



## USER GUIDE

*Designing and running an eCraft2Learn Project*







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## Overview

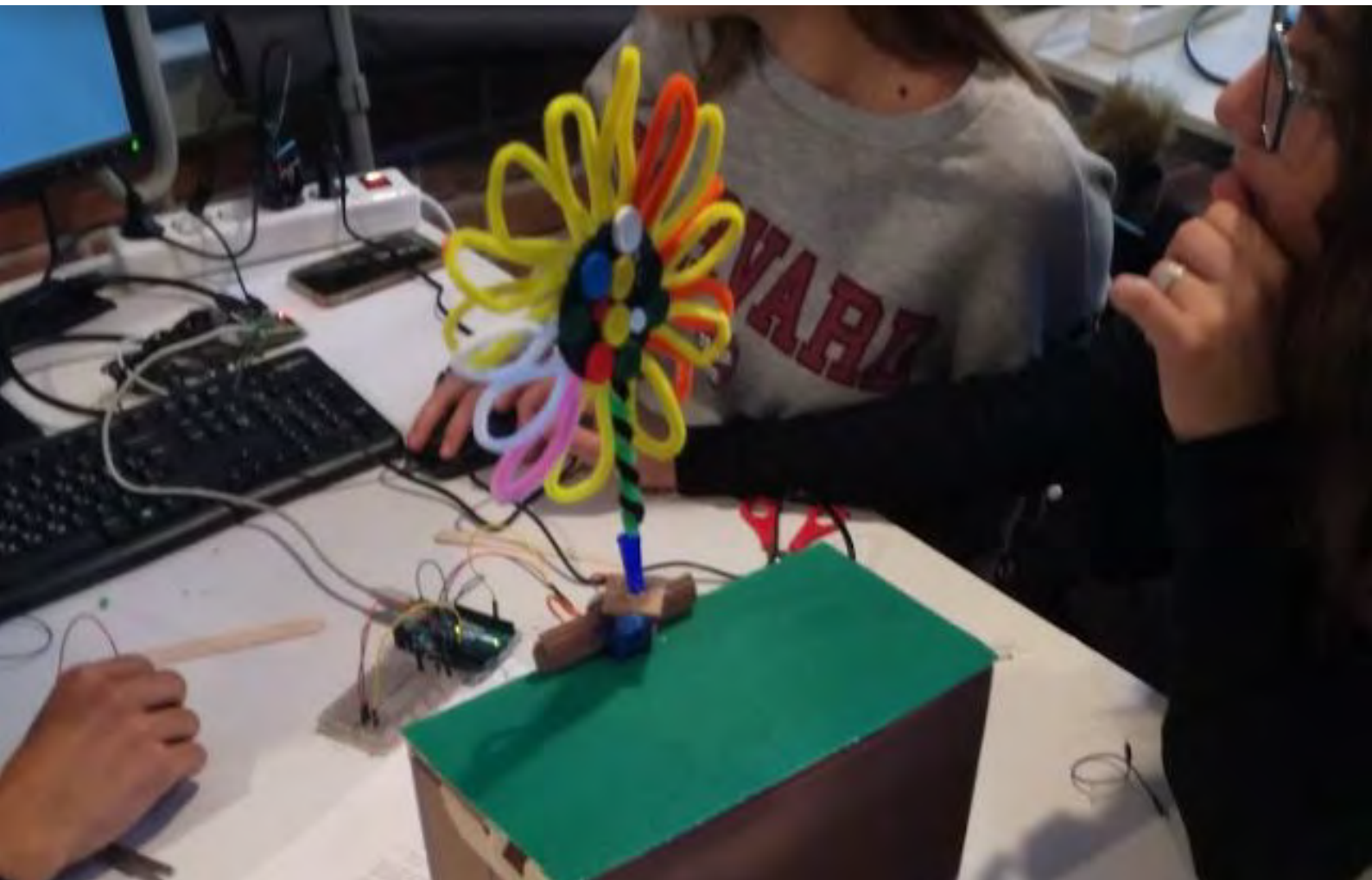
eCraft2Learn is an EU funded project centred around researching, designing, piloting and validating an ecosystem based on digital fabrication and making technologies for creating computer-supported artefacts.

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 designing and running an eCraft2Learn project with a group of students. The guide will take you through the following:

- The eCraft2Learn pedagogical model
- Selecting a project or topic
- Planning a project
- Running a project
- The five stage pedagogy best practices

