USER GUIDE

Introducing eCraft2Learn
The project, pedagogy, technology, tools, resources and outcomes

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.

The project aims at reinforcing personalised learning and teaching in science, technology, engineering, arts and math (STEAM) education, and to assist the development of 21st century skills that promote inclusion and employability for youth in the EU. The eCraft2Learn ecosystem supports both formal and informal learning by providing the appropriate digital fabrication tools and resources.

For learners (13-17 year olds) and their teachers/instructors/coaches who want to learn by making in an engaging and rewarding environment supporting creativity, eCraft2Learn is an integrated learning ecosystem that provides tools, support and training for innovative learning, contributing to opening learning towards innovation through a craft- and project-based pedagogical approach in STEAM education.

The eCraft2Learn ecosystem consists of a series of documentation, tools and resources that are completely n-source and accessible to all educators and students who wish to set-up, run and participate in STEAM based maker educator projects.

You can learn more about the project at: https://project.ecraft2learn.eu/
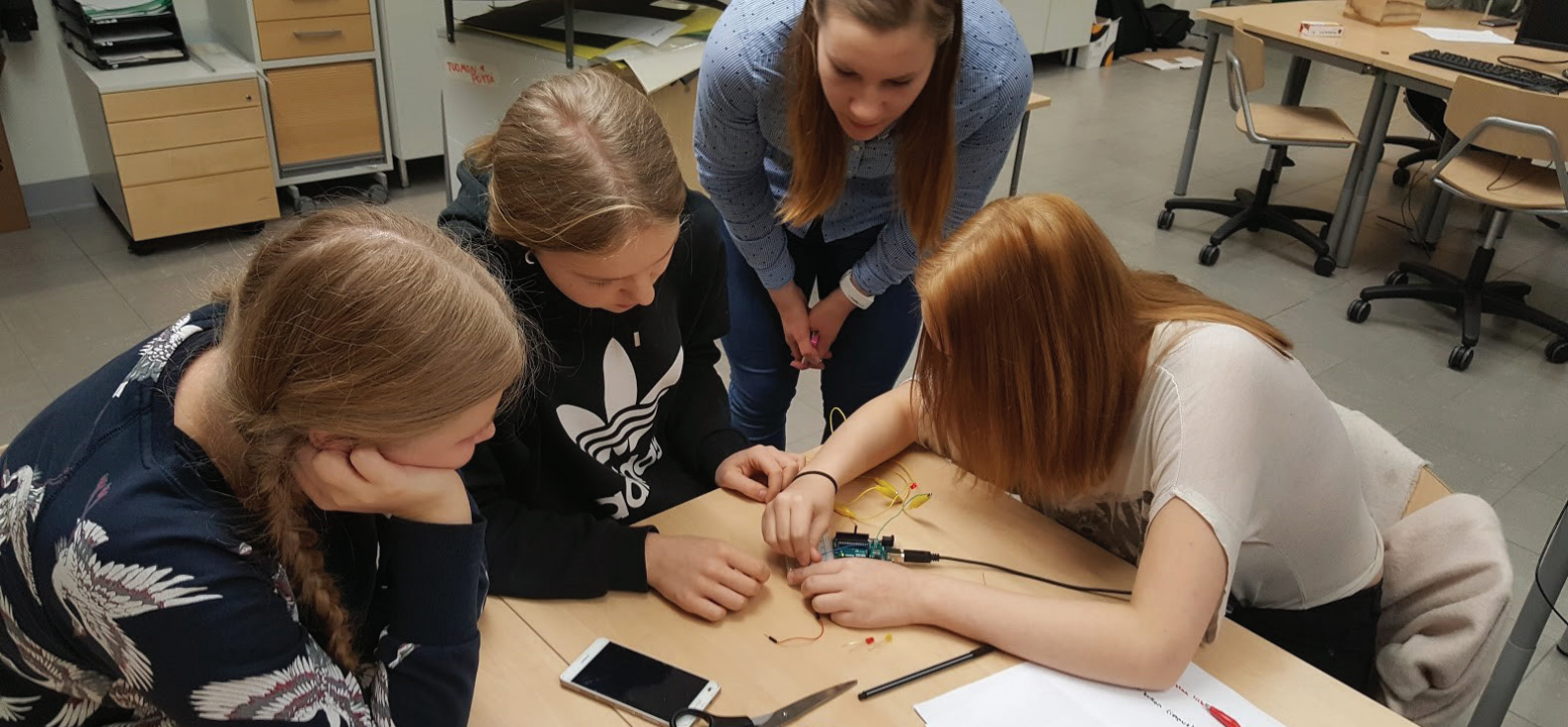
PROJECT DOCUMENTATION

A wide range of different documentation is available to support the project, this includes:

- Education guides - a series of ten guides (of which this is the first) to introduce and help educators to get started with eCraft2Learn.
- Open Educational Resources - a series of resources for educators and students to learn about the various eCraft2Learn tools and technologies including electronics, programming, 3D modelling and 3D printing.
- Research Project Reports - a series of in depth research reports documenting all of eCraft2Learn development, technologies and delivery. This also includes technical documentation and a detailed teacher training manual.

