and define some main questions about this idea, from these questions a challenge is proposed. Students should address the challenge looking for a collaborative solution that involves their peers, teachers,

experts, etc. After this, the solution, will be assessed [11]. "Standard Challenges are longer (one month and longer) and allow considerable latitude for the Learners. Working together, the Learners identify and investigate Big Ideas, develop Challenges, do extensive investigation across multiple disciplines and take full ownership of the process. The Framework is used from start to finish, including implementation and evaluation of the Solution in an authentic setting" [12]. Although in the literature there is not a clear description about how many hours the students employ to this type of challenges per day, we are considering 4 hours per day, 5 days per week and 4 weeks per month. This means that it should comprise 80 working hours, from which around 40-60 should be at class and 20-40 is personal work of the student. Examples of standard challenges:

Big Idea: Gender Equality

Main question: How do we achieve gender equality?

Challenge: Build a culture of gender equity!

Later we will have some guiding questions, research, act and reflect (https://cbl.digitalpromise.org/2018/02/18/big-idea-gender-equality/)

- **Mini-Challenge:** Are not so big as a standard challenge and increase the level of choice and responsibility of a nano-challenge, typical duration is around 2-4 weeks. These challenges allow learners "to start with a Big Idea and work through the entire framework. The research depth and the reach of their Solutions increases, and the focus can be content specific or multidisciplinary. Taking a "show me what you can do" perspective, Mini Challenges are good for intense learning experiences that stretch the Learners and prepare them for longer Challenges"[12]. Regarding duration with 4 hours per day, 5 days per week and 2 weeks per moth. With this model we can talk about a minimum of 40 hours per mini challenges, which

20-30 should be at class and 10-20 is students' personal work. Several mini-challenges could be the base for a standard challenge.

- **Nano-Challenges:** "Nano Challenges are shorter in length, focus on a particular content area or skill, have tight boundaries and are more teacher directed. The Learners typically start with the Challenge without identifying a Big Idea or Essential Question. The process includes the Investigation and Act phases, but at a significantly lower level of intensity and often stop short of implementation with an external audience. Typically, Nano Challenges are used as scaffolding leading to more significant Challenges or during longer Challenges to address specific concepts." That is, nano-challenge will be our minimum unit to build challenges, it is more oriented to a Project based learning approach, it could involve external people, but it is not necessary. Regarding the number of hours required by it we are talking between 6-10 hours of classes and 4-6 of students work. Several nano-challenges can be used to solve a mini-challenge.

2.2. The challenge template

In this section it is possible to see the challenge, mini-challenge and nano-challenge template agreed by the partners to be used in RoboSTEAM Project.

Author:
Institution:

Title	*Write in this field a title for the challenge*
Description	
Write in this field the description for the challenge	
Goal/s	
Describe in this field the goals of the challenge	
Evaluation	
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc.	

Any challenge can be divided in Minichallenges, please describe them.

MINICHALLENGES (Repeat as many tables as minichallenges you have for the current challenge)

Title	*Write in this field a title for the michallenge*
Research question or problem addressed by this minichallenge	
Describe the research question or problem addressed by this minichallenge	
Description	
Write in this field the description for the michallenge	
Goal/s	
Describe in this field the goals of the minichallenge	
Evaluation	
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc.	

Any challenge can be divided in Nanochallenges, please describe them.
NANOCHALLENGE (Repeat as many tables as nanochallenge you have for the current minichallenge)

Title	*Write in this field a title for the michallenge*
Specific Issue to deal with	
Describe the specific issue to deal with during the nanochallenge	
Description	
Write in this field the description for the nanochallenge	
Goal/s	
Describe in this field the goals of the minichallenge	
Kits to use	
Please describe the kind of kits or technology that can be employed to solve the nanochallenge	
Evaluation	
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc.	

2.3. The kit template

Author:
Institution:

Title	*Write in this field a title for the challenge*
Reference	*Reference provided by the manufacturer if any*
Description	
Write in this field the description for the challenge	
Proposal	
Describe in this field the proposal of the kit	
Components (Repeat these rows as many times as components you have)	

Describe the components of the kit with specifying what each can do, how to use and how to install it.
Sample of use
Describe a sample of use for the kit
User Manual
Link the user manual for the kit if there is a web with it
Other information
Other information related to the kit, more documentation, where to acquire it, cost, etc.

2.3. Samples of Challenges and kits

Author: Miguel Ángel Conde González
Institution: University of León

Title	*Improve Transportation*
Description	
The use of vehicles that employ fossil fuels has a great impact in the environment. Propose approaches to reduce this impact	
Goal/s	
- *Improve environment.* - *Define the proper research question/s for the problem you are dealing with.* - *Look for successful transportation solutions.* - *Built a possible approach.* - *Ask your parents, experts and peers looking for the best solution.*	
Evaluation	
During this challenge we can assess: - *Time employed to solve the challenge* - *Degree of success producing a solution* - *Number of people involved in the challenge (students, experts, parents, etc.)* - *Perception about STEEM* - *Assessment of STEM skills and CT skills before and after the challenge*	

Any challenge can be divided in Minichallenges, please describe them.
MINICHALLENGES (Repeat as many tables as minichallenges you have for the current challenge)

Title	*Use mobile robots to improve transportation*
Research question or problem addressed by this minichallenge	
Can we employ mobile robots to reduce the transportation impact in the environment?	
Description	

The use of vehicles that employ fossil fuels has a great impact in the environment. A possible solution to address this problem in controlled environments can be the use of mobile robots. Think about how to employ mobile robots to reduce the environmental impact in transportation
Goal/s
- *Study mobile robots* - *Study possible ways to apply mobile robots to improve the environment* - *Explore the scenarios were mobile robots can be applied* - *Built a possible approach based on mobile robots* - *Ask your parents, experts and peers looking for the best solution.*
Evaluation
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc.
- *Time employed to solve the challenge* - *Degree of success producing a solution that employ mobile robots* - *Number of mobile robots used* - *Type and number of issues related with mobile robots navigation solved* - *Number of people involved in the challenge (students, experts, parents, etc.)* - *Perception about STEEM* - *Assessment of STEM skills and CT skills before and after the challenge*

Any challenge can be divided in Nanochallenges, please describe them.
NANOCHALLENGE (Repeat as many tables as nanochallenge you have for the current minichallenge)

Title	*Follow lines with a mobile robot to facilitate autonomous navigation*
Specific Issue to deal with	
Use or built a robot that was able to follow a line	
Description	
The use of vehicles that employ fossil fuels has a great impact in the environment. A possible solution to address this problem in controlled environments can be the use of mobile robots. However, a successful use of mobile robots with transport proposes should explore the navigation problems and one of the most common is how to use a robot to follow a line.	
Goal/s	
- *Study mobile robots* - *Study navigation issues in mobile robots* - *Study possible ways facilitate that a mobile robot follow a line* - *Explore the scenarios were mobile robots can be applied* - *Built a possible approach of a mobile robot that follows a line* - *Ask your parents, experts and peers looking for the best solution.*	
Kits to use	

It is possible to use mRobot
Evaluation
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc.
- *Time employed to solve the challenge* - *Degree of success using or building a robot that follow a line* - *Robot accuracy following the line* - *Number of mobile robots used* - *Number of people involved in the challenge (students, experts, parents, etc.)* - *Perception about STEEM* - *Assessment of STEM skills and CT skills before and after the challenge*

NANOCHALLENGE (Repeat as many tables as nanochallenge you have for the current minichallenge)

Title	*Avoid obstacles with a mobile robot to facilitate autonomous navigation*
Specific Issue to deal with	
Use or built a robot that was able to avoid obstacles	
Description	
The use of vehicles that employ fossil fuels has a great impact in the environment. A possible solution to address this problem in controlled environments can be the use of mobile robots. However, a successful use of mobile robots with transport proposes should explore the navigation problems and one of them is to avoid obstacles.	
Goal/s	
- *Study mobile robots* - *Study navigation issues in mobile robots* - *Study possible ways to facilitate that a mobile robot follow avoid an obstacle* - *Explore the scenarios were mobile robots can be applied* - *Built a possible approach of a mobile robot that avoid obstacles* - *Ask your parents, experts and peers looking for the best solution.*	
Kits to use	
It is possible to use mRobot	
Evaluation	
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc.	
- *Time employed to solve the challenge* - *Degree of success using or building a robot that avoids obstacles* - *Time required to complete navigate through an scenario with obstacles* - *Number of mobile robots used* - *Number of people involved in the challenge (students, experts, parents, etc.)* - *Perception about STEEM*	

- *Assessment of STEM skills and CT skills before and after the challenge*

Each of the partners propose one or several challenges and kits to address them. These can be seen in the following appendix.