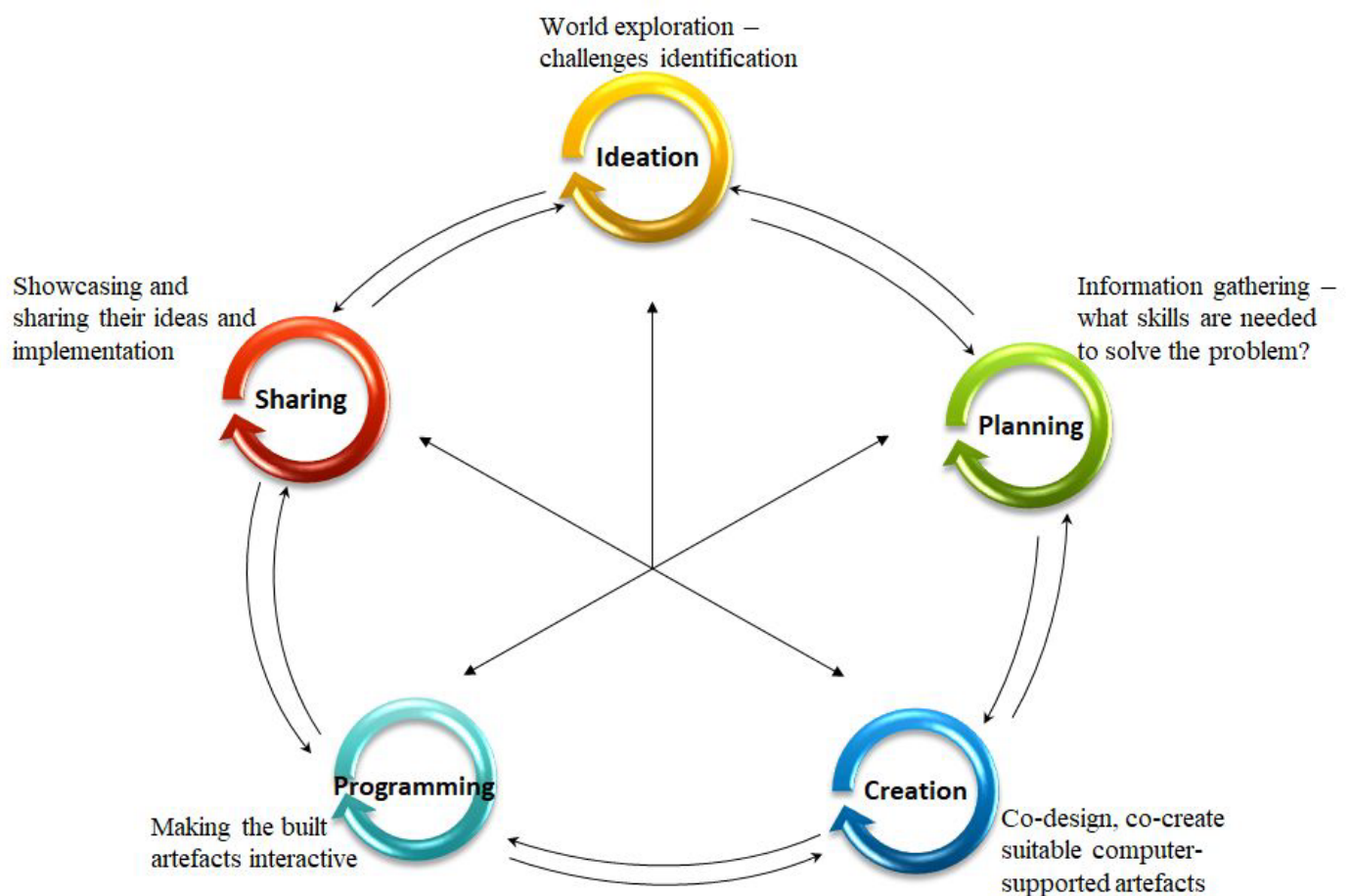
Throughout the guide, you will be signposted to various other more detailed documentation from the eCraft2Learn academic research and project pilots. These documents provide a more detailed insight into how the eCraft2Learn ecosystem was developed and trialled along with the approach and outcomes from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



# The eCraft2Learn pedagogical model

It is important to understand the eCraft pedagogical model before embarking on an eCraft2Learn project. The key elements are:

- Project and inquiry based learning approach
- Students working collaboratively in project teams
- Role of the teacher as a coach
- The five stage eCraft2Learn project framework



A good overview of the pedagogical model is provided in Teacher Guide 1 Introducing eCraft2Learn which can be downloaded at: <https://project.ecraft2learn.eu/introducing-ecraft2learn/>

You can learn more about the pedagogical model and the research behind it in Project Report D3.4 Section 2 at: [https://project.ecraft2learn.eu/wp-content/uploads/2018/05/eCraft2Learn\\_D3.4\\_M16\\_Manual-of-Craft-and-Project-based-Learning-STEAM-Training-for-Teachers.pdf](https://project.ecraft2learn.eu/wp-content/uploads/2018/05/eCraft2Learn_D3.4_M16_Manual-of-Craft-and-Project-based-Learning-STEAM-Training-for-Teachers.pdf)

## SELECTING A PROJECT OR TOPIC

Running an eCraft2Learn project is likely to be very different to running your usual curriculum projects and activities. Primarily because the projects will be more free flowing and not as structured as what you will be used to.

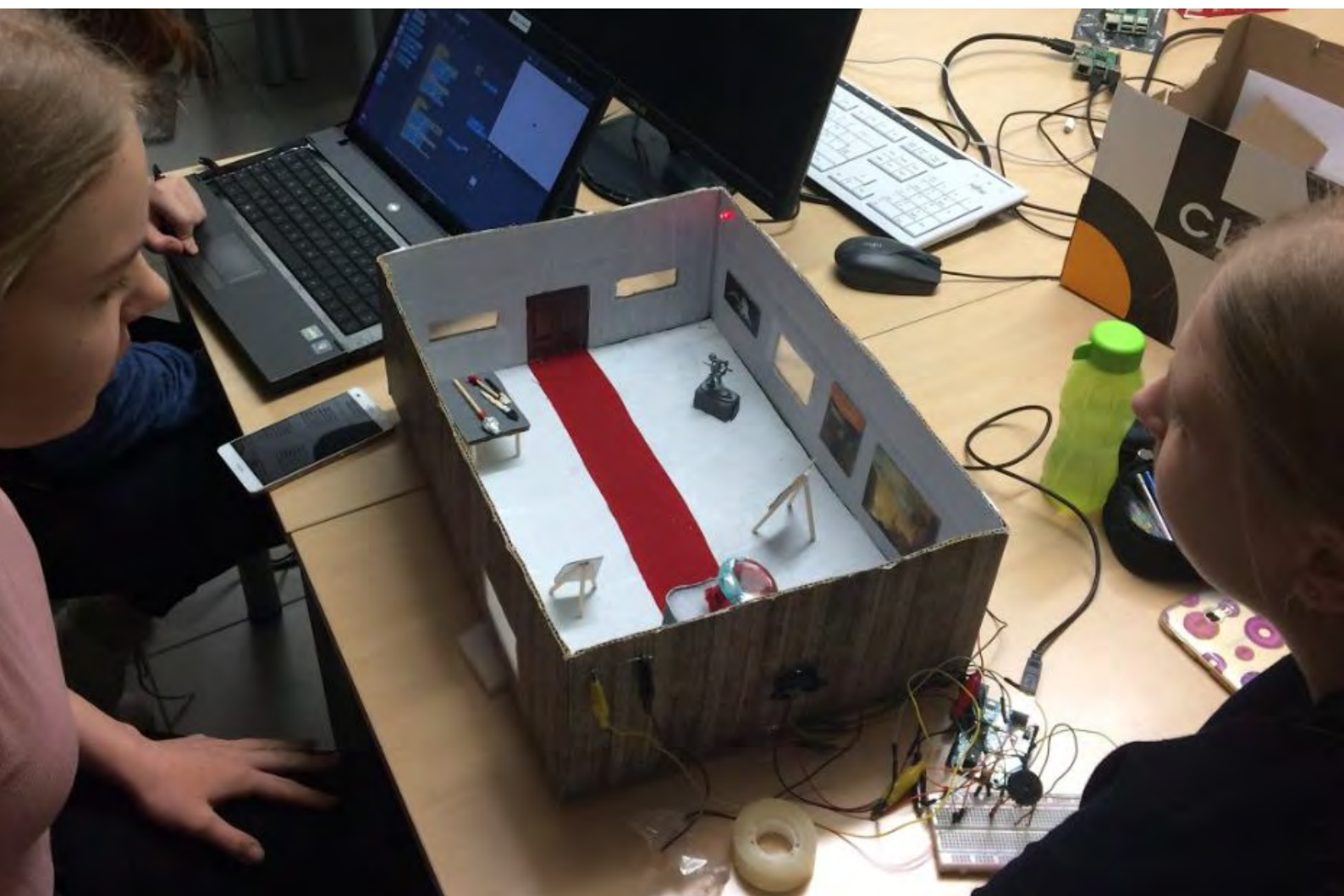
When planning your first eCraft2Learn project it may be beneficial to either select one of the eCraft2Learn exemplar projects as these have been successfully trialled with teachers and students during the eCraft2Learn project pilots.

Alternatively if planning your own project, you may wish to plan it around an existing project or curriculum topic you are already familiar with, as this will allow you to focus on adapting to the role of a coach rather than focusing on the subject matter which you will already be familiar with.

When you first start using the eCraft2Learn it is likely that initially you will want to define projects or topics for the students to work on. The benefits of defining a project or topic is that student groups will all be working towards similar outcomes, this will provide more structure to eCraft2Learn sessions whilst yourself and the students learn how the eCraft2Learn ecosystem, tools and pedagogy works.

After running your first project(s) you may wish to develop new project briefs for students, you can get ideas for projects from other educators in the eCraft2Learn Community Group or by using the Inspiratorium tool that is available in the UUI.


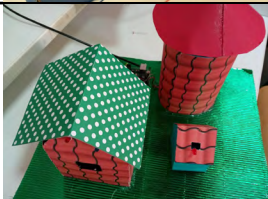




Ultimately you should be aiming to reach the stage where students are confident and independent enough to develop their own project briefs and working on artifacts to solve problems that they define.

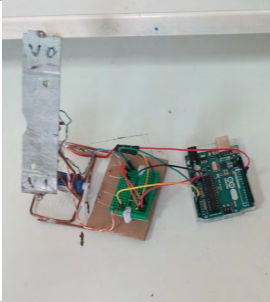

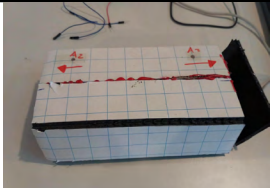
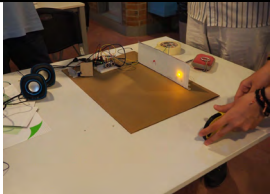
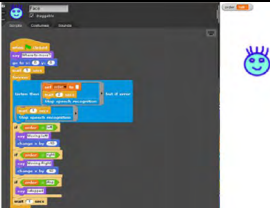
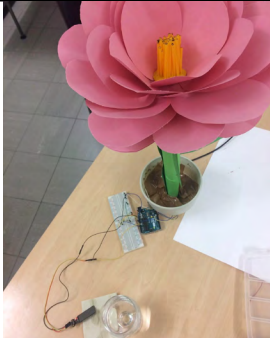

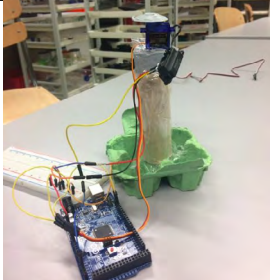








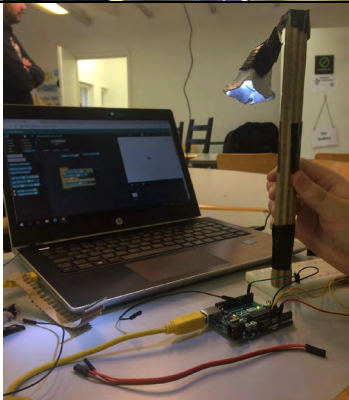
## ECRAFT2LEARN EXEMPLAR PROJECTS

During the eCraft2Learn research and pilot phase, a series of 19 exemplar projects were developed and piloted with teachers and students in formal and informal education settings in Finland and Greece. These provide a good starting point if you are looking for initial projects to try out with groups of students. The projects are interdisciplinary in nature bringing together a combination of different disciplines from the field of Science, Technology, Engineering, Arts and Math (STEAM).

Project Title	Example Outcome	Brief Project Description
No1: The lighthouse project		The lighthouse that blinks in dark
No2: The small village project		Few buildings together constitute a small village with lights that blink during the night and at various rates
No3: The shy rabbit project		The animal that reacts to loud sounds
No4: The sunflower project		The phenomenon of phototropism and the case of the sunflowers
No5: Christmas artefacts		Several computer-supported artefacts that reflect the Christmas mood
No6: DIY automobiles		Several types of DIY automobiles with simple and more advanced functionalities

Project Title	Example Outcome	Brief Project Description
No7: The solar panel project		An artefact that simulates the movement of solar panels and can be used to initiate discussion about solar energy
No8: The 3D bridge project		A bridge structure with 3D printed parts
No9: Video game joypad		A joypad for controlling a video game made in Scratch
No10: The 3-level security control system		A security system for a museum with three control zones
No11: The voice driven face		A face that follows voice commands. A project that is based on AI (Artificial Intelligence) programming
No12: Photosynthesis project		A representation of photosynthesis (especially the reactants, light, water and CO <sub>2</sub> , in the photosynthesis process)
No13: Security in society project		A security system where the designed precious item is protected from being stolen with the created security system around the item
No14: Robot Head project		A robot that moves its head when someone is approaching it or when it notices too much light



Project Title	Example Outcome	Brief Project Description
No15: The Cold War project		Projects created around the topic of Cold War. Student chose a specific event of the Cold War and built a project about Korean War or Cuban Missile crisis, for instance
No16: Solar system project		Different projects developed around the Solar system topic in which craft materials, electronic components and AI programming were combined
No17: Geographical phenomenon project		A project to represent a geographical phenomenon. Projects included interactive maps where flat maps were enriched with geographical information through AI programming
No18: Interactive art project		An artwork enhanced with technology. In this project arts and visual expression worked as a starting point and the work was initiated through arts
No19: Smart home project		A project about a smart home application with remote control or security systems for instance

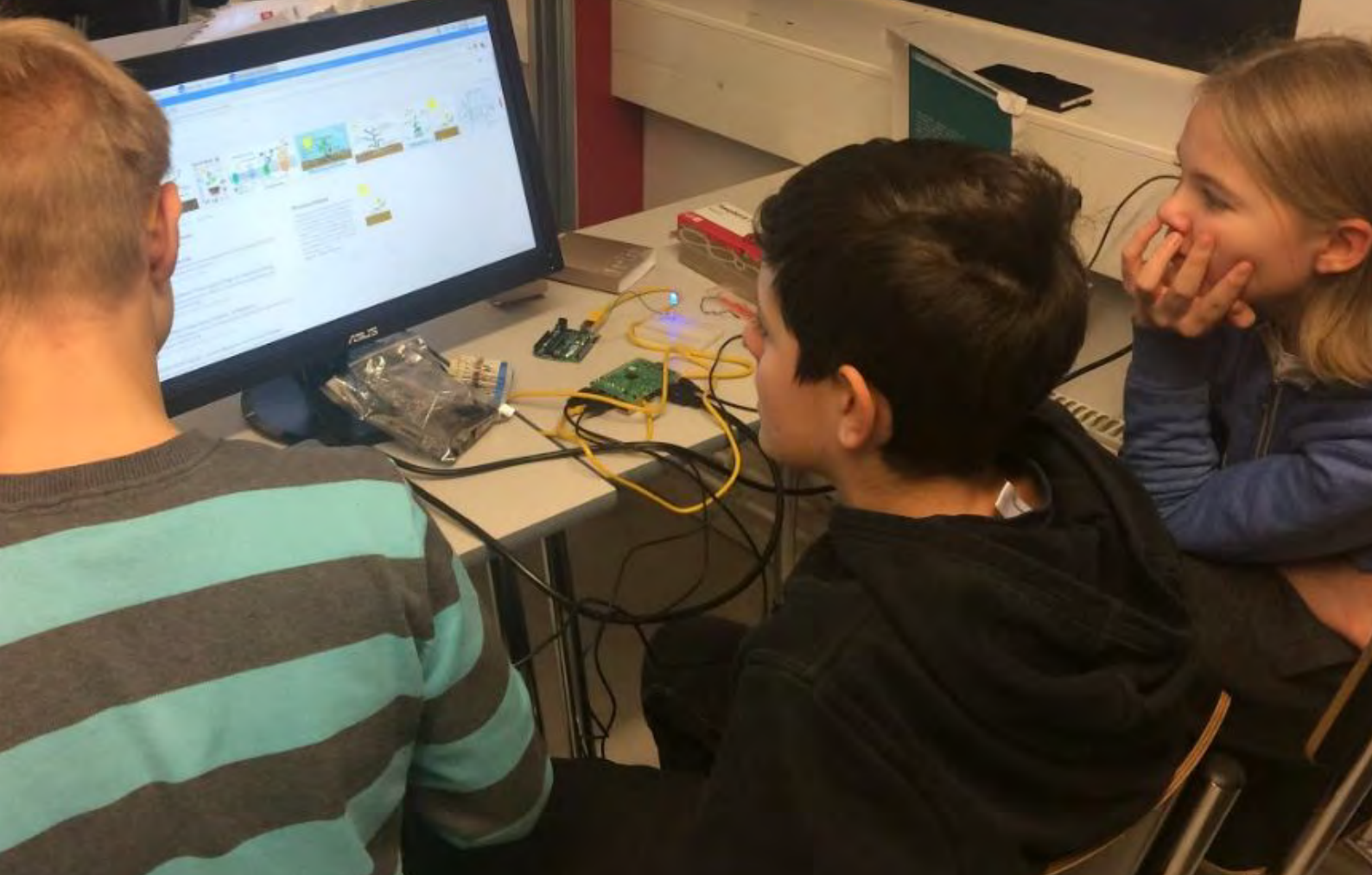
Project report D5.5 Section 4 documents each of the 19 exemplar projects in detail. In the report, the context and scenario of each project is described along with the following details:

- Time allocated for the project
- List of hardware and materials used in the project
- Technical details and software used
- Photographs of student outcomes
- Links to best practice videos that showcase the artifacts created (where available)

You can learn more about each of the exemplar projects in Project Report D5.5 Section 4 at: <https://project.ecraft2learn.eu/wp-content/uploads/2019/01/D5.5-Small-scale-case-pilot-report-and-good-practice-videos.pdf>

The Exemplar Projects videos can also be viewed at: <https://www.youtube.com/watch?v=QZHyYlv87no&list=PLgKtrHOACe-J6bvq-ka5ue4ERs142f4De>





## ADAPTING AN EXISTING CURRICULUM TOPIC

In order to integrate eCraft2Learn into your existing curriculum, you could adapt an existing curriculum topic and turn it into an eCraft2Learn project.

### Brainstorm and Imagine

Brainstorm possible topics, areas and ideas either alone as the teacher or as a group with your students. The topic can be taken from your subject curriculum or it can be an integration of several subject areas. Make as big list as possible, no need to restrict your imagination!

### Specify

Scan through the individual ideas and see if you can bring some ideas together. What could be the topic, concept or issue students are addressing? What is meaningful for them? What do they need to learn based on the curriculum? Remember to keep the topic broad enough without narrowing it down too much. You can pose an inquiry-based question to students that requires students to ponder and answer with more than one word or a sentence. The question can have multiple solutions and this can inspire students.

You can learn more about each of the exemplar projects in Project Report D3.4 Section 4 at: [https://project.ecraft2learn.eu/wp-content/uploads/2018/05/eCraft2Learn\\_D3.4\\_M16\\_Manual-of-Craft-and-Project-based-Learning-STEAM-Training-for-Teachers.pdf](https://project.ecraft2learn.eu/wp-content/uploads/2018/05/eCraft2Learn_D3.4_M16_Manual-of-Craft-and-Project-based-Learning-STEAM-Training-for-Teachers.pdf)

## USING THE INSPIRATORIUM FOR PROJECT IDEATION

A good way to get ideas for projects is to search projects that others have done. Instructables.com is an online platform that provides instructions to thousands of different projects.

The Inspiratorium tool in the eCraft2Learn UUI provides a visual search interface to browse the projects published on instructables.com. While the native instructables.com search is text-based and filters the project titles and descriptions, the Inspiratorium search displays the 100 most popular keywords as colourful bubbles. As a user clicks on bubbles, the search results narrow down to only those projects that are assigned all selected keywords. The search results are presented as a project list, ordered by popularity.



Selected keywords are coloured orange (music and jewellery in the example shown), possible additional keywords are coloured yellow, and keywords that were not assigned to any of the projects that match the previous selection are coloured grey (Figure 9). This immediate visual response has a playful element and stimulates users' creativity by showing unexpected combinations (e.g. "music, jewellery, furniture") and speeds up the exploration of Instructables projects.

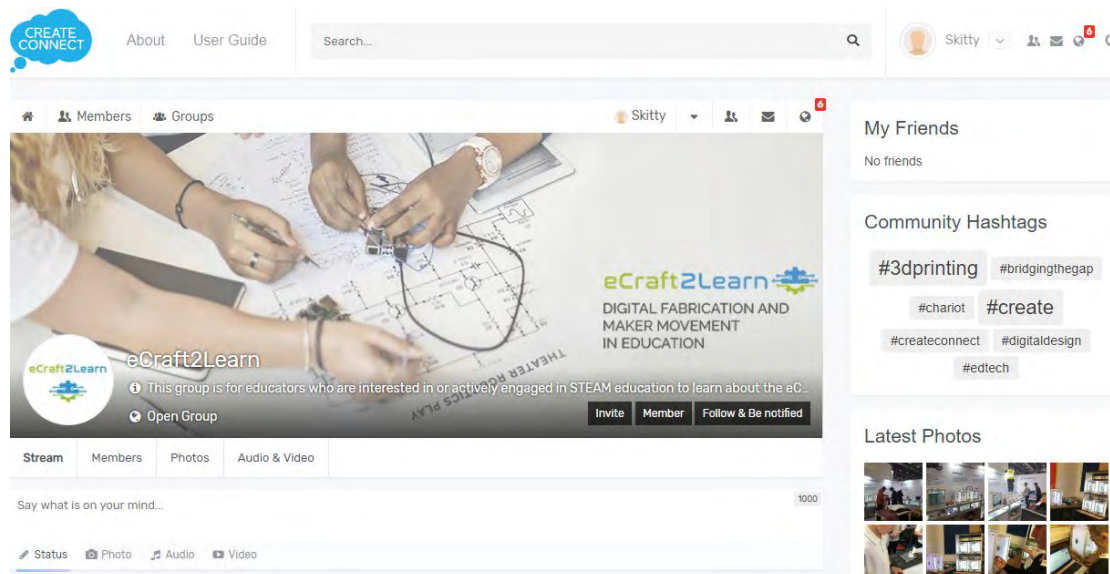
The Inspiratorium then displays a list of the projects tagged to the selected keywords, with links to their corresponding Instructable page.

**The Inspiratorium can be accessed through the UII  
or directly at: <https://ecraft.zsi.at/>**

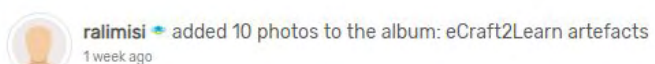


## USING THE ECRAFT2LEARN COMMUNITY FOR PROJECT IDEATION

The eCraft2Learn community group is where you can connect with other eCraft2Learn educators.

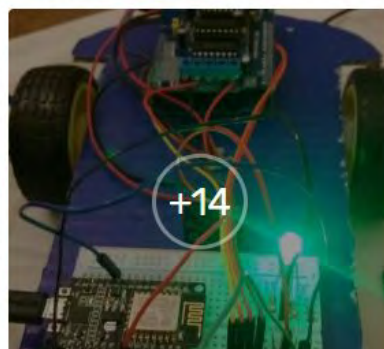
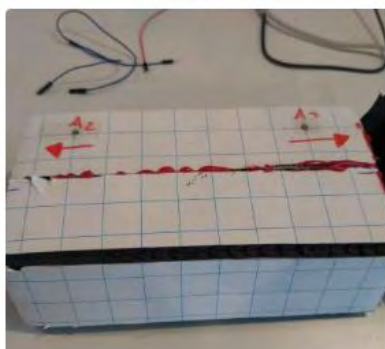
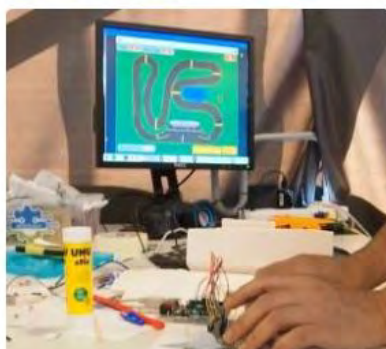
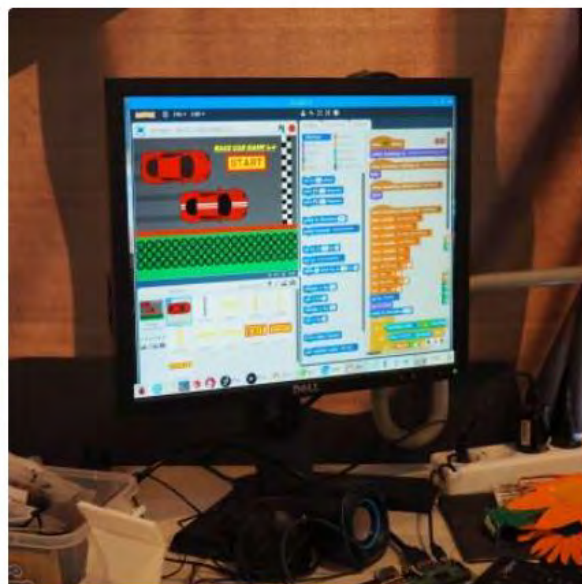
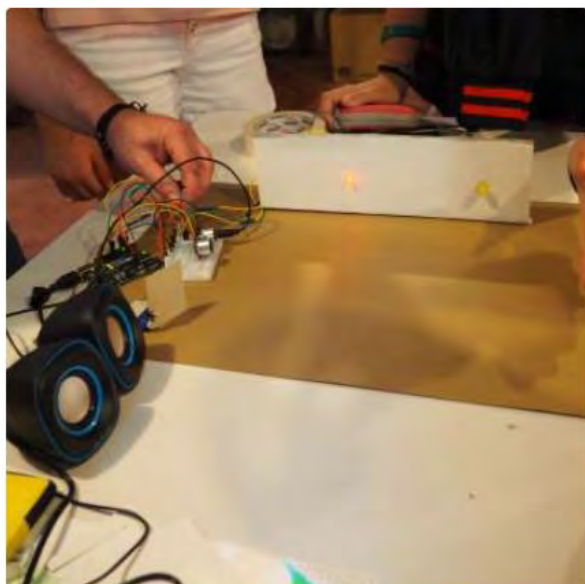


Here you can browse through the posts, photographs and videos uploaded to the group to get inspiration for projects. Alternatively you can post questions or ask the other group members to share their ideas or examples of successful projects with you.



Pictures of the computer-supported artefacts developed by the students

Do you have more pictures to show? Feel free to add them here !



## Planning a project

Running an eCraft2Learn project is likely to be very different to running your usual curriculum projects and activities. Primarily because the projects will be more free flowing and not as structured as what you will be used to. Consequently you will have to plan the project differently and your planning and may require less detail than usual to allow for this.

In your planning, time at the beginning of the project will be required to familiarise students with the eCraft2Learn five stage methodology, the Unified User Interface, the open education resources and the tools embedded in the UUI.

One of the key concepts of the eCraft2Learn methodology is that of the role of the teacher as a coach. Therefore, the onus should be placed more on the students to plan their own projects, define and allocate tasks using the planning tools in the UUI.

They should also be responsible for managing their own time and tasks within their groups. However this is easier said than done, especially when introducing eCraft2Learn for the first time and if there is a specific time constraint which limits the number of hours/sessions that the students will to work on their projects.

In these cases it may be beneficial for you to have an approximate time/activities plan to ensure that you encourage the students to progress through the activities at a steady pace. If you do this please bear in mind that the eCraft2Learn five stage process is not linear and students will need to constantly reevaluate their project and revisit other stages. You will also need to allow for failure as this provides some of the greatest learning opportunities so time plans should be flexible and provide plenty of time for revisiting and trying again.





## Running a project

When running the project with groups of students, the main consideration is in your role as a coach. Your role will be to encourage students to choose their learning paths and to learn on their own or in small groups, whilst guiding students and provide them with real-time feedback. In this way, students are supported to become more self-regulated and in charge of their own learning processes.

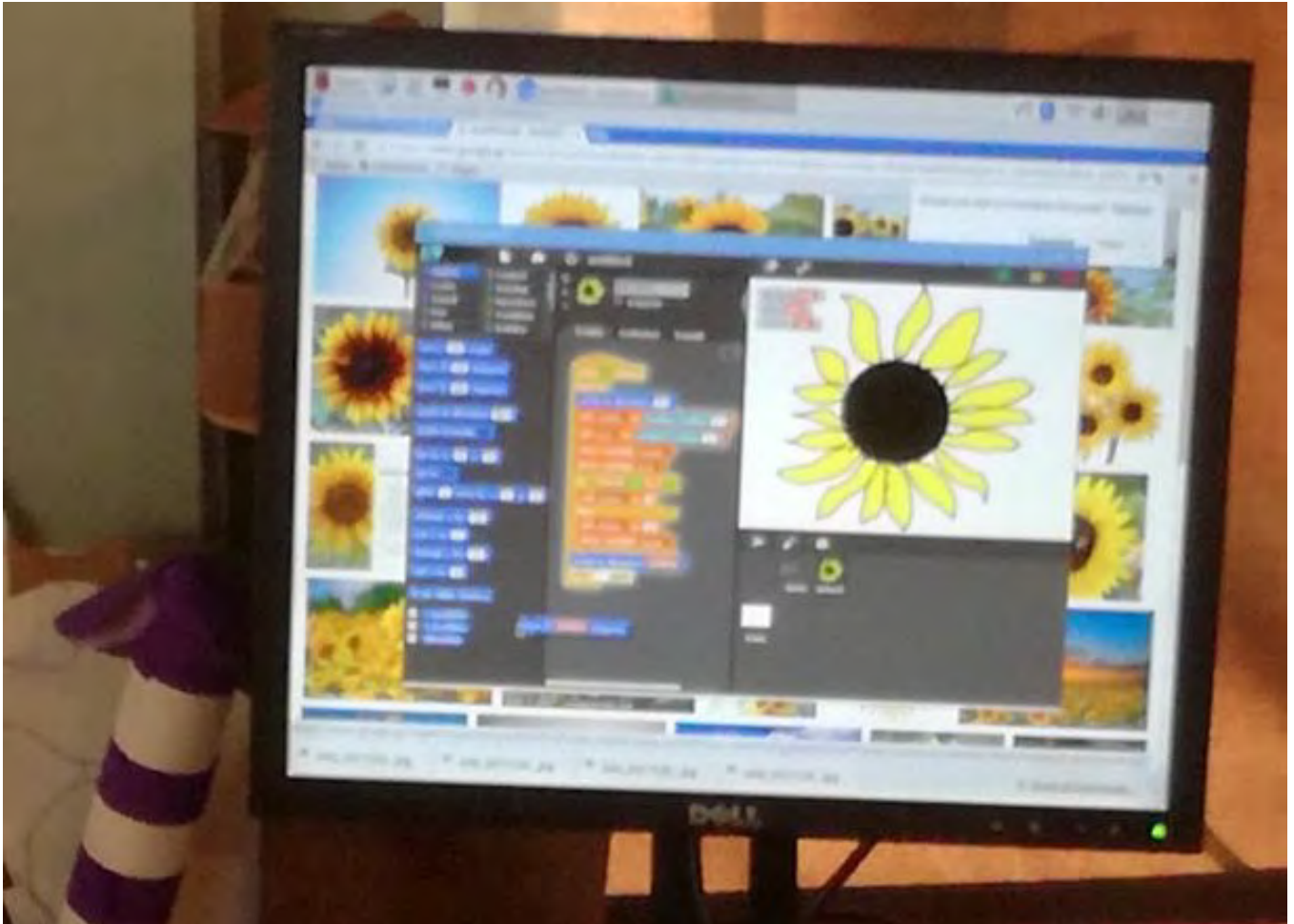
When working through the project, students will follow the 5 stage pedagogy, however it should be highlighted that this is not a strictly linear process, they should be constantly reviewing their project and encouraged to go back and revisit stages as the project dictates to make refinements and changes using the experiences gained up to the current stage.



