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**DISCOVERY  
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# Workshop 1: Augmented Reality in Educational Robotics

**Dr. Mikhail Fominykh, Dimitris Karampatzakis, Olga Firssova,  
and Gregory Milopoulos**

EU Code Week Teach Day 2024  9 March 2024  Online

<https://e-robson.eu/>

eROBSON project has received funding from the European Union's Erasmus Plus programme Grant agreement 2020-1-NO01-KA226-SCH-094120.





## ER - Educational Robotics



# Educational Robotics and STEM

- **Educational Robotics (ER)** has gained ground in the last years.
- Based on research findings, **ER** are used not only for teaching robotics but also to support teaching of other subjects in lab/classroom.
- That is the reason why it has been correlated with **STEM/STEAM**.

## ▶ **STEM**

- ▶ Science,
- ▶ Technology,
- ▶ Education,
- ▶ and Mathematics.

## ▶ **STEAM**

- ▶ Science - Technology,
- ▶ Engineering,
- ▶ **Arts**,
- ▶ and Mathematics.

# Educational Robotics and STEM

- The whole **process of learning robotics** helps students be improved in many subject areas such as **maths, programming, system and computational thinking**.
- Also, it has been noticed that students studying robotics tend to stay concentrated on an activity for quite a long time while they are able to make greater achievements than their peers due to their **social and emotional development**.

# Educational Robotics Kits

In **eROBSON**, we have studied thirteen (13) ER Kits.

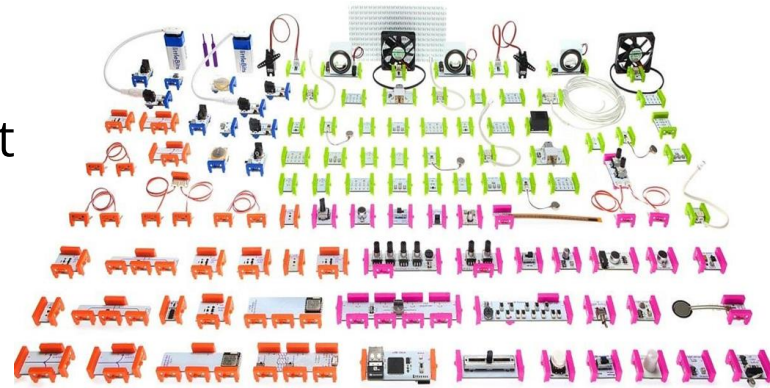
**ER Kits** are:

- Board based (like Arduino, RP) 1
  - Robot based (like Sphero BOLT) 2
  - **Brick/module based** 3
  - Computer based (RPi4/5) 4
- ER Platform - ER Kit**
- 1 Lego Mindstorms EV3 Kit
  - 2 Lego Wedo 2.0 Kit
  - 3 Arduino Kit
  - 4 **Sphero - LittleBits**
  - 5 Sphero - BOLT - SPKR+
  - 6 ESP32 Kit
  - 7 microbit Kit
  - 8 Raspberry RP2040 - RP Pico Kit
  - 9 Seeduino (Grove) Kit
  - 10 Raspberry Pi 4 Kit
  - 11 Lego Robot Inventor
  - 12 Lego Spike
  - 13 Sipeed Maixduino Kit for RISC-V AI
  - + IoT

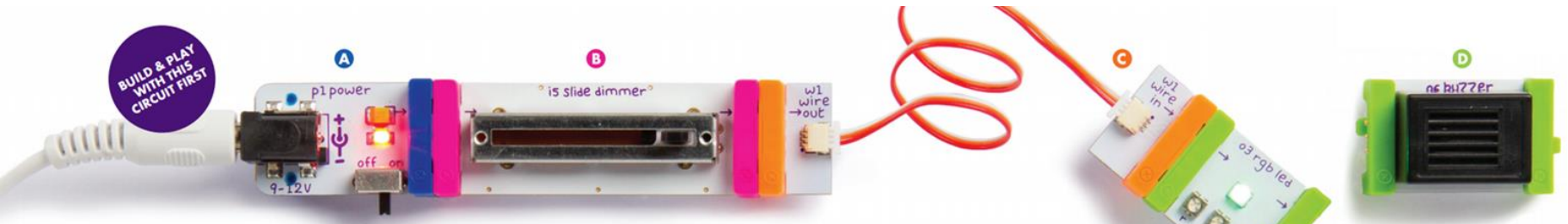


# ER Kit - Sphero LittleBits

- **LittleBits** (acquired by Sphero) is open-minded, open hardware, and works fine with other ER platforms (Arduino, makey makey, Microbit and Scratch).
- By using their rich **library of Bits** (electric/electronic parts), educators can introduce principles of art, design, and technology into their lessons to bring robust STEAM learning to life.



# ER Kit - Sphero LittleBits



**1 ANATOMY OF A BIT™**  
Learn how you can tell top from bottom.

**2 COLOR-CODED BY FUNCTION**  
Bits™ are grouped into four different categories, which are color-coded.

**A POWER (BLUE)**  
Power Bits, plus a power supply, run power through your circuit.

**WIRE (ORANGE)**  
Wire Bits connect to other systems and let you build circuits in new directions.

**I INPUT (PINK)**  
Input Bits accept input from you or the environment and send signals that affect the Bits that follow.

**O OUTPUT (GREEN)**  
Output Bits do something - light up, buzz, move...

Learn more about your Bits in the **BIT INDEX ON PG 06**

**3 MAGNET MAGIC!**  
Bits snap together with magnets. The magnets are always right - you can't snap them together the wrong way.

**ARROWS SHOULD POINT IN THE SAME DIRECTION**

**IF THE BITS WON'T SNAP TOGETHER, TRY SPINNING ONE AROUND AND MAKE SURE THE ARROWS POINT IN THE SAME DIRECTION**

**4 ORDER IS IMPORTANT**  
**POWER BITS** always come first and **INPUT BITS** only affect the **OUTPUT BITS** that come after them.

**WITH NO OUTPUT BIT AFTER IT, THE INPUT BIT HAS NOWHERE TO SEND ITS SIGNAL**

**THE INPUT BIT AFFECTS THE OUTPUT BITS THAT FOLLOW**

**5 SOME BITS ARE ADJUSTABLE**  
Switches, buttons, and dials on the board allow you to change how the Bit functions.

**FLIP THE SWITCH TO CHANGE MODES**

**ADJUST SENSITIVITY WITH PURPLE SCREWDRIVER**



# eROBSON Erasmus+ Project

## Motivation

Laboratory-dependent courses (such as engineering and robotics) suffer the most from COVID19, due to the necessity of f2f collaboration at a close distance with in a lab and students' physical interaction with equipment devices.

## Concept

Use AR is to simulate (a) the necessary ER-equipment / ER kit components, including its appearance, behavior, and user interaction and (b) some of the ER learning processes and methods.

## Activities

Spring 2021 - Spring 2023:

- Research and Development

Summer 2023 - Winter 2023 in Norway, Greece, and Netherlands:

- Evaluation at schools and museum

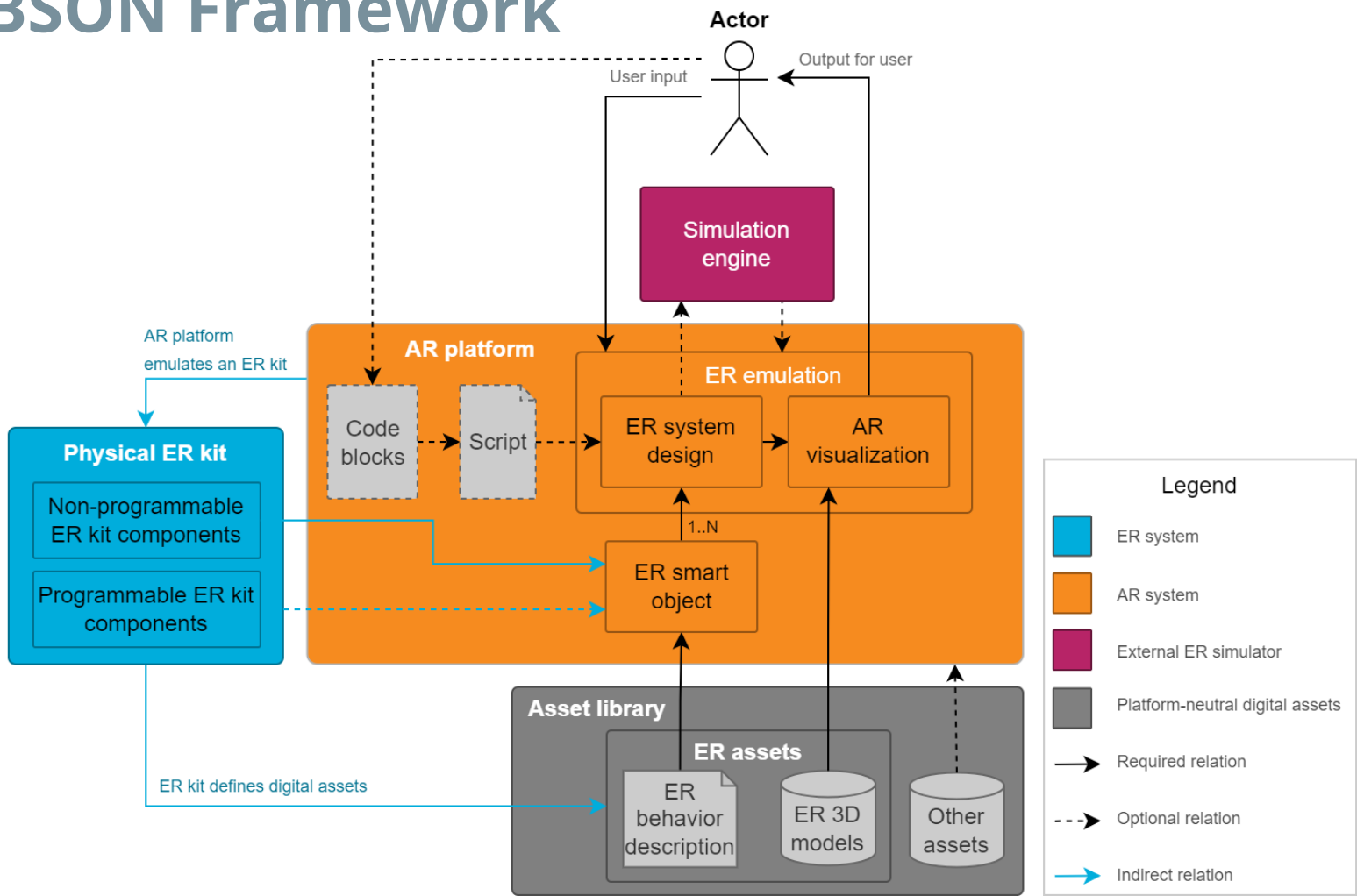
- Teacher training workshops and public events



9 March 2024 - Workshop 1: Augmented Reality in Educational Robotics



# eROBSON Framework





## **Augmented Reality for Teaching Educational Robotics Online: Design Decisions with Group Concept Mapping**

by Olga Firssova, Nardie Fanchamps, Dimitris Karampatzakis, Giel Van Lankveld, & Mikhail Fominykh  
<https://doi.org/10.21125/iceri.2023.2145>



IEEE  
**EDUCON 2024**  
IEEE Global Engineering Education Conference

## **Educational Robotics at Schools Online with Augmented Reality**

By Dimitris Karampatakis, Mikhail Fominykh, Nardie Fanchamps, Olga Firsova, Petros Amanatidis, Giel Van Lankveld, Thomas Lagkas, Avgoustos Tsinakos, & Roland Klemke  
Accepted and to appear in IEEE Xplore