3. ACKNOWLEDGEMENTS

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APPENDIX A. CHALLENGES

Mini challenge

Author: Susana Celis Tena and Covadonga González Barrientos

Institution: I.E.S. Eras de Renueva.

Title	**Illuminated sign**
Description	
The school festival will be held in the auditorium. Students' relatives and friends will be welcome to the event. We want to signal how to get to the auditorium from the main entrance. To do this you will have to design the light signalling. Design a program to get 8 different colour LEDs to turn on and turn off in a simple sequence. Insert them in a board to get the route correctly marked. It is required to use a simulator program before making the model.	
Goal/s	
GENERAL OBJECTIVES - Know the basics of computational thinking and acquire the skills to use it when solving simple problems. – Understand and practice basic programming concepts acquiring the ability to create simple programs using them. – Address diversity in the classroom: use methodologies and resources that have been specifically selected for STEAM teaching with students with different cultural, academic and competence levels. – Identify and use relevant everyday real-life contexts and scientist reasoning to promote the essential values of our society. – Foster inclusive education and intercultural learning through the use of STEAM contexts **SPECIFIC OBJECTIVES** – Know how a LED diode works. – Calculate the current limiting resistors you should place in a circuit with LED diodes. – Send different values to an Arduino digital pin. – Work with loops to send different values with different delays	

Evaluation
An active methodology, based on learning making, will be used. Special emphasis is placed on the social and connected nature of learning when designing the activities, by encouraging communication among participants. Teachers will act as facilitators, monitoring the activities and providing the necessary support for for a fruitful experience. Teachers will be also in charge of proposing the challenges students will rise to and provide them with web sources where to obtain the necessary information to carry out these challenges. In addition, every participant will be able to help and collaborate with other participants to solve difficulties and challenges that could arise. Every participating group of students will generate a solution to solve the challenge. The realization of the activity plan will contribute to the development and improvement of digital competence, particularly in the Digital contents generation and Solving problems areas.

NANOCHALLENGE 1

Title	**Make an LED turn on and off**
What is an LED?	
What type of component is an LED? How is it connected? What resistor is required?	
Description	
- Research into the necessary components for the circuit to work correctly. - Calculate the resistor needed to prevent LED from blowing. - Create a program to turn on an LED. - Simulate the circuit using, for example, Tinkercad and send different values to an Arduino digital pin. - Connect the components to the breadboard. - Power on the Arduino board by connecting it to a computer using an USB cable. - Check that the real circuit works.	
Goal/s	
Know how to connect an LED to turn it on and off	

Kits to use
Simulator program, Arduino Uno or similar Arduino board, a breadboard (preferably with a positive and negative rail), an LED, a resistor, jumper wires, USB cable, a computer, IDE Arduino
Evaluation
The students should connect correctly all the components and calculate the value for the resistor

NANOCHALLENGE 2

Title	**Make an LED turn on and off with a switch or push**
What is a switch? And a push?	
What is a switch used for? What is a push used for?	
Description	
- Research into different types of switches - Decide which is more suitable for the project - Create a program to turn on an LED with a switch/push. - Simulate the circuit using, for example, Tinkercad - Connect the components to the breadboard. - Power on the Arduino board by connecting it to a computer using an USB cable. - Check that the real circuit works.	
Goal/s	
Know how to control an LED using a switch/push	
Kits to use	
Simulator program, Arduino Uno or similar Arduino board, a breadboard (preferably with a positive and negative rail), an LED, a resistor, a switch/push, jumper wires, USB cable, a computer, IDE Arduino	
Evaluation	
The students should connect correctly all the components	

NANOCHALLENGE 3

Title	**Make at least 8 LED turn on and off using a switch**
How can the LEDs be connected?	
Is it possible to light up only some of them? Is it possible to light up all of them at the same time?	
Description	
- Research into different ways of connecting the LEDs. - Try different sequences to find the best for the project. - Create a program to turn on the LEDs using a switch/push. - Simulate the different sequences using, for example, Tinkercad. - Connect the components to the breadboard. - Power on the Arduino Uno or similar Arduino board by connecting it to a computer using an USB cable. - Check that the real circuit works properly.	
Goal/s	
Know how to connect several LEDs to turn them on and off according to a designed sequence	
Kits to use	
Simulator program, Arduino Uno or similar Arduino board, a breadboard (preferably with a positive and negative rail), LEDs, resistors, jumper wires, USB cable, a computer, IDE Arduino	
Evaluation	
The students should design a light sequence and connect correctly all the components to get the design sequence	

NANOCHALLENGE 4

Title	**Design the illuminated sign and the light sequence**
Model shape? Size? Required materials?	
What type of component is an LED? How is it connected? What resistor is required?	
Description	
- Research into the suitable dimensions for the illuminated sign to be seen.	

- Design several ideas and decide the one which better meets the project specifications - Select the materials for making the model - Make the model and fix the circuit inside - Check the proposal works.
Goal/s
Know how to design and make a model
Kits to use
Simple tools for making the model
Evaluation
The students should think up several ideas, select the more suitable for the project, plan the materials, tools and the construction process, make the model, evaluate it and present the result

Challenge Template

Author: Juha Paavilainen, Hannu Vähäkoski & Ilkka Jormanainen

Institution: UEF, University training school

Title	*Entertainment of senior citizens*
Description	
Life of senior citizens is not always easy, and they don't have enough support or activity in their everyday life. Make suggestions how senior citizens standard of living could be improved.	
Goal/s	
- learn about senior citizens life *- consideration of different approaches* *- making of research and working plan* *- know about implements tools, communication possibilities and entertainment* *- using of robotics and computational thinking* *- collaboration*	
Evaluation	
During this challenge we can evaluate: *- collaboration* *- self-guidance* *- understanding the concept* *- documentation* *- STEAM-skills and computational thinking*	

Any challenge can be divided in Minichallenges, please describe them.

MINICHALLENGES (Repeat as many tables as minichallenges you have for the current challenge)

Title	*Entertainment*
Research question or problem addressed by this minichallenge	
What kind of entertainment equipments can we design using robotics?	
Description	
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. Find out what kind of restrictions senior citizens have and think how mobile robots could be used to bring entertainment in their everyday life.	
Goal/s	
- study robotics and CT *- study and design possible ways to apply robotics to improve senior citizens well-being* *- find out about senior citizens life, make an interview or questionnaire* *- design a possible solution using robotics kit*	
Evaluation	
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc. *- self-evaluation* *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*	

Any challenge can be divided in Nanochallenges, please describe them.