When starting with eCraft2Learn, we recommend that you refer to the education guides first:

1. Introducing eCraft2Learn - The project, pedagogy, tools, resources and outcomes.
2. Getting Started with eCraft2Learn.
3. Setting up an eCraft2Learn learning environment - hardware, software, tools and materials.
4. Using the eCraft2Learn Digital Platform (The UUI)
5. Designing and running an eCraft2Learn Project
6. Integrating DIY electronics into an eCraft2Learn project.
7. Integrating 3D printing into an eCraft2Learn project.
8. Using the eCraft2Learn teachers interface and learning analytics tools.
9. Collaborating and sharing in the eCraft2Learn connected community.
10. The eCraft2Learn Research - documentation, outcomes, impacts and recommendations.

The Education Guides can be downloaded at:
https://project.ecraft2learn.eu/getting-started-with-ecraft2learn/
The Open Education Resources can all be accessed from within the eCraft2Learn Project Platform (The UUI) at: https://ecraft2learn.github.io/uui/
The Research Project Reports can all be accessed at: https://project.ecraft2learn.eu/reports/

The eCraft2Learn Pedagogy

The project aims to reinforce personalised learning and teaching in STEAM education. It also aims to assist in the development of twenty-first century skills that promote inclusion and employability for youth in the EU. Some examples of twenty-first century skills include collaboration, negotiation and communication, creativity, critical thinking, problem-solving and learning skills as well as the ability to use technology and engage in real-world tasks

To meet these aims eCraft2Learn follows a craft and project-based methodology, a combination of the inquiry-based approach with design thinking through the use of DIY (do-it-yourself) electronics and 3D printing technologies. The eCraft2Learn pedagogical framework is developed within five stages and is based on the idea of the project- and craft-based learning within open learning scenarios.

You can learn more about the theoretical foundations of eCraft2Learn pedagogical framework in Project Report D3.1 Sections 1-3 at: https://project.ecraft2learn.eu/wp-content/uploads/2017/05/ Deliverable-D3.1-Development-of-personalised-craft-and-project-based-learning.pdf

THE FIVE STAGES OF ECRAFT2LEARN

The eCraft2Learn learning methodology is based on inquiry-based learning and design thinking elements and consists of five stages: ideation, planning, creation, programming and sharing, that aim at learning through projects and producing a computer-supported artefact. The five stages present a framework for eCraft2Learn project work however the stages are not necessarily performed in a linear manner, the process is cyclical with the opportunity for students to jump to or revisit any stage at any time, as represented in the diagram below.

Usually, inquiry-based learning is initiated when students pose questions, problems or scenarios and the process is supervised by a "coach" (teacher acting as a coach). Students identify study issues and formulate questions in order to develop their knowledge or solutions. The process is intrinsically argumentative, where the students create questions, obtain supporting evidence to answer the questions, explain the evidence collected, connect the explanation to knowledge obtained from the investigative process and finally create an argument and justification for the explanation. Inquiry-based methods are usually related to scientific activities and scientific thinking in STEM. However, we refer to STEAM when there is need to take into account arts and craft and therefore, in eCraft2Learn approach we integrate inquiry-based method with a Design Thinking method.

world exploration –
challenges identification

IDEATION

SELF-REFLECTION

SELF-REGULATION

SHARING

PLANNING

showcasing and
sharing their ideas
and implementation

information gathering —
what skills are needed to
solve the problem?

COLLABORATION

PROGRAMMING

CREATION

making the built
artefacts inter-
active

co-design, co-create suit-
able computer-supported
artefacts

1   IDEATION

In order to explore the kinds of challenges that students or others face in their daily lives, a student could explore the world physically (e.g. taking pictures, exploring situations outside the classroom, newspapers, etc.) or virtually (e.g. through online support community discussion, online news, documents, local news/websites) and then decide what their challenge/problem will be.

2   PLANNING

The creation stage is where stage, the students work on the co-design and co-creation of their computer-supported artefact solutions through the application of DIY technologies. The visualisation and simulation of the designs are also an important part of this stage. In starting the creation stage, students set their goals for this stage in order to organise their work. They will be asked to reflect on their set goals during this and other stages and evaluate how well they have reached these goals, in what ways they were successful and what hindered their success.

3   CREATION

The creation stage is where stage, the students work on the co-design and co-creation of their computer-supported artefact solutions through the application of DIY technologies. The visualisation and simulation of the designs are also an important part of this stage. In starting the creation stage, students set their goals for this stage in order to organise their work. They will be asked to reflect on their set goals during this and other stages and evaluate how well they have reached these goals, in what ways they were successful and what hindered their success.

4 PROGRAMMING

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5 SHARING

In order to enhance motivation and presentation skills, students are encouraged to share and showcase their projects and implementation ideas: 'Good makers always share their make!' This will be done through the open (online) communities and/or through school/community showcasing events. In return, they will receive feedback from artists, designers and engineers from around the world as well their peers.

You can learn more about the five stages with guidance notes for implementing the five stages in Project Report D3.1 Section 4.2 at:
https://project.ecraft2learn.eu/wp-content/uploads/2017/05/Deliverable-D3.1-Development-of-personalised-craft-and-project-based-learning.pdf

ROLES OF THