# USER GUIDE

## *Setting up an eCraft2Learn learning environment*

*hardware, software, tools and materials*

eCraft2Learn

# TABLE OF CONTENTS

# Overview

**eCraft2Learn** is an EU funded project centred around researching, designing, piloting and validating an ecosystem based on digital fabrication and making technologies for creating computer-supported artefacts.

**You can learn more about the eCraft2Learn Project in Teacher Guide 1 Introducing eCraft2Learn which can be downloaded at: https://project.ecraft2learn.eu/introducing-ecraft2learn/**

This guide has been created to assist you in the process of setting up an eCraft2Learn workspace in your school or organisation. The guide will take you through the following:

- Organising a workspace
- Equipping the workspace
- Setting up the group workstations
- Setting up the 3D printing workstation

Throughout the guide, you will be signposted to various other more detailed documentation from the eCraft2Learn academic research and project pilots. These documents provide a more detailed insight into how the eCraft2Learn ecosystem was developed and trialled along with the approach and outcomes from the project pilots. Follow the links in the guide to learn more.

# Organising a workspace

## SELECTING A WORKSPACE

First of all you need to identify a suitable workspace for running eCraft2Learn projects. This can be an existing classroom or a dedicated space. The room will need to accommodate the number of students taking part in the project at any one time.

The room will need to have enough workspace to accommodate all of the hardware with enough electric power points in suitable locations around the room.

The room should also have suitable storage to accommodate the electronics and craft resources, materials and tools as well as a safe space to store and/or display the students project work.

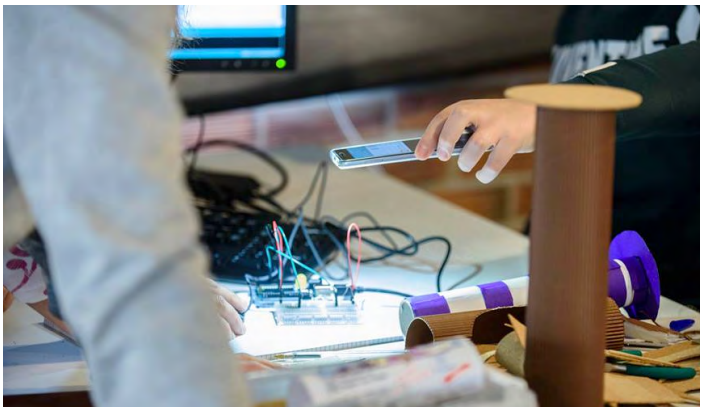
## ORGANISING THE WORKSPACE

The workspace should be organised to provide a workstation for each group of students. This would need to consist of a table or group of tables that are large enough to accommodate all the technical hardware as well as providing enough space for students to organise craft and electronics materials and resources and use the tools.

Where possible each group of students working on a project should be able to sit together, ideally they should be able to sit around a table rather than in rows as this will encourage collaborative working.

Each workspace will require its own power supply, therefore care needs to be taken in positioning the workstations to avoid or minimise running power extension cables across the room.

We would also recommend that each workstation also has a wastepaper bin as this will help to keep the workspaces tidy and minimise the movement of students around the room.



# Equipping the workspace

Before setting up, you will need to source and purchase or gather together a range of different hardware, tools, components and materials. These will be both for setting up the technical environment and to provide resources for students to use when undertaking their project work. This section of the guide provides a series of recommendations which aim to provide you checklists to help you in this task.

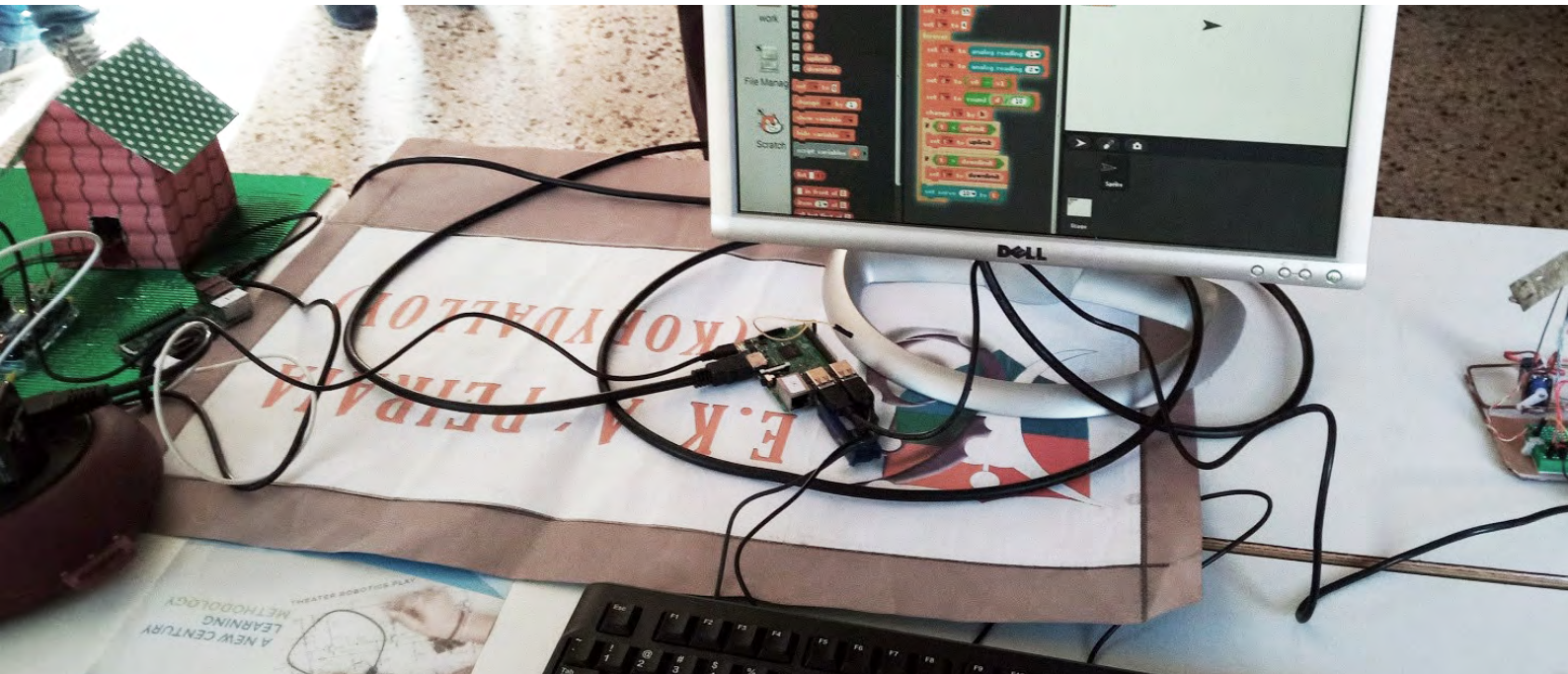
**Please note:** These are recommended lists for an ideal eCraft2Learn workspace. However the setup is flexible and can be changed to suit your existing equipment and any budget constraints. For example is you already have a suite of computers or laptops, these can be used as student workstations instead of the Raspberry Pi's. If your budget cannot stretch to accomodate a 3D printer, you can run projects without one, although students would be limited to craft based outcomes.

## HARDWARE

| ✓ | ITEM | QTY | NOTES |
|---|---|---|---|
| | Raspberry Pi 3 **or** desktop/laptop Computer | 1 per group | |
| | Monitor | 1 per group | Only required if using RPi's |
| | Keyboard | 1 per group | Only required if using RPi's |
| | Mouse | 1 per group | Only required if using RPi's |
| | 3D Printer | 1 | Ultimaker 2+ or Ultimaker 3 are recommended solutions |
| | Desktop/laptop computer | 1 | For the 3D printing workstation if using RPi's for the student workstations |
| | MicroSD 16GB Class 10 SD Adapter SDC10/8GB | 1 per group | |
| | USB powered speakers | 1 per group | |
| | USB powered microphone | 1 per group | |
| | HDMI cable | 1 per group | |
| | Ethernet cable | 1 per group | |

## TOOLS AND EQUIPMENT

| ✓ | ITEM | QTY | NOTES |
|---|---|---|---|
| | Soldering iron & stand | 1 per group | |
| | Solder | 3-4 rolls available in lab | |
| | Pliers | 3-4 available in the lab | |
| | Wire Cutters & Strippers | 3-4 available in the lab | |
| | Stapler | 3-4 available in the lab | |
| | Sellotape and masking tape | Several rolls | |
| | Scissors | 1 per group | |
| | Glue | 1 per group | Paper glue and PVA |
| | Marker pens | Several per group | |
| | Silicon pistols | 3-4 available in the lab | |
| | Kit for measurements (i.e. rulers) | 1 per group | |
| | 3D pen | 3-4 available in the lab | Optional |
| | Tenon and coping saws | 3-4 available in the lab | Only required if supplying wood as a craft material |
| | Bench vice and bench hook | 1-2 available in lab | Only required if supplying wood as a craft material |



## ELECTRONIC COMPONENTS

| ✓ | ITEM | QTY | NOTES |
|---|---|---|---|
| | Arduino Uno | 1 per group | |
| | USB cable (A-B type) | At least 2 per group | |
| | Jumper wires (M-M and F-M) | Several | Usually they are in packs of ten or more. You will need both M-M and F-M |
| | Alligator clips | Several | |
| | Resistors (1K and 10K) | Several | |
| | LED's | Several | Provide a selection of colours |
| | Servo motors and angle servo motors | At least 4 per group | |
| | DC Gear Motor | At least 4 per group | |
| | Breadboards | At least 2 per group | |
| | Button modules | 1 per group | |
| | Motor driver L293D | 2 per group | |
| | Simple potensiometer 10K | 1 per group | |
| | Light sensors (Photoresistor LDR 5mm) | At least 2 per group | |
| | Touch sensors | 1 per group | |
| | Ultrasonic/analog distance sensors | At least 2 per group | |
| | Temperature sensors (Thermistor) | 1 per group | |

## CRAFT MATERIALS AND RESOURCES

| ✓ | ITEM | QTY | NOTES |
|---|---|---|---|
| | Recycled packaging | Large selection | Eg. cardboard boxes and tubes, plastic containers and bottles, plastic cups |
| | Cardboard | Several sheets | Variety of weights and sizes |
| | Paper | Several sheets per group | |
| | Tissue paper | Few sheets | |
| | Felt | Few pieces | |
| | Fabric | Several pieces | For most projects scraps would suffice |
| | Wool | 1 roll | |
| | String | 1 roll | |
| | Metal wire | 1 roll | |
| | Foil | 1 roll | |
| | Wooden sticks & dowel | Several | |
| | Wood | Several pieces | Selection of sizes and offcuts such as square section lengths, thin plywood or mdf sheet. |
| | Glasspaper (different grades) | A few sheets | Only required if supplying wood as a craft material |
| | Straws | 1 box | |
| | Buttons | Several | |
| | Copper wires | 2 rolls | Red and black roll for wiring |
| | Filament for 3D printer | Selection of colours | If a 3D printer is available |
| | Filament for 3D pens | Selection of colours | If 3D pens are available |

## ALTERNATIVE WORKSPACE EQUIPMENT CONFIGURATIONS

The equipment lists above provide an overview of suggested equipment for an ideal eCraft2Learn workspace, however the eCraft2Learn workspace can be configured in different ways to meet the equipment and resources that are available to the school. The following table includes a list of alternative eCraft2Learn workspace scenarios.

<table>
<tr><th></th><th>PC ONLY</th><th>PC + ARDUINO</th><th>RPI3 + MONITOR + KEYBOARD</th><th>PC + ARDUINO + RPI</th><th>PC + ARDUINO + RPI+ 3D PRINTER</th><th>MOBILE DEVICE + ?</th></tr>
<tr><td colspan="7">Overall</td></tr>
<tr><td>What parts can be used in each phase based on the technical setup?</td><td colspan="5">Running UUI</td><td>Running UUI (Simplified Version)</td></tr>
<tr><td></td><td colspan="6">Educational Resources</td></tr>
<tr><td></td><td colspan="6">eCraft Project Management</td></tr>
<tr><td></td><td colspan="6">eCraft Actions</td></tr>
<tr><td></td><td colspan="6">eCraft Achievements</td></tr>
<tr><td colspan="7">Imagine</td></tr>
<tr><td></td><td colspan="6">Running eCraft Search</td></tr>
<tr><td></td><td colspan="5">Running Inspiratorium</td><td>-</td></tr>
<tr><td colspan="7">Plan</td></tr>
<tr><td></td><td colspan="6">eCraft Plan</td></tr>
<tr><td></td><td colspan="6">eCraft ToDo</td></tr>
<tr><td></td><td colspan="5">Trello</td><td>-</td></tr>
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| | PC ONLY | PC + ARDUINO | RPI3 + MONITOR + KEYBOARD | PC + ARDUINO + RPI | PC + ARDUINO + RPI+ 3D PRINTER | MOBILE DEVICE + ? |
|---|---|---|---|---|---|---|
| **Create** | | | | | | |
| | 3D Design | | | | | - |
| | Circuit Design | | | | | - |
| | Beetle Blocks | | | | | - |
| | 3D Slicing | | | | 3D Slicing + 3D Printing | - |
| | Cura | | Cura via VNC | Cura | Cura + 3D Printing | - |
| | 3D Slash | | | | | - |
| **Program** | | | | | | |
| | Snap! | | | | | - |
| | - | Snap4Arduino | - | Snap4Arduino | | - |
| | - | Craftbot for Arduino | - | Craftbot for Arduino | | - |
| | - | Ardublock | - | Ardublock | | -- |
| | - | - | Scratch for RPi | | | - |
| | - | Scratch for Arduino | - | Scratch for Arduino | | - |
| | - | Arduino IDE | - | Arduino IDE | | - |
| | App Inventor | | | | | - |
| | Netblox | | | | | - |
| | Pocket Code | | | | | - |
| **Share** | | | | | | |
| | Thingiverse | | | | | - |
| | eCraft Sharing Tool | | | | | |

# Setting up the group workstations

Each group workstation will need to be set up, this requires you to first connecting the technical core, then access the digital platform, then finally to connect the Arduino to enable DIY electronics.

## CONNECT THE TECHNICAL CORE

The technical core can be a RPi3 or a desktop/laptop computer. If you are using the a desktop or laptop computer, you will have nothing to set up, you just require an internet connection and the URL for the UUI.

If you are using Raspberry Pis to run the technical core, these need connecting up and configuring first. For each workstation you will need the following:

- Raspberry Pi 3 (RPi3)
- USB Keyboard
- USB Mouse
- Monitor
- HDMI Cable

Connect the RPi3 to the peripherals by plugging the USB keyboard and mouse directly into the USB ports on the RPi3, then connecting the monitor to the RPi3 using the HDMI cable.

The Raspberri Pi will also need connecting to the internet so that it can access the UUI. You can access detailed instructions for doing this at: https://www.raspberrypi.org/documentation/configuration/wireless/

## ACCESS THE DIGITAL PLATFORM (THE UUI)

When the technical core is set up, the next stage is to access the UUI. Open a browser window and use the following link to access the UUI:

https://ecraft2learn.github.io/uui/

At this stage it is also recommended that Tinkercad is launched via the browser and you login to Tinkercad (create an account first if you have not done so). You can access TInkercad to login at www.tinkercad.com

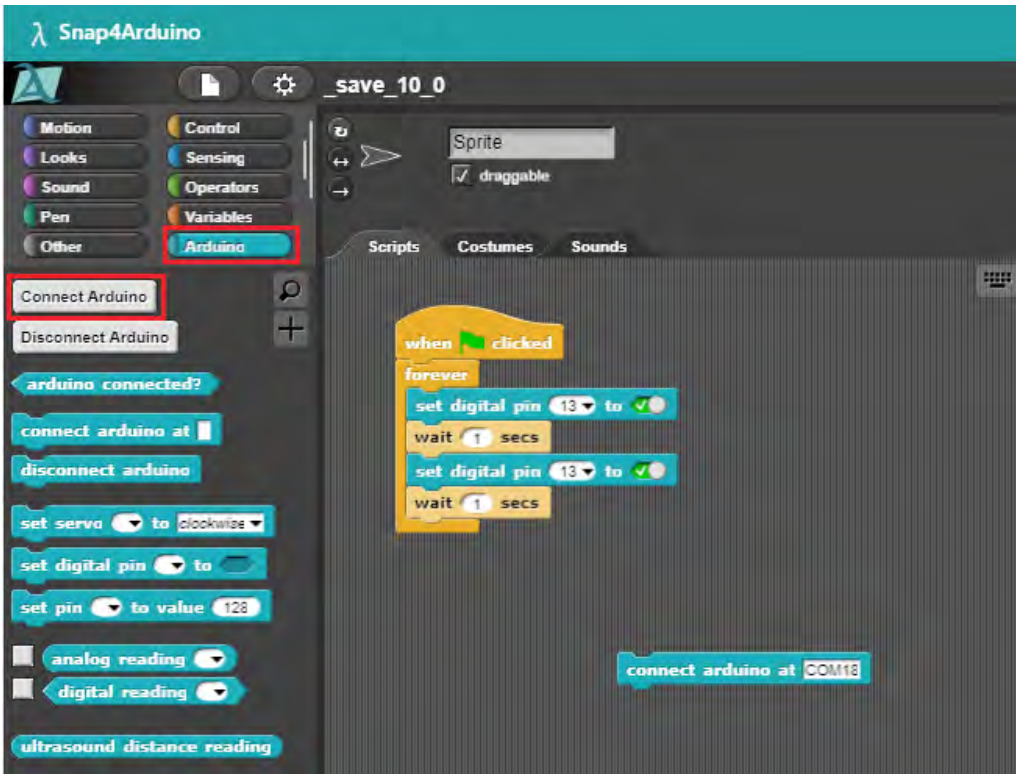
After login in to Tinkercad, the application can then be launched and used from within the UUI. We advise you to create one common account that you can share with your students group for working with their 3D designs and 3D circuits simulations.