NANOCHALLENGE (Repeat as many tables as nanochallenge you have for the current minichallenge)

Title	*Voice command*
Specific Issue to deal with	
Design a mobile robot to react to voice command	
Description	
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. Find out what kind of restrictions senior citizens have and think how mobile robots could be used to bring entertainment in their everyday life.	
Goal/s	
- study mobile robots *- study sensors* *- study possible way to control the robot* *- study senior citizens life* *- design and built a possible approach of a mobile robot that can respond to voice commands* *- collaboration*	
Kits to use	
Hummingbird (microbit-based extension kit), Lego EV3-kit, makeblock-kit (m Bot)	
Evaluation	
- self-evaluation *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*	

Title	*Dancing robot*
Specific Issue to deal with	
Design a mobile robot to dance	

Description
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. Find out what kind of restrictions senior citizens have and think how mobile robots could be used to bring entertainment in their everyday life.
Goal/s
- study mobile robots *- study sensors* *- study possible way to control the robot* *- study senior citizens life* *- design and built a possible approach of a mobile robot that can move according to music* *- collaboration*
Kits to use
Hummingbird (microbit-based extension kit), Lego EV3-kit, makeblock-kit (m Bot)
Evaluation
- self-evaluation *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*

Title	*Art robot*
Specific Issue to deal with	
Design a robot to present artistic lights and pictures	
Description	
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. Find out what kind of restrictions senior citizens have and think how mobile robots could be used to bring entertainment in their everyday life.	

Goal/s
- study mobile robots *- study sensors* *- study possible way to control the robot* *- study senior citizens life* *- design and built a possible approach of a mobile robot that can present lights and artistic pictures* *- collaboration*
Kits to use
Hummingbird (microbit-based extension kit), Lego EV3-kit, makeblock-kit (m Bot)
Evaluation
- self-evaluation *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*

Challenge Template

Author: Juha Paavilainen, Hannu Vähäkoski & Ilkka Jormanainen

Institution: UEF, University training school

Title	*Well-being of senior citizens*
Description	
Life of senior citizens is not always easy, and they don't have enough support or activity in their everyday life. Make suggestions how senior citizens standard of living could be improved.	
Goal/s	
- learn about senior citizens life *- consideration of different approaches* *- making of research and working plan* *- know about implements tools, communication possibilities and entertainment* *- using of robotics and computational thinking* *- collaboration*	
Evaluation	
During this challenge we can evaluate: *- collaboration* *- self-guidance* *- understanding the concept* *- documentation* *- STEAM-skills and computational thinking*	

Any challenge can be divided in Minichallenges, please describe them.

MINICHALLENGES (Repeat as many tables as minichallenges you have for the current challenge)

Title	*Implement tools*
Research question or problem addressed by this minichallenge	
What kind of implement tools can we design using robotics?	
Description	
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. A possible solution to solve these problems could be implementations of robotics. Find out what kind of restrictions senior citizens have and think how mobile robots or different implementations could solve these problems.	
Goal/s	
- study robotics and CT *- study and design possible ways to apply robotics to improve senior citizens well-being* *- find out about senior citizens life, make an interview or questionnaire* *- design a possible solution using robotics kit*	
Evaluation	
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc. *- self-evaluation* *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*	

Any challenge can be divided in Nanochallenges, please describe them.

NANOCHALLENGE (Repeat as many tables as nanochallenge you have for the current minichallenge)

Title	*Follow lines and avoid walls and obstacles with a mobile robot*
Specific Issue to deal with	
Design a mobile robot to follow line, turn before wall and avoid obstacles	
Description	
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. A possible solution to solve these problems could be implementations of robotics. Design and built a moving robot which can follow line, turn before walls and avoid obstacles.	
Goal/s	
- study mobile robots *- study sensors* *- study possible way to control the robot* *- study senior citizens life* *- design and built a possible approach of a mobile robot that can follow line, turn before wall and avoid obstacles* *- collaboration*	
Kits to use	
Hummingbird (microbit-based extension kit), Lego EV3-kit, makeblock-kit (m Bot)	
Evaluation	
- self-evaluation *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*	

Title	*Grab or collect an item with mobile robot*
Specific Issue to deal with	
Design a mobile robot to grab or collect an item	

Description
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. A possible solution to solve these problems could be implementations of robotics. Design and built a moving robot which can grab or collect an item and move it.
Goal/s
- study mobile robots *- study sensors* *- study possible way to control the robot* *- study senior citizens life* *- design and built a possible approach of a mobile robot that can grab or collect an item and move item* *- collaboration*
Kits to use
Hummingbird (microbit-based extension kit), Lego EV3-kit, makeblock-kit (m Bot)
Evaluation
- self-evaluation *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*

Title	*Reacts to different kinds of detects*
Specific Issue to deal with	
Design a robot to react sound, touch or rotational motion	
Description	
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. A possible solution to solve these problems could be implementations of robotics. Design and built a moving robot which detects and is controlled by sound, touch and rotational motion.	

Goal/s
- study mobile robots *- study sensors* *- study possible way to control the robot* *- study senior citizens life* *- design and built a possible approach of a mobile robot that is controlled by sound, touch or rotational motion* *- collaboration*
Kits to use
Hummingbird (microbit-based extension kit), Lego EV3-kit, makeblock-kit (m Bot)
Evaluation
- self-evaluation *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*

Challenge Template

Author: Juha Paavilainen, Hannu Vähäkoski & Ilkka Jormanainen

Institution: UEF, University training school

Title	*Well-being of senior citizens*
Description	
Life of senior citizens is not always easy, and they don't have enough support or activity in their everyday life. Make suggestions how senior citizens standard of living could be improved.	
Goal/s	
- learn about senior citizens life *- consideration of different approaches* *- making of research and working plan* *- know about implements tools, communication possibilities and entertainment* *- using of robotics and computational thinking* *- collaboration*	
Evaluation	
During this challenge we can evaluate: *- collaboration* *- self-guidance* *- understanding the concept* *- documentation* *- STEAM-skills and computational thinking*	

Any challenge can be divided in Minichallenges, please describe them.

MINICHALLENGES (Repeat as many tables as minichallenges you have for the current challenge)

Title	*Implement tools*
Research question or problem addressed by this minichallenge	
What kind of implement tools can we design using robotics?	
Description	
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. A possible solution to solve these problems could be implementations of robotics. Find out what kind of restrictions senior citizens have and think how mobile robots or different implementations could solve these problems.	
Goal/s	
- study robotics and CT *- study and design possible ways to apply robotics to improve senior citizens well-being* *- find out about senior citizens life, make an interview or questionnaire* *- design a possible solution using robotics kit*	
Evaluation	
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc. *- self-evaluation* *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*	

Any challenge can be divided in Nanochallenges, please describe them.

NANOCHALLENGE (Repeat as many tables as nanochallenge you have for the current minichallenge)

Title	*Follow lines and avoid walls and obstacles with a mobile robot*
Specific Issue to deal with	
Design a mobile robot to follow line, turn before wall and avoid obstacles	

Description
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. A possible solution to solve these problems could be implementations of robotics. Design and built a moving robot which can follow line, turn before walls and avoid obstacles.
Goal/s
- study mobile robots *- study sensors* *- study possible way to control the robot* *- study senior citizens life* *- design and built a possible approach of a mobile robot that can follow line, turn before wall and avoid obstacles* *- collaboration*
Kits to use
Hummingbird (microbit-based extension kit), Lego EV3-kit, makeblock-kit (m Bot)
Evaluation
- self-evaluation *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*

Title	*Grab or collect an item with mobile robot*
Specific Issue to deal with	
Design a mobile robot to grab or collect an item	
Description	
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. A possible solution to solve these problems could be implementations of robotics. Design and built a moving robot which can grab or collect an item and move it.	

Goal/s
- study mobile robots *- study sensors* *- study possible way to control the robot* *- study senior citizens life* *- design and built a possible approach of a mobile robot that can grab or collect an item and move item* *- collaboration*
Kits to use
Hummingbird (microbit-based extension kit), Lego EV3-kit, makeblock-kit (m Bot)
Evaluation
- self-evaluation *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*

Title	*Reacts to different kinds of detects*
Specific Issue to deal with	
Design a robot to react sound, touch or rotational motion	
Description	
Senior citizens may have restrictions in their moving, immobilization in their limbs or difficulties in communication. A possible solution to solve these problems could be implementations of robotics. Design and built a moving robot which detects and is controlled by sound, touch and rotational motion.	

Goal/s
- study mobile robots *- study sensors* *- study possible way to control the robot* *- study senior citizens life* *- design and built a possible approach of a mobile robot that is controlled by sound, touch or rotational motion* *- collaboration*
Kits to use
Hummingbird (microbit-based extension kit), Lego EV3-kit, makeblock-kit (m Bot)
Evaluation
- self-evaluation *- group-evaluation* *- documentation of challenge* *- self-assessment of STEAM-skills and CT before and after the challenge*

Kit

Author: Susana Celis Tena y Covadonga González Barrientos

Institution: I.E.S. Eras de Renueva

Title	**Illuminated sign kit**
Reference	***Arduino:*** ELEGOO UNO Project Basic Starter Kit with Tutorial and UNO R3 Board Compatible with Arduino IDE for Beginner
Description	
Components needed for turning the LEDs of the illuminated sign on according to the sequence designed by the students	
Proposal	
Cheap and basic kit for beginners. Applicable Age: 12+ To use Elegoo starter kits requires basic electronic knowledge. If the user has no experience, it would be better to have someone lead and teach them while studying	
Components	
1pcs ELEGOO R3 Controller Board 1pcs USB Cable 1pcs Breadboard pcs 65 Jumper Wire 1pcs IC 74HC595 1pcs Active Buzzer 1pcs Tilt Switch 2pcs Photo resistor 5pcs Yellow LED 5pcs Blue LED 5pcs Green LED 5pcs Red LED 1pcs RGB LED 5pcs Button(small) 10pcs Resistor (10R) 10pcs Resistor (100R) 30pcs Resistor (220R) 10pcs Resistor (330R) 10pcs Resistor (1K) 10pcs Resistor (2K)	

10pcs Resistor (5K1) 10pcs Resistor (10K) 10pcs Resistor (100K) 10pcs Resistor (1M) 5pcs Female-to-male DuPont Wire
Sample of use
https://www.mblock.cc/example/blink/ https://www.youtube.com/watch?v=e1FVSpkw6q4
User Manual
Link the user manual for the kit if there is a web with it
Other information
Other information related to the kit, more documentation, where to acquire it, cost, etc.

Kit Template

Author:

Institution: KIT

Title	*Write in this field a title for the challenge* e.g. “Invention Workshop” (depends on the topic the teacher wants to address)
Reference	*Arduino LiliyPad (former eduwear starter kit) and amici software (open source), available at Watterott online*
Description	
The challenge is based on project work for collaborative prototyping	
Proposal	
Describe in this field the proposal of the kit Arduino LilyPad components and amici software (open source available at http://dimeb.informatik.uni-bremen.de/eduwear/ Smart textiles offer many possibilities for creative engagement with so-called "intelligent" attractable media (wearables). They form a new generation of systems embedded in textiles and establish a link to mobile technologies that can be worn on the skin; the implemented computer becomes visible. New interfaces - sewn, woven or embroidered - between body, clothing and environment are made tangible.	
Components	
The “kit” is rather a collection which consists of single electronic components, such as sensors, actuators and the LilyPad main board: Smart Textiles (for example conductive yarn and fabrics), LEDs, vibrating motors, buzzers, light sensors, heat sensors, motion detectors and a small and handy micro-controller which can be used for the construction of intelligent clothes. Amici is a visual programming language which enables programming novices to program Arduino boards without having to master the textual programming language Arduino. Amici is since the Arduino software is based on the open-source open (source code on request), released under the GPL.	
Components	
conductive fabrics	

Components conductive yarn
Components LED in different colours and with changing colours
Components vibrating motors
Components buzzers
Components light sensors
Components (heat/temperature sensors)
Components motion detectors
Components micro-controller, main board
Components Adapter and USB cable to transfer the amici program onto the LilyPad main board
Describe the components of the kit with specifying what each can do, how to use and how to install it. *The sensors can realize the environment related to* • *Heat/Temperature* • *Motion* • *Light* *The actuators can respond to generate outputs such as* • *Light/LED* • *Sound* • *Vibration (motor)*
Sample of use
Describe a sample of use for the kit An interactive sneaker with LED and motion sensor can react to movements of a person with blinking lights

The main focus was on the development of own project idea (according to the topic “inventing new interactive objects for my favourite profession”). Through the creative examination of microcontrollers, the participants are to acquire a deeper technical understanding in the area of control and regulation and to experience the computer as an independently designable and controllable machine through programming. Also the learners experience self-efficacy. An iconic interface (AMICI) was used to be able to realize independent, module-based programming steps.
User Manual
Link the user manual for the kit if there is a web with it The overall handbook/Tutorial to get started with Smart textile/Wearables with Arduino LilyPad can be accessed at: http://www.taccle3.eu/deutsch/wp-content/uploads/sites/4/2015/12/Tutorial_Lilypad_aduino_ed.pdf
Other information The hardware components are not available as a complete set anymore (the former eduwear starter kit), but the single components required can be bought one at a time (e.g. at watterott.com)
Other information related to the kit, more documentation, where to acquire it, cost, etc. Arduino LilyPad main board is around 22 EURO, Sensors and actuators around 4-6 EUR

Challenge Template

Author: Manuel Jesus, Jonny Alves

Institution: CIC

Title	*Logistic management of a warehouse*
Description	
This challenge aims to present a problem inspired on the deployment of autonomous mobile robots on a factory shop floor. One or more robots should be able to transport materials between warehouses or machines that process those materials.	
Goal/s	
The robots must collect, transport and deliver the materials, self-localize and navigate in a maze.	
Evaluation	
The robot with the highest total number of Final Parts placed on the outgoing warehouse is the winner. If there are teams with the same total number of parts, the team that took less time to achieve that has the advantage.	

Any challenge can be divided in Minichallenges, please describe them.

MINICHALLENGES (Repeat as many tables as minichallenges you have for the current challenge)

Title	*Machine supply (from incoming warehouse to machine)*
Research question or problem addressed by this minichallenge	
Navigation and decision on part type	
Description	
In this minichallenge, the robot should pick a part from the warehouse and deliver it to the machine, depending on the RFID TAG identification	
Goal/s	
The main goal is to pick and deliver a part correctly from the incoming warehouse to the machine while navigating on the shop floor	
Evaluation	
A part should be placed correctly on the destination machine.	

Title	*Final delivery (from machine to outgoing warehouse)*
Research question or problem addressed by this minichallenge	
Navigation through the middle maze	
Description	
In this minichallenge, the robot should pick a part from the machine and deliver it to the outgoing warehouse.	
Goal/s	
The main goal is to pick and deliver a part correctly from the machine to the outgoing warehouse while navigating on the shop floor	
Evaluation	
A part should be placed correctly on the destination warehouse.	

Title	*Direct delivery (from incoming to outgoing warehouse)*
Research question or problem addressed by this minichallenge	
Navigation between warehouses	
Description	
In this minichallenge, the robot should pick a part from the incoming warehouse and deliver it to the outgoing warehouse, depending on the RFID TAG identification	
Goal/s	
The main goal is to pick and deliver a part correctly from the incoming warehouse to the outgoing warehouse while navigating on the shop floor	
Evaluation	
A part should be placed correctly on the destination machine.	

Any challenge can be divided in Nanochallenges, please describe them.

NANOCHALLENGE (Repeat as many tables as nanochallenge you have for the current minichallenge)

Title	*Line follower*
Specific Issue to deal with	
To control the mobile robot direction through a line and crosses	

Description
In this nanochallenge, it is desired to develop low level control algorithms to keep the robot drive through a line and crosses
Goal/s
The main goal is to navigate on a floor line following it
Kits to use
Warehouse robot kit
Evaluation
The robot should comply the navigation on a line and crosses

Title	*RFID identification*
Specific Issue to deal with	
Identify the different type of parts	
Description	
In this nanochallenge, it is desired to read a RFID tag that differentiates the part (each one has its own ID)	
Goal/s	
The main goal is to read a RFID tag based on a RFID reader module	
Kits to use	
Warehouse robot kit	
Evaluation	
The robot should acquire the ID of the part	

Title	*Navigation on site*
Specific Issue to deal with	
Localize and navigation of the robot	
Description	
The robot should localize in the maze, based on the crosses and turns. With that information, a state machine should be developed to perform the movements.	
Goal/s	
To navigate in the maze based on the localization	

Kits to use
Warehouse robot kit
Evaluation
This nanochallenge is correctly performed if the robot is able to move from the source to the destination.

Challenge Template

Author: Francisco Rodríguez

Sedano Institution: ULE

Title	USE OF AUTONOMOUS ROBOT FOR ASSISTANCE OF DEPENDENT PERSONS

Description

In these last two decades, life expectancy has increased, while the number of people with functional diversity and reduced mobility has increased. To all this is added the fact that a high percentage of people over 65 live alone and have to use technical aids to be able to carry out the activities of daily living.

Given this panorama, all the mechanical and technological aids that serve to improve the lifestyle of this important part of the population are beneficial and desirable. With the advances that have taken place in recent years with respect to robotics, a hopeful image is drawn in the almost immediate future.

To these advances must be added the possibilities offered by autonomous navigation that opens a whole field of possibilities to autonomous cars that, in the future, will be the ideal medium for many people with reduced mobility.

The concept of robotic assistance arises, which aims to develop robotic devices that provide assistance to dependents, increase their quality of life and facilitate domestic tasks as much as possible and, to their caregivers, help them in daily assistance and care from the patients.

Goal/s

- Know the problems of dependent people in their daily lives.
- Seek solutions to these problems and improve their quality of life.
- Define the appropriate research questions for the problem you are dealing with.
- Design solutions applying robotics concepts and build prototypes.

Evaluation

- Time employed to solve the challenge.
- Degree of success producing a solution.
- Number of people involved in the challenge (students, experts, parents, etc.).
- Perception about STEEM.
- Assessment of STEM skills and CT skills before and after the challenge.

MINICHALLENGE 1

Title	PROGRAM A ROBOT WITH A PROGRAMMING LANGUAGE BY BLOCKS
Research question or problem addressed by this mini-challenge	
Learn to program a robot with a simple and intuitive programming language.	
Description	
In this mini challenge the student will learn the basics of robotics and programming using bitbloq 2, a block programming language and the ZQ robotics kit from BQ.	
Goal/s	
▪ Know the programming environment. ▪ Know the basic programming concepts (variables and functions, initial instructions, loops and algorithms). ▪ Program a solution to a problem posed using the concepts learned.	
Evaluation	
The teachers will supervise the procedures used by the students to solve the problems posed with the help of the bitbloq 2 compiler and verify that they are appropriate.	

NANOCHALLENGE 1.1

Title	BEFORE YOU START WITH BITBLOQ 2
Specific Issue to deal with	
Installation of the software and the necessary drivers to start programming with Bitbloq 2.	
Description	
Before you start programming with Bitbloq 2 it is important to make sure you have everything you need to make it work correctly on your computer. For this it is necessary to follow a series of steps.	
Goal/s	
▪ Connect the corresponding board to the computer with the USB cable. ▪ Install the Web2board program so that the computer recognizes the controller board. ▪ Load a program and verify that it is compiled correctly.	
Kits to use	
Software Bitbloq 2 and Web2Board. ZUM BT-328 controller board.	

Evaluation
The teacher will check that the student is able to connect the controller board correctly and will help solve problems that may arise.

NANOCHALLENGE 1.2

Title	KNOWING BITBLOQ 2
Specific Issue to deal with	
Know what Bitbloq 2 is and how it works	
Description	
In this nano challenge the student will learn the Bitbloq2 programming environment and its main options.	
Goal/s	
▪ Know the interface of Bitbloq 2 and its different options. ▪ Learn to connect and verify the controller board. ▪ Make and compile the first program: turn on a led.	
Kits to use	
Software Bitbloq 2 and Web2Board. ZUM BT-328 controller board.	
Evaluation	
The teacher will verify that the student can compile a simple program and help solve problems that may arise.	

NANOCHALLENGE 1.3

Title	PROGRAM THE SOLUTION TO A PROBLEM USING CONTROL LOOPS
Specific Issue to deal with	
Use a control loop to solve a real problem.	
Description	
A control loop is a part of the program that repeats as long as a condition is met. The student will use the different types of control loops available in Bitbloq 2 to solve a problem posed by the teacher.	
Goal/s	
▪ Learn the different types of control loops. ▪ Use the appropriate control loop for each type of problem. ▪ Program a solution to a real problem using the control loops.	
Kits to use	
Software Bitbloq 2 and Web2Board. ZUM BT-328 controller board.	
Evaluation	

The teacher will verify that the student can compile a simple program and help solve problems that may arise.

MINICHALLENGE 2

Title	KIT ASSEMBLY
Research question or problem addressed by this mini-challenge	
Learn to assemble a robot from the components provided in a kit and check its correct operation.	
Description	
In this mini challenge the student will assemble a robot with the components provided in a kit and check the correct functioning of the robot, loading and compiling a simple program.	
Goal/s	
▪ Assemble a robot from the components of a robotics kit. ▪ Check the operation of the different electronic components of the robot. ▪ Test the robot by compiling a simple program.	
Evaluation	
The teacher will verify that the student can mount the robot and check its correct functioning and will help solve the problems that may arise.	

NANOCHALLENGE 2.1

Title	PRINTBOT EVOLUTION ASSEMBLY
Specific Issue to deal with	
Learn how to assemble the robot from the components of the PrintBot Evolution kit	
Description	
In this nano challenge the student will learn to assemble the robot step by step from the components provided in the PrintBot Evolution kit.	
Goal/s	
Assemble the robot from the components of the PrintBot Evolution kit	
Kits to use	
PrintBot Evolution kit by BQ.	
Evaluation	
The teacher will supervise that the student can mount the robot and help solve the problems that may arise.	

NANOCHALLENGE 2.2

Title	TEST OF THE DIFFERENT SENSORS OF THE ROBOT
Specific Issue to deal with	
Test the correct functioning of the different sensors of the robot.	
Description	
In this nano challenge, the student will learn to check the correct functioning of the different sensors of the robot by compiling simple programs.	
Goal/s	
▪ Know the different sensors of the robot and its function. ▪ Check its operation.	
Kits to use	
PrintBot Evolution kit by BQ.	
Evaluation	
The teacher will verify that the student can check the operation of the different sensors of the robot and will help solve the problems that may arise.	

NANOCHALLENGE 2.3

Title	PROGRAMMING THE ROBOT
Specific Issue to deal with	
Program the robot to solve a real problem.	
Description	
In this nano challenge, the student will learn to program the robot to solve a real problem posed by the teacher.	
Goal/s	
▪ Learn to use the robot's sensors to find a solution to a real problem. ▪ Program this solution and compile it. ▪ Test the program on the robot.	
Kits to use	
PrintBot Evolution kit by BQ. Software Bitbloq 2 and Web2Board.	