There will however be some elements of the project that you will need to lead on, especially if this is the students first experience of eCraft2Learn such as setting the project, explaining the eCraft2Learn methodology and introducing students to the UI, OER's and digital tools. Once the project is running it will be your role to facilitate the students learning during the sessions and managing the end the end of each session to ensure that everything is packed away and switched off.

## SET THE PROJECT

Any topic could become an eCraft2Learn topic! This means that you could for example pose a question or a challenge for students to solve. In formal context the topic of your task could be taken from your subject curriculum (e.g. photosynthesis, security, the new world discovery, etc.) or be an integration of several subject areas. In informal context you can provide more freedom for students and let their imagination fly in any topic or theme they feel curious about. Once the topic is selected, divide the students into working groups. This could be done by the teacher or by the students' self organization.



If students need background knowledge of the task, then now is the time to provide information to them (e.g. what is photosynthesis and when it occurs?). There might also be a need to explain the basics of programming or electronics and this could be done during this first phase. Notice that the eCraft2Learn pedagogical approach is not only relying on programming or coding and so this is not a prerequisite for the students. They will learn the skills they need during the process of making. Once the students have fundamental knowledge of the tools available to them, we trust that they will be confident and creative during the project.

## EXPLAIN THE METHODOLOGY TO STUDENTS

If this is the first eCraft2Learn project the students have experienced, you will need to introduce them to the five stage eCraft2Learn methodology:

- Ideation
- Planning
- Creation
- Programming
- Sharing

It is important to emphasize to students that although they can work systematically through these stages and this is how they might initially approach the project, their work does not have to be linear. They can work on whatever stage is appropriate at that time, group members may be working on different stages in parallel with each other and they may end up revisiting stages several times.

The eCraft2Learn user interface aims at assisting each pedagogical stage by providing digital tools for documenting what has happened during that stage. A simple how-to through the stages is given below:

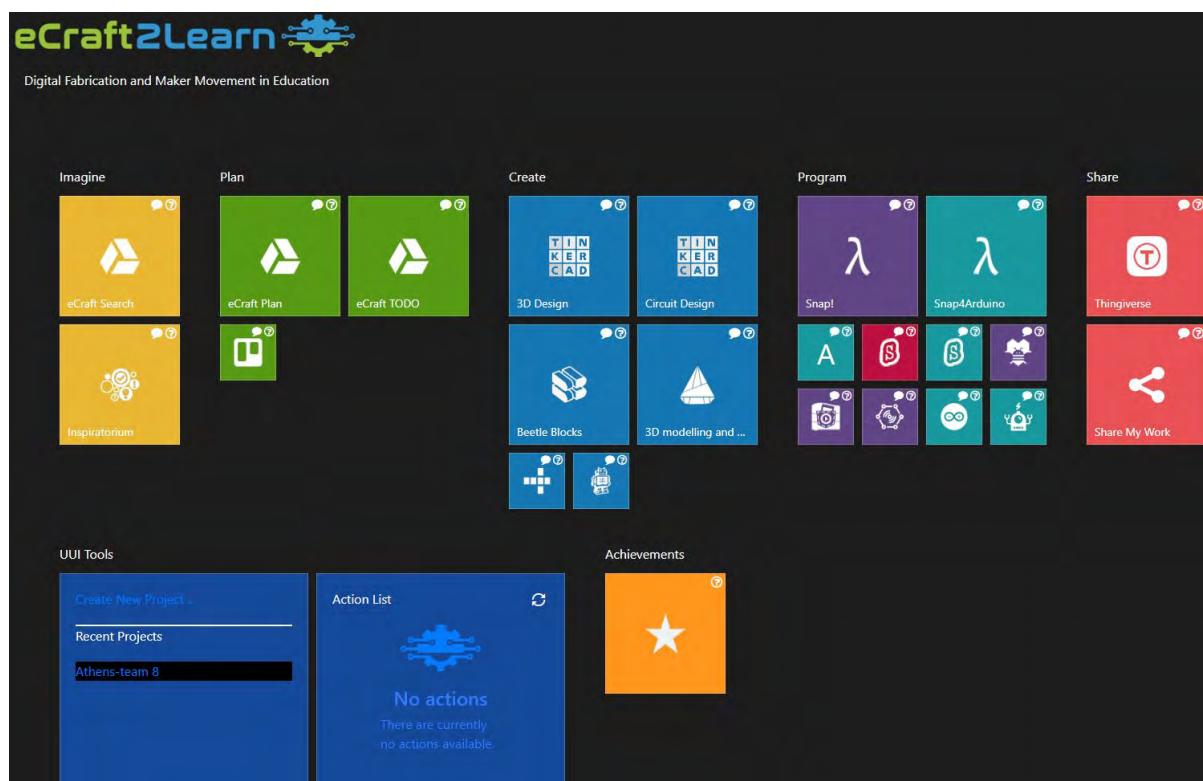
AIM/GOAL	CONTENTS	TECHNOLOGY/MATERIALS	WAY OF WORKING
To start working with the five stages pedagogical model (see Figure above)	<b>Ideation/Imagine</b> To ideate/imagine how to create an artefact that solves or represents a solution to the given (or selected) task/problem	Laptops, smartphones, web browser, Google drive, eCraft2Learn user interface, Pinterest  Peer teaching can be used during the exploring a new working plate (crossing the group borders)	Note taking, conversation in groups, together, mind mapping, making collage or with other technique.  eCraft2Learn-platform is supporting the ideation as well as YouTube-videos (of DIY, robotics)
To plan the artefact	<b>Planning</b> To assign roles within the group – who will do what in order to arrive at a suitable solution to the given (or selected) task/problem.  To understand what strategies are needed to carry out the task	During the planning students, make list of the material they will need for their artefact and activities they need to perform.	Students set a target for their working and organise the division of labour  Making a collage
To start to create the artefact	<b>Creating</b> To physically make the artefact or solution that the students had imagined and planned	eCraft2Learn -platform Recycled material 3D-printers Electronic components (e.g. LEDs, sensors, etc.)	Organised in the division of labour
To make the programming for the artefact	<b>Programming</b> To bring the created artefact to life!	Possibility to use Snap, Scratch, some already-known app The eCraft2Learn -working platform/ instructional videos	Creating, programming proceed hand in hand
Sharing the result of the process (artefact)	<b>Sharing</b>	eCraft2Learn -platform	Presenting the artefacts to each other and through the platform/ social media



## INTRODUCE THE UII, OER'S AND DIGITAL TOOLS

If this is the first eCraft2Learn project the students have experienced, you will need to introduce them to the Unified User Interface (UII) along with the Open Education Resources (OER's) and the various digital tools that are available to them from within in the UII.

The UII can be accessed at: <https://ecraft2learn.github.io/uii>



When a student has logged in they will be able to access all the UII tools (unless they have logged into a specific project where you have limited the access to some of the tools through the teacher interface).

The UII contains tools for each stage of the methodology, education resources for learning about the eCraft2Learn technology and a self evaluation tool.

You can learn more about the UII in Teacher Guide 4 Using eCraft2Learn Project Platform (The UII) which can be downloaded at: <https://project.ecraft2learn.eu/using-the-ecraft2learn-project-platform/>

You can access detailed documentation about the UII tools in Project Report D4.4 Section 2 at [https://project.ecraft2learn.eu/wp-content/uploads/2019/02/D4.4\\_The-unified-user-interface-A-software-solution-for-3D-design-programming-and-making-computer-supported-ed-artefacts.pdf](https://project.ecraft2learn.eu/wp-content/uploads/2019/02/D4.4_The-unified-user-interface-A-software-solution-for-3D-design-programming-and-making-computer-supported-ed-artefacts.pdf)

## FACILITATE THE STUDENTS LEARNING

Whilst students are working on their projects, your role will be to act as a facilitator to their learning, the following tips will help you transition from your role as a teacher to that of a coach:

- Plan a craft- and project-based eCraft2Learn activity where students do not have any detailed instructions on how to proceed. You can give broad guidelines on the topic or the problem. What do the students need to create? How much time do they have?
- Engage the students to ideate and plan their own projects. What do they want to learn? Ask students to create their own goals. If requested, help students to work step by step by setting their goals.
- Map students' prior knowledge. This can be done for example through open discussions, mind maps or small quizzes, individually or in groups. Understanding the background knowledge of the students will help you when scaffolding the students in their learning processes.
- Give positive and constructive feedback to students. What are they doing well? How could they improve? How have they achieved their results? What kind of steps or processes were needed? Give positive and specific feedback to students when showing that they are working hard and are engaged in the processes (let the students understand what they did that deserved the praise).
- When students have a question or a problem, try not giving a direct answer. Instead, pose new questions, paraphrase the discussion or try to steer the conversation in a way that students find out solutions by themselves. Make them work and solve questions and problems in teams with their peers or discuss on how they could find the answer, what (online/offline) sources are available to use, etc. Help students to discover the answer by themselves, not solving the problem behalf of them.
- If you do not know the answer for a problem, honestly admit it. Make this an opportunity to learn with the students, to create trust and improve the classroom atmosphere. You can find the answer together, demonstrating the example that we do not know the answer to everything, but we can still find answers and solve problems. This is what we call learning.
- Your classroom is full of talented students and each of them has a unique variety of skills and knowledge. Try to empower the students to help their peers and learn from each other.
- Trust your students. When you give them freedom and authority you will be amazed by how much intensity and effort they put into their work. Embrace uncertainty, not knowing exactly what will happen next. New ways of working and learning take time to develop, do not give up! Students as well will need time to get familiar with new working and learning. Be patient and be gentle to yourself and your students. At the beginning, students might need more help to adapt to these new working and learning ways, but it will be very rewarding in the end to see how much they actually learn and how deeply they engage and enjoy working and learning.
- Assess the processes rather than the outcome of the product, helping students themselves to evaluate themselves, with peers and together with teacher/coach

## ENDING AN ECRAFT2LEARN SESSION

The following checklist provides a list of tasks to undertake at the end of each eCraft2Learn session:

- Always unplug the Raspberry Pi.
- Always unplug all DIY electronics material.
- Always unplug the 3D printer unless it is still running a print, if so return later to turn off the printer.
- Put into a box the semi-developed projects.
- Put into a box all materials and equipment that did not get used.
- Turn off all main power sources within the laboratory.
- Open at least a window or door to properly flow fresh air within the laboratory especially after any 3D printing project.
- Perform a visual inspection of possible wire tears, short circuits that might cause injuries.
- Perform a visual inspection of moving mechanical parts and furniture of any damage.





## eCraft2Learn best practices

During the eCraft2Learn research and pilots, a number of best practices were observed, here is a brief summary of some of the best practices:

**Support of the ideation process:** The teachers tailored their roles and support to the needs of the students and discreetly empowered them so that to develop confidence and to start shaping their own ideas towards computer-supported artefact construction. The teachers supported the ideation phase with easy to start with projects and worksheets or with pre-defined by the curriculum topics moving the students to extend the project topics based on their interests and personal preferences. In addition, the teachers supported the generation of ideas during problem solving by raising prompt questions that could help the generation of ideas towards problem solving, providing useful explanations and boosting students' self-confidence and 'can-do' attitude.

**The creation of meaningful making experiences:** The sharing of ideas, practices and experiences was considered of great significance as it could inspire new and potentially innovative ideas for computer-supported artefact construction.

**Good practices for sharing:** These included the triggering mechanisms for sharing in the class (presentation of the current status of work and good practices exchange), in school events and well-attended festivals, in meetings with representatives of the scientific community, and online through the UUI and social media.

**Project processes:** In the context of the eCraft2Learn workshops, the students were observed to go through multiple processes: from idea generation, to planning, to collaborative hands-on construction, to problem solving, reflection, sharing, re-design and re-construction. All these processes were interwoven in the eCraft2Learn pedagogical model and learning methodology and ideally suited in the making process.

**Failure, reflection and iteration:** The iterative nature of the eCraft2Learn learning methodology allowed for reflection and helped students to see that failure is an important part of the learning process. The analysis of the failure and continuous improvement process was important for developing a growth mindset and encouraging persistence, challenge seeking, and learning.

You can learn more about the good practices that were observed during the eCraft2Learn pilots in Project Report D5.5 Sections 2-5 at: <https://project.ecraft2learn.eu/wp-content/uploads/2019/01/D5.5-Small-scale-case-pilot-report-and-good-practice-videos.pdf>

You can also view a series of best practice videos from the pilots at: <https://youtu.be/pOqfKEochHs>



<https://project.ecraft2learn.eu/>

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01/2017 – 12/2018



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CITY OF ATHENS



ARDUINO

Ultimaker  
It's in the making



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