# eROBSON App



Extended from the open-source  
**MirageXR**



# MirageXR



**WEKIT ECS**  
Holographic Training Company

**AR training platform**

**Content authoring:** in-situ, in AR

**Content delivery:** AR app

**Learning Analytics:** Experience API

**Data repository:** LearningLocker

**Content repository:** ARLEM standard for Moodle

**Cross-platform:**

HoloLens 2



**Open source:** MIT License



# eROBSON app



**eROBSON**  
Educational Robotics in  
Augmented Reality

## **New augmentation type: LittleBits**

### **Each bit**

Appearance: 3D model, including moving parts

Behavior: snapping to ports, value control

Manipulation: movement and rotation

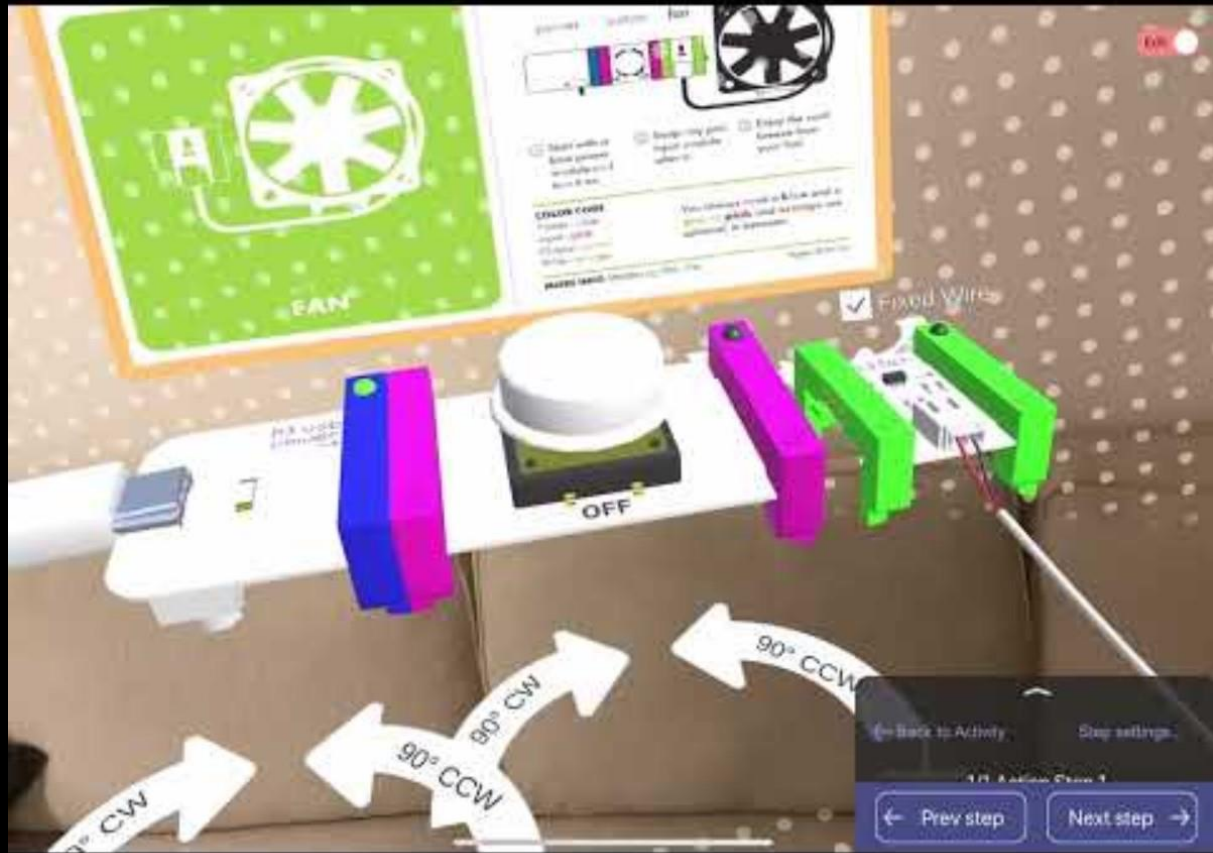
### **Circuits**

Behavior: simulation

### **Assessment**

Checking circuit connections





[Click here to view](#)

The logo for AR Tutor 4 features the text 'ARTutor' in a blue, sans-serif font. The letter 'A' is stylized with a light blue diagonal stripe. Above the 'u' and 't' are several small icons: a film strip, a camera, a 3D cube, a musical note, and a gear. The letter 'o' is replaced by a 3D cube with a dashed outline. Below 'ARTutor' is a large, bold blue number '4'.