Evaluation
The teacher will verify that the student can solve a real problem using the sensors of the robot and compiling a program made by himself and help solve the problems that may arise.

Challenge

Authors: Maria João Ramos, Luísa Fernandes and Manuel

Trovisco Institution: Agrupamento de Escolas Emídio Garcia (AEEG)

Title	*Wildfires Prevention – a global issue.*

Description

Wildfires concern all of us. It is a worldwide issue. According to Environmental Defence Fund (EDF), the number of annual large fires in the American West has doubled. In Europe, numbers and facts must be similar. We want to avoid the causes of wildfires and understand at what extent is Climate change responsible for wildfires in Iberian Peninsula. Propose approaches to reduce the impact of Global Warming (GW) on wildfires and suggest Prevention strategies.

Goal/s

i) Improve Environment;
ii) define the proper research question(s) for the problem mentioned above;
iii) look for successful strategies in order to prevent fires in Iberian territory and reduce GW impact;
iv) build a possible approach;
v) be a team player. Find out a collaborative solution/strategy that involves students, parents, teachers and experts in this field.

Evaluation

During this challenge we can assess:

i) Time employed to solve the challenge (stds will fill in a grid);
ii) degree of success producing a solution (stds will fill in a self and hetero evaluation report);
iii) number of people involved in the challenge (information sheet including age, role/status and Education level);
iv) perception about STEAM (stds will be asked to talk about their experience throughout the whole process of this challenge – they can make a video, around two minutes);
v) assessment of STEM skills and CT skills before and after the challenge (online questionnaires).

MINICHALLENGE

Title	*Use mobile robots to detect and avoid the cause(s) of wildfires and reduce the impact of global warming on this issue.*
Research question or problem addressed by this minichallenge	
Can mobile robots prevent fire(s)? (acts of arson, lack of cleanliness, global warming – drought and severe heat- etc)	
Description	
Human activities such as lighting campfires, discarding lit cigarettes, acts of arson, bushfires etc are mainly responsible for starting a fire. However, hotter weather makes forests drier and more prone to burn. Rising temperatures, a key indicator of climate change, evaporate more moisture from the ground, drying out the soil and making vegetation more flammable. *Think about how to employ mobile robots to reduce the impact of global warming on environment and avoid other causes of wildfires.*	
Goal/s	
i) Study mobile robots; ii) develop computational thinking; iii) study possible ways to apply mobile robots to improve environment; iv) develop soft skills; v) implement collaborative solution/strategy that involves students, parents, teachers and experts in this field; vi) design and explore the scenarios where mobile robots can be applied; vii) develop creativity.	
Evaluation	
i) Time employed to solve the challenge (stds will fill in a grid); ii) degree of success producing a solution (stds will fill in a self and hetero evaluation report); iii) number of people involved in the challenge (information sheet including age, role/status and Education level); iv) perception about STEAM (stds will be asked to talk about their experience throughout the whole process of this challenge – they can make a video, around two minutes); v) assessment of STEM skills and CT skills before and after the challenge (online questionnaires).	

NANOCHALLENGES

Title	*Follow lines with a mobile robot to patrol the forest*
Specific Issue to deal with	
Use or built a robot that was able to follow a line	
Description	
Human activities in the countryside namely forests have a great impact on the environment. A possible solution to address this issue can be the use of mobile robots. *We want to find out how to use a robot to follow a line in order to patrol the forest.*	
Goal/s	
i) study navigation issues in mobile robots; ii) study possible ways to make a mobile robot follow a line; iii) explore scenarios where mobile robots can be applied; iv) implement collaborative solution/strategy that involves students, parents, teachers and experts in this field; v) develop soft skills; vi) develop CT skills; vii) enhance creativity.	
Kits to use	
mBot, a STEAM educational robot for beginners.	
Evaluation	
i) Time employed to solve the challenge (stds will fill in a grid); ii) degree of success producing a solution (stds will fill in a self and hetero evaluation report); iii) number of people involved in the challenge (information sheet including age, role/status and Education level); iv) perception about STEAM (stds will be asked to talk about their experience throughout the whole process of this challenge – they can make a video, around two minutes); v) assessment of STEM skills and CT skills before and after the challenge (online questionnaires).	

Title	*Avoid obstacles with a mobile robot to facilitate autonomous navigation*
Specific Issue to deal with	
Use or built a robot that was able to avoid obstacles	

Description
Human activities in the countryside namely forests have a great impact on the environment. A possible solution to address this issue can be the use of mobile robots. *We want to find out how to use a robot to follow a line that can avoid obstacles.*
Goal/s
i) study navigation issues in mobile robots; ii) study possible ways to make a mobile robot follow a line; iii) explore scenarios where mobile robots can be applied; iv) implement collaborative solution/strategy that involves students, parents, teachers and experts in this field; v) develop soft skills; vi) develop CT skills; vii) enhance creativity.
Kits to use
mBot, a STEAM educational robot for beginners.
Evaluation
i) Time employed to solve the challenge (stds will fill in a grid); ii) degree of success producing a solution (stds will fill in a self and hetero evaluation report); iii) number of people involved in the challenge (information sheet including age, role/status and Education level); iv) perception about STEAM (stds will be asked to talk about their experience throughout the whole process of this challenge – they can make a video, around two minutes); v) assessment of STEM skills and CT skills before and after the challenge (online questionnaires).

Title	*Follow lines with a mobile robot to allow waste transport*
Specific Issue to deal with	
Use or build a robot which can transport waste by following a line	
Description	
Human activities in the countryside namely forests have a great impact on environment. A possible solution to address this issue can be the use of mobile robots. *We want to find out how to use a robot to follow a line in order to pick up waste and carry it into a bin.*	
Goal/s	
i) study navigation issues in mobile robots; ii) study possible ways to make a mobile robot follow a line; iii) explore scenarios where mobile robots can be applied; iv) implement collaborative solution/strategy that involves students, parents, teachers and experts in this field; v) develop soft skills; vi) develop CT skills; vii) enhance creativity.	
Kits to use	
mBot, a STEAM educational robot for beginners.	
Evaluation	
i) Time employed to solve the challenge (stds will fill in a grid); ii) degree of success producing a solution (stds will fill in a self and hetero evaluation report); iii) number of people involved in the challenge (information sheet including age, role/status and Education level); iv) perception about STEAM (stds will be asked to talk about their experience throughout the whole process of this challenge – they can make a video, around two minutes); v) assessment of STEM skills and CT skills before and after the challenge (online questionnaires).	

Kit Template

Author: Francisco Rodríguez

Sedano Institution: ULE

Title	*USE OF AUTONOMOUS ROBOT FOR ASSISTANCE OF DEPENDENT PERSONS*
Reference	Kit Printbot Evolution BQ
Description	
BQ PrintBot Evolution is a product of educational robotics from BQ, a company dedicated to the design, sale and distribution of smartphones, tablets, electronic readers, 3D printers and robotics kits. BQ PrintBot is designed for a comprehensive work in robotics: study of its components, 3D printing of parts, assembly and programming	
Proposal	
With this PrintBot Evolution Kit, students can assemble their first printing robot in a simple way. With its follow-lines, follow-light functions and its ultrasonic sensor, you can create your own applications with the different components of the kit, customizing the robot and creating your own character.	

Components

Printed parts:

- Body (centrepiece that houses the two continuous rotation motors, the buzzer and the ZUM plate),
- Battery holder (part that supports an 8 AAA battery holder),
- 2 wheels,
- 2-wheel covers,
- Miniservo holder (part that holds the ultrasound mini-servo),
- Hold ultrasound,
- 2 fenders.