**Note**
It is important to use the digital tools by launching them through the UUI; this is useful for learning analytics data collection purposes.

## CONNECT THE ARDUINO

Finally connect the Arduino Uno board to either the RPi3 or the desktop/laptop computer using a USB lead.

Then launch the UUI and open the Snap4Arduino application. Click on the Arduino blocks menu on the coding area on the left, then press the ‘Connect Arduino’ button from the Arduino blocks palette. Use this to check whether it is possible to communicate with the Arduino board. Once the board is connected to Snap4Arduino, programs can be executed in the board.




### TROUBLESHOOTING

If during the setting of the connection between RPi and the Arduino board problems happen then the following is advised:

- If Snap4Arduino programming environment launches but cannot connect to the Arduino board, then the browser needs to be changed to Chrome or a Chrome extension needs to be installed. Instructions on how to do this are given through the UUI Educational Resources - Troubleshooting - eCraft2Learn Components.
- If the browser is the recommended one and the proper extension is installed but still there are connection problems then the connection needs to be reset by disconnecting and reconnecting the USB cables.
- It is always advisable to disconnect the Arduino board after finishing using Snap4Arduino.

## OTHER TOOLS MATERIALS AND RESOURCES

Whilst participating in eCraft2Learn project work the groups of students will need to access a range of other tools, materials and components including DIY electronics tools and components, craft tools materials and resources (please refer to the equipment lists earlier in this document). There different ways to organise this.

You could set up each workstation with a kit providing them with everything they need to hand except for perhaps the craft materials as it will depend on their projects which materials they require. The advantage of this approach is that there will be less movement around the room to collect equipment and students will be in a position to start immediately and be able to work at a faster pace, packing up at the end of a session would also be quicker. However this approach would require some storage at each workstation and large enough workstations to accommodate the kits without cluttering the table tops excessively.

An alternative approach is to have all supplementary tools, materials and components stored around the room. This has the advantage that the workstations can be kept clearer as students will only gather the items they require when they need them however there will be much more movement around the room, potentially affecting the pace of project work and more time will be required to pack away at the end of each session.

# Setting up the 3D Printing Workstation

The 3D printing workstation will be a shared space for all groups to use. For this a 3D printer and a desktop or laptop computer are required. If you are using desktop or laptop computers for the student workstations instead of Raspberry Pi's. You will not require a seperate computer for the 3D printing workstation, instead you can set up each of the workstation computers up for 3D printing.

Please note, Ultimaker 2+ and Ultimaker 3 are the recommended 3D printers for eCraft2Learn. All of the 3D printing open education resources, information, instructions and support are based around these specific 3D printer models. However if you have a different 3D printer, this can be used but you will need to refer to the manufacturer documentation for further information, help and support.

## SETTING UP THE 3D PRINTER

The 3D printer needs to be unpackaged and placed on a sturdy, flat, level surface where it will not be disturbed whilst in operation. Usually this is on a desk or furniture unit at the side of the room. Ideally it should also be positioned away from doors and open windows as drafts can affect the quality of the prints.

Before using the 3D printer, it will need to be calibrated to ensure that the build plate is level and in the correct position. Then filament will need to be inserted. Please follow the detailed step-by-step instructions that are on the quickstart guide which is in the printer packaging. When the printer has been set-up you are ready to run a test print.

If you experience any problems with setting up the printer or running the test print, refer to the Troubleshooting Guide. This is available in the UUI at:

https://ecraft2learn.github.io/uui

Education Resources>Troubleshooting>3D Printing>Other 3D Printing Problems

Setting up the desktop/laptop computer(s)

In order to 3D print, you need to download and install the "Cura" slicing software. You can download it at:

https://ultimaker.com/en/products/ultimaker-cura-software

If you are using an Ultimaker 3, to allow it to print wirelessly over the network directly via Cura, you will need to install Wi-Fi and update the firmware on the printer. Full instruction for how to do this are available at:

https://ultimaker.com/en/resources/23115-installing-wi-fi-and-firmware

At the beginning of each session, you will need to login to Tinkercad in a browser. You can access TInkercad to login at www.tinkercad.com

After login in to Tinkercad, open the UUI and launch Tinkercad from here. The 3D printing workstation is now set up and ready for designing, slicing and 3D printing models.



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