**ARTutor**  
**4**

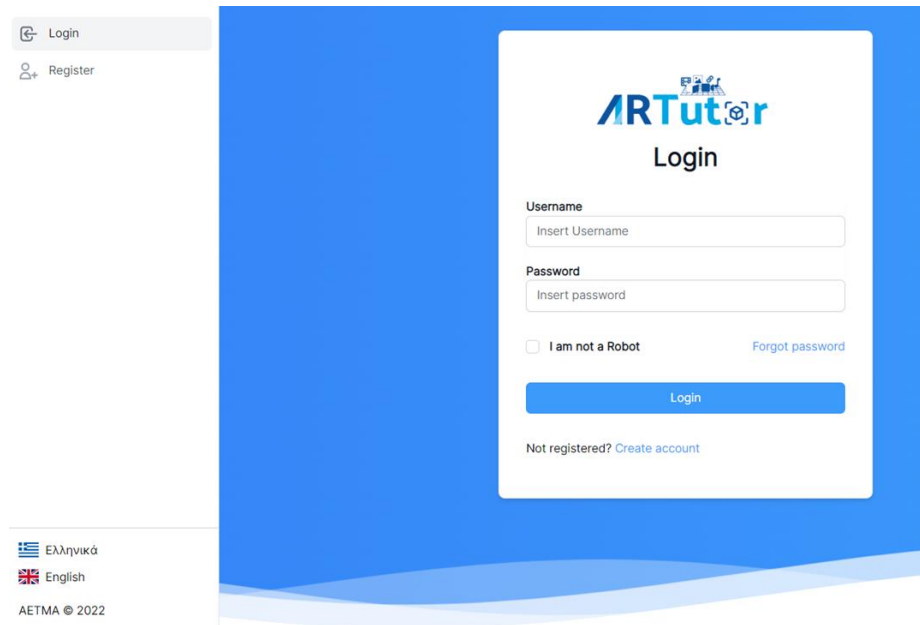
eROBSON AR tools

## 3 steps for the creation and projection of an AR experience

### Step 1

**Register** for **free** at  
<http://artutor.ihu.gr>  
or

**Login** if you have  
already registered



The screenshot shows the ARTutor login interface. On the left, there is a navigation menu with 'Login' (selected) and 'Register'. The main content area has a blue background with a white login form. The form includes the ARTutor logo, the title 'Login', and input fields for 'Username' and 'Password'. Below these fields are a checkbox for 'I am not a Robot' and a link for 'Forgot password'. A blue 'Login' button is positioned below the form. At the bottom of the form, there is a link for 'Not registered? Create account'. The footer of the page contains language selection options for 'Ελληνικά' and 'English', and the copyright notice 'AETMA © 2022'.

## 3 steps for the creation and projection of an AR experience

### Step 2

Create a **Book** by uploading a pdf file and add augmentations by selecting specific parts of the Book

- Create
- My Books
- Public Books
- Account
- Logout

Ελληνικά  
English  
AETMA © 2022

The screenshot shows the 'Greek History' book creation interface. It features a sidebar with navigation options: Create, My Books, Public Books, Account, and Logout. The main content area is titled 'Greek History' and includes tabs for 'Book', 'Augmentations', and 'Permissions'. The 'Book' tab is active, displaying a form with the following fields:

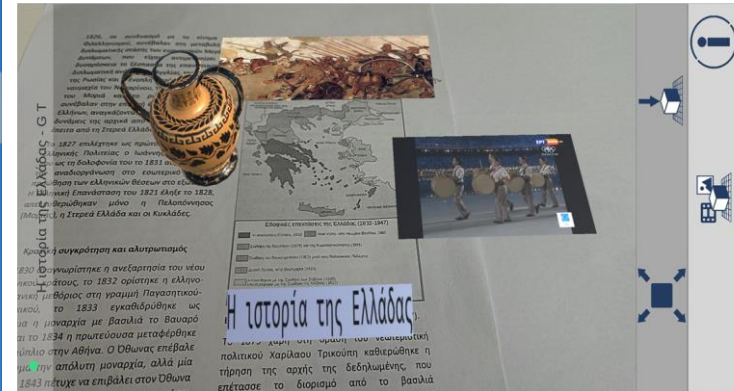
- Title:** Greek History
- Description:** (Empty text area)
- Labels (Up to 20):** Press ENTER to add
- Category:** Books
- Language:** Ελληνικά
- Knowledge field:** History
- Educational level:** Grade School
- Publication options\*:** Private (unchecked), Visible (checked)
- Cover:** Drop file to upload, or browse (with a file upload icon)
- Select Book (PDF):** Drop file to upload, or browse (with a file upload icon)
- QR Code:** A QR code is displayed next to a PDF icon.

At the bottom of the form, there are 'Save' and 'Delete' buttons.