Other components:

- Methacrylate base,
- 26 M3 x 8 mm screws,
- 6 M3 x 12 mm screws,
- 2 M3 x 25 mm screws,
- 34 M3 nuts,
- 2 O-rings (4 mm thick and 56 mm internal diameter),
- 4 15 mm hexagonal spacers with M3 at one end,
- Allen wrench.

Electronic components:

- Battery holder,
- ZUM BT-328 controller board,
- 2 continuous rotation servos,
- Mini-servo,
- 2 ZUMbloq light sensor,
- ZUMbloq buzzer,
- ZUMbloq infrared 2x Siguelíneas,
- Ultrasound sensor,
- USB Cable.

Sample of use

- Program the robot using its ultrasonic sensor to dodge obstacles.
- Program the robot using its lights sensor to follow a line.
- Program and control the robot from a terminal with the help of a mobile application prototyping tool.

User Manual
http://diwo.bq.com/product/kit-printbot-evolution/
Other information
Price: 104.90 €

Kit Template

Author: José Lima

Institution: IPB

Title	*Warehouse robot kit*
Reference	*To be developed*
Description	
The proposed robot was designed to be able to pick parts and move them from source to destination points. The parts should be picked based on a controlled magnet placed on the front of the robot. An identification of parts (with a RFID reader) should also be included to decide the destination of the parts.	
Proposal	
The robot kit will be developed applying 3D printing technology, using PLA or ABS, and the robot modules are intended to be assembled and connected in a fast and easy way.	
Components (Repeat these rows as many times as components you have)	
–Arduino based microcontroller: *–RFID: A SPI protocol radio-frequency identification reader to identify the part type.* *–Part switch detector: a switch to be assembled on the front of the robot to detect the presence of the part.* *–Batteries: two 18650 lithium batteries to supply the robot* *–Step Down converter: A switching converter to supply the 5 V components in an efficient way.* *–Motor driver: Receives the signals (PWM and direction) from the microcontroller and actuates the motors.* *–Electro-Magnet: A magnet controller by a bit is used to hold the part while moving on the floor.* *–Motors: Two Geared motors (left and right) are used to move the robot in a differential architecture.* *–Floor line detector: A PCB composed by 5 infra-red emitters and receivers is used to detect the white line on the floor. It is used to follow the line during the competition.*	
Sample of use	

The robot should be programmed within the Arduino IDE. (several low level functions will be provided to the students)
User Manual
None.
Other information
None.

Kit Template

Author: José Gonçalves

Institution: IPB

Title	*mBot robot*
Reference	https://www.makeblock.com/steam-kits/mbot
Description	
Students can develop Nano Challenges using this platform, that can consist in following a line, obstacle avoidance, sensing the environment while navigating and material transportation.	
Proposal	
The device used is the mBot robot, from Makeblock Co. Ltd., an entry-level STEAM educational robot kit for beginners that makes teaching and learning robot programming simple.	
Components	
About the specifications of mBot, the main control board is microcontroller ATmega328 and comes with a light sensor, button, IR receiver, ultrasonic sensor, line follower sensor, there are the possibilities to program other modules like the buzzer, 2x RGB LED, IR transmitter and two motors. Can be powered with a 3.7V lithium battery or 6V (4x 1.5V) batteries]. To program the robot the students used mBlock 5 PC version, a software-based on Scratch 3.0 designed to support STEAM education. By supporting block-based and text-based programming, mBlock 5 allows users to freely program the robot to solve the challenge.	
Sample of use	
Thereby, the students involved during the challenges can learn about some of the robot machinery and electronic parts, get ideas about how works the fundamentals of block-programming, and develop their logical thinking and design skills. *The mBot already comes with 3 pre-set control* *modes: 1 - Obstacle avoidance mode,* *2 - Line follow mode* *3 - Manual control mode.*	
User Manual	
https://www.makeblock.com/steam-kits/mbot-2#Manuals	

Other information
Acquired at https://www.botnroll.com with a cost of 91.50 euros.

Kit Template

Author: Daniela Reimann

Institution: KIT

Any challenge can be divided in Mini-challenges, please describe them.

MINICHALLENGES (Repeat as many tables as mini-challenges you have for the current challenge)

Title	*Write in this field a title for the mini-challenge* **Overall challenge "Make it shine"** **M1: What's that? – Explore electronic components**
Research question or problem addressed by this mini-challenge	
The **overall challenge** "make it shine" aims to enable pupils to develop circuits, construct and program smart textile objects. The duration of the overall challenge is 5 blocks á 3,5 hours/week. It consists of **5 mini challenges,** which are connected and to be done in order. They are single activities but supposed to be applied in context of the overall goal to make an LED shine. The pupils explore all the steps necessary, such as: 1. **"What's that? Explore the electronic components of the Arduino LilyPad technology!" (such as interactive mother board, sensors, actuators and connectors and the pins)** 2. "Cable spaghetti? – develop a circuit!" (Using crocodile clips, conductive yarn) 3. "Do you speak computer?" (What is an Algorithm? Understand if-then relations without using a computer, but laying technique with paper elements) 4. Make it shine! Programme your circuit and let the LED shine with Amici 5. "Pimp it up! Test your program! Does the LED shine? Test and correct, improve it.	
Description	
Write in this field the description for the mini-challenge 1. "What's that? Explore electronics": Pupils are asked to identify electronic components, pins and opportunities, connections (Arduino mother board, light sensor, temperature sensor, conductive yarn and conductive textile). This will	

be done using physical components and work sheets, so that pupils have to identify the sensors and match to the names given on the sheets.
Goal/s
Describe in this field the goals of the mini-challenge The challenge overall aim is to enable pupils to develop circuits, construct and program smart textile objects. The goal of mini challenge 1 is, that pupils get familiar with the electronic components and pins, so that they know functions and opportunities of sensors, actors and connectors in a activity oriented way.
Evaluation
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc. Observation sheets will be used by KIT researchers and student mentors. All items are clearly described by the indicators to be observed. →The RoboSTEAM survey will be used where applicable.

MINICHALLENGES (Repeat as many tables as mini-challenges you have for the current challenge)

This is mini challenge 2 of the overall challenge “Make it shine”

Title	*Write in this field a title for the mini-challenge* 2 “Cable spaghetti? – develop a circuit!” (using conductive yarn and conductive material)
Research question or problem addressed by this mini-challenge	
How can we connect electronic components and make it work? Explore wiring electronic circuits using crocodile clips, (later electronic yarn), by connecting pins, and construct a circuit with a sensor and LED	
Description	
Write in this field the description for the mini-challenge Pupils are asked to wire electronic components to develop a circuit.	

Goal/s
Describe in this field the goals of the mini-challenge The goal is to enable pupils to wire a circuit (consisting of motherboard, sensor and LED)
Evaluation
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc. Teams will be observed by student mentors using an observation sheet

MINICHALLENGES (Repeat as many tables as mini-challenges you have for the current challenge)

This is part 3 of the challenge “Make it shine”

Title	*Write in this field a title for the mini-challenge* 3. “Do you speak computer?”
Research question or problem addressed by this mini-challenge	
What is an Algorithm? Understanding if-then relations without using a computer, but using the laying technique with paper elements (if…then…)	
Description	
Write in this field the description for the mini-challenge Pupils learn about the meaning of algorithms as recipes for activities. They learn to understand if-then relations without using a computer, but using the laying technique with paper elements (if…then…)	
Goal/s	
Describe in this field the goals of the mini-challenge The goal: After the challenge pupils know the basics of algorithms, as recipes for activities	

Evaluation
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc. Observation sheet by student mentors, RoboSTEAM survey, if applicable

MINICHALLENGES (Repeat as many tables as mini-challenges you have for the current challenge)

Title	*Write in this field a title for the mini-challenge* 4. Make it shine!
Research question or problem addressed by this mini-challenge	
How to make the LED shine? Programme your circuit and let the LED shine with Amici	
Description	
Write in this field the description for the mini-challenge Pupils use the circuit (light sensor, LilyPad Arduino board, power holder, battery and LED) and program to make the LED shine using Amici environment	
Goal/s	
Describe in this field the goals of the mini-challenge Teams of pupils get familiar with the interface of amici using the different functions e.g. loop, If…on/if…off…	
Evaluation	
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc. Observation sheets will be used by student mentors, RoboSTEAM survey if applicable	

MINICHALLENGES (Repeat as many tables as mini-challenges you have for the current challenge)

Title	*Write in this field a title for the mini-challenge* 5. "Pimp it up! Test your program! Does the LED shine? Test and correct, improve it.
Research question or problem addressed by this mini-challenge	
How to make the LED shine? Programme your circuit and let the LED shine with Amici	
Description	
Write in this field the description for the mini-challenge Pupils use the circuit (light sensor, LilyPad Arduino board, power holder, battery and LED) and program to make the LED shine using Amici environment	
Goal/s	
Describe in this field the goals of the mini-challenge Teams of pupils get familiar with the interface of amici using the different functions e.g. loop, If…on/if…off…	
Evaluation	
Describe what you want to evaluate during the pilot and how to measure the grade of success, the instruments used, etc. Observation sheets will be used by student mentors, RoboSTEAM survey if applicable	

Kit Template

Author: Francisco Javier Rodriguez Lera

Institution: ULE

Title	*Art and robotics*
Description	
Enthusiasm for art and new technologies would be seen as two different worlds, however, it is necessary to start thinking if the robots would generate any kind of artistic expression.	
Goals	
This challenge deals with different aspects of art and robotics - Generate more enthusiastic environments for art and robotics. - Minimize the fear to robot unknown. - Maximize multidisciplinary scenarios. - Understand the robot possibilities when doing artistic tasks. - Gather more information about the relations between kids and technology.	
Evaluation	
This challenge will evaluate the next items: - Perception about STEAM: art vs robots? - Number of people involved in the challenge. - Perception of each discipline by each participant. - Open discussions, could kids and machines create art?	

MINICHALLENGES 1

Title	*Use robots for making art*
Description	
The use of robots and AI for generating future art works is fuzzy. There are several Machine Learning approaches for generating pictures and music approaches using robots. This challenge proposes to use the project kit for generating art.	
Goals	
Measure the expectations of teachers and pupils when the art should be done by a robot. The sub goals associated: - Study robot features and programming environments. - Explore principles of art: painting, sculpture, literature, architecture, music, dance, theatre, photography and films. - Explain to others (family, friends) which are the opportunities of both art and robotics.	
Evaluation	
1. Timing for solving the minichallenge: from idea to real world. 2. Surveys about the question, can machines create art? 3. Artistic works generated during the challenge. 4. Measuring technical side: programming, deployment, applications. 5. Collaborations between humans and machine doing artistic tasks.	

NANOCHALLENGE 1.1

Title	*Performing theatre with robots*
Specific Issue to deal with	
Use a robot that is able to talk, walk or act in any way.	
Description	
The use of robots for cinema is huge, the kids should propose how to use a robot for performing part of a theatre scripts	
Goals	

- Understand robot features and potential actions. - Read a theatre book. - Program a set of robot actions.
Kits to use
It is possible to use any robotic kit, however, its appearance and characteristics will define the final goal.
Evaluation
1. Timing for solving the nanochallenge: from idea to real world. 2. Essay about the book. 3. Surveys for measuring the impact of using robots in art classes and the artwork in the technological field. 4. Surveys for evaluating the knowledge acquired in programming.

NANOCHALLENGE 1.2

Title	*Visualartthoughtroboteyes*
Specific Issue to deal with	
Use a robot for creating visual art.	
Description	
Most part of robots assemble cameras that allow to perceive the environment. The images gathered by the camera sensor could be modified in several ways applying filters and effects, thus the kids would observe the world from a different perspective and therefore, generate creative images and videos.	
Goals	
- Understand camera features and potential actions. - Understand robot navigation features for recording different scenes. - Summarize and apply basic principles of photography to generate artistic variations.	
Kits to use	
It is possible to use any robotic kit that includes one or multiple cameras. To deploy RGB-D cameras is a plus	
Evaluation	

1. Timing for solving the nanochallenge: from idea to real world.
2. Essay about photography principles.
3. Surveys for evaluating the knowledge acquired in robotics perception.
4. Surveys for evaluating the knowledge acquired in programming.

Kit Template

Author: Francisco Javier Rodriguez Lera

Institution: ULE

Title	*Little Sophia*
Reference	*https://www.hansonrobotics.com/little-sophia-2/*

Description

Little Sophia is a toy robot of 36cm tall. It has human shape. Hanson robotics presents it as a robot friend that offers learning STEM, coding and AI for kids 8+ years old. Its appearance is human-like.

Proposal

The idea is to use this robot for teaching not only programming lessons but also Human Robot Interaction principles. Litte Sofia robot is beyond pure technical solutions such as Arduino and wheels, its appearance would attract a different range of kids.

Components

Little Sophia robot

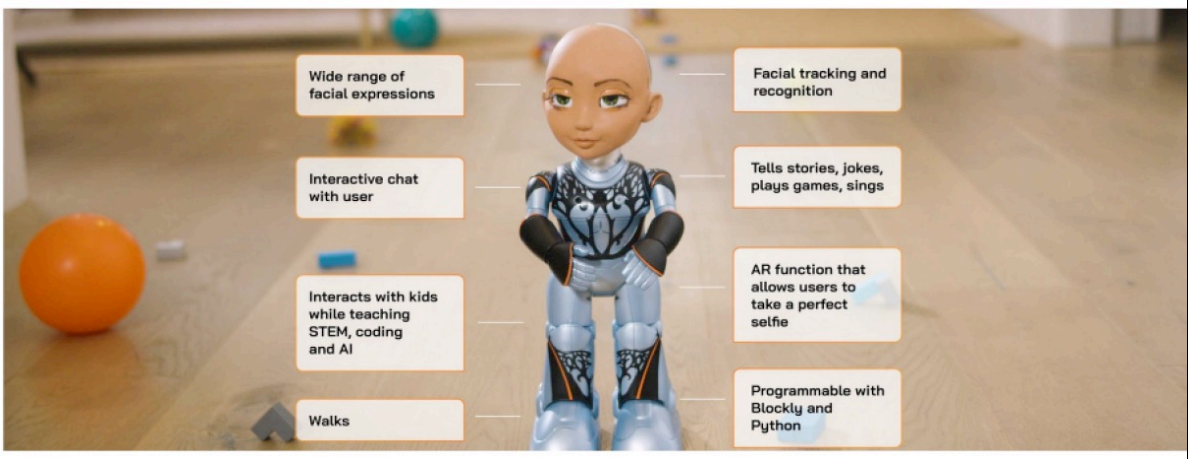

Illustration 1: Extracted from Hanson Robotics web page https://www.hansonrobotics.com/little-sophia-2/

Sample of use

The kids program the robot for interacting with other kids verbally. A set of quiz games would be programmed and deployed in the classroom using the course syllabus of any subject in the school.
Other information
Cost: 149 $ Video of sofia: https://www.voutube.com/watch?v=omgJi5-YT6U Where to buy: https://www.kickstarter.com/pro[ects/1240047277/little-sophia-bv- hanson-robotics