## 3 steps for the creation and projection of an AR experience

### Step 3

View the **AR experience** using the **ARTutor mobile application** and **share it with everyone.**





## ARTutor Educational Platform mobile APP.

**ARTutor** is an Augmented Reality Educational Platform developed by the Advanced Educational Technologies and Mobile Applications (AETMA) Research Lab at the International Hellenic University, since 2016. (more info <https://artutor.ihu.gr/home/>)



Available for all Android devices that support ARCore



Available for all iOS devices that support ARKit



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<https://e-robson.eu/>



# ARTutor in the eROBSON Context

- The training material can be sent **via email** (PDF files) and even used **at home!**
- With **eROBSON**, students can experiment in developing Educational Robotics **in and out of school** through **Augmented Reality (AR)**



Exercise



CIRCUIT #1

Design of a control circuit using a led bar and a push button

Solution



Cards

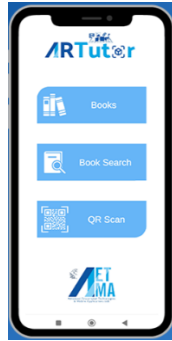


QR



# ARTutor in the eROBSON Context

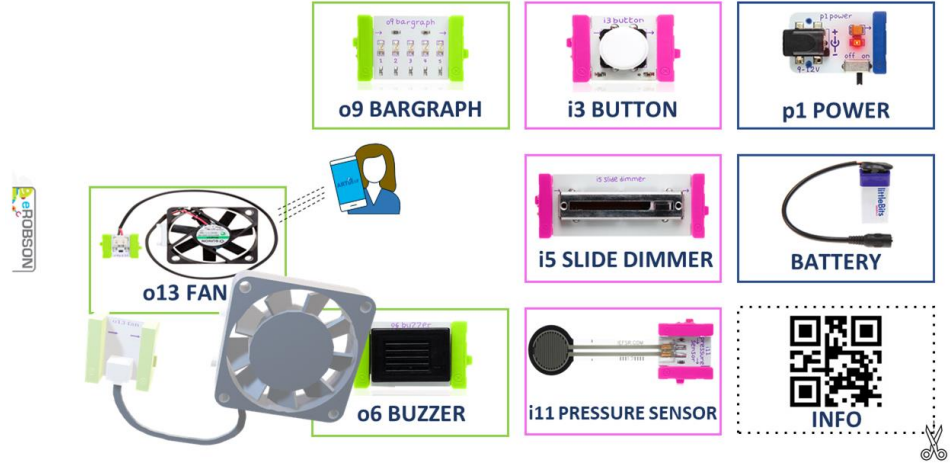
- The students receive email attachments, print them on paper, and then utilize the **ARTutor App**.

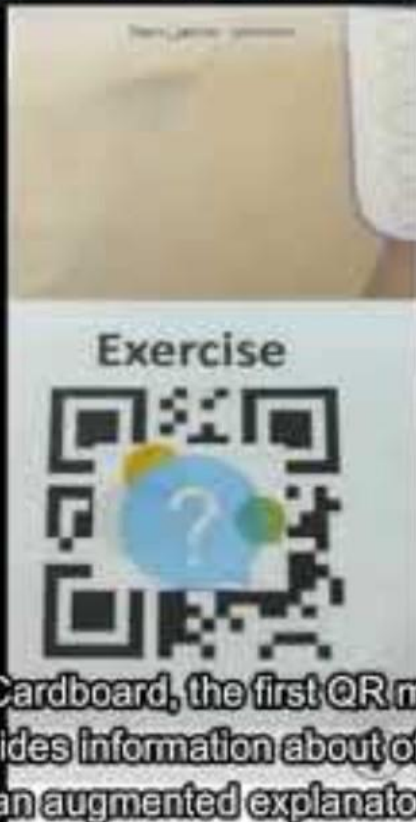


- 2D** printed material is augmented to **3D**



## LIBRARY OF AVAILABLE LITTLEBITS





On the Cardboard, the first QR marker on the left provides information about of the exercise using an augmented explanatory video

[Click here to view](#)

# eROBSON - Hands on Material



little girl Bits

## LESSON 1° littleBits

Getting to know Basic Bits



March 2024

### littleBits

### Lesson 1° littleBits

**Course objective:**  
To get acquainted with basic devices or Bits. You will know some bits (each with its own characteristics) which you will then use to implement simple and complete applications.

- Attention:** We will work with electric/electronic components so we must:
- (1) avoid using them in or near water.
  - (2) do not plug them into electrical outlets in your home.
  - (3) do not touch or hold them while they are operating.
  - (4) keep conductive materials (such as foil, paper clips, staples, staple pins, etc.) out of reach.
  - (5) avoid handling by children younger than three (3) years of age as they contain small parts.
  - (6) close them when you notice that they have become excessively hot (which is normal in most of the time).
  - (7) the devices contain magnets: if ingested, they may stick together inside the body, so seek medical attention immediately.

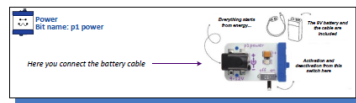
To create an application that implements something specific (e.g. an alarm clock, a beeper, etc.) we need to implement a **circuit**: all circuits, usually, have four (4) basic units:

- **Power** (The color is blue)
- **Input** (The color is pink)
- **Output** (The color is green)
- **Wires** (The color is orange)

We can use **Wires**, they are bits that connect different units between (wired or wireless), to extend our circuit or to redirect its direction (flow of current or data).

Each circuit must, in order to work, receive **energy** in the same way as your mobile phone or your TV works. This energy usually comes from batteries (even a TV or a car can run on batteries) or from an electrical outlet (the appliances in our home get their power from an electrical outlet).

So, the first circuit that all your applications will start with is the following:



Let's think... Why do we always have to start with the blue circuit, i.e. Power (or energy)

### littleBits

### Lesson 1° littleBits

**Wondering...** Could our watch work without a battery (which provides the energy that it needs)? Could we vary the intensity of a light bulb in our office? Could we see the volume of the music on our sound system?

The device we use, because it will affect our output, so it's an **input**, it is **pink**, and it's called a **dimmer** or **slide dimmer**.



**Materials needed**  
Composition of circuits from previous applications:  
One (1) **device (o6 bit) buzzer** (output circuit that produces sound).

**Application 1.1:** Build an alarm clock using littleBits circuits from the above applications (whichever you deem appropriate), a buzzer to create the noise, and a **light sensor**.

The purpose of the application is to place it near the window at night. Set the light sensor to send a **signal**.

Wondering... Could our watch work without a battery (which provides the energy that it needs)? Could we vary the intensity of a light bulb in our office? Could we see the volume of the music on our sound system?

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**Materials needed**  
Composition of circuits from previous applications:  
One (1) **device (i5 bit) slide dimmer** (input circuit that produces sound).

**Application 1.1:** Build an alarm clock using littleBits circuits from the above applications (whichever you deem appropriate), a buzzer to create the noise, and a **light sensor**.

The purpose of the application is to place it near the window at night. Set the light sensor to send a **signal**.



Exercise

### Application 1.1



Solution

22.06.23, 11:32

Document

Application\_1.1  
Author  
peamana

The book is available for downloading in PDF format from the following link:  
<http://artutor.ihu.br/artutor/file/Text/1/29d521f8ddea8488.pdf>



### LIBRARY OF AVAILABLE LITTLEBITS

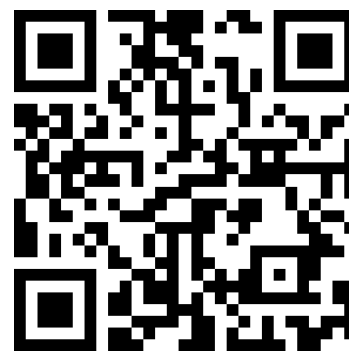
 o9 BARGRAPH	 i3 BUTTON	 p1 POWER
 o13 FAN	 i5 SLIDE DIMMER	 BATTERY
 o6 BUZZER	 i11 PRESSURE SENSOR	 INFO





Download ARTutor mobile APP here...

Download eROBSON  
TeachDay2024 material here...



Available for all Android  
devices that support ARCore

Available for all iOS  
devices that support ARKit

<https://tinyurl.com/eROBSONTD2024>



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# Workshop 1: Augmented Reality in Educational Robotics

## Thank you for your participation!!!

**Mikhail Fominykh** [mikhail.fominykh@ntnu.no](mailto:mikhail.fominykh@ntnu.no)

**Dimitris Karampatzakis** [dkara@cs.ihu.gr](mailto:dkara@cs.ihu.gr)

**Olga Firssova** [olga.firssova@ou.nl](mailto:olga.firssova@ou.nl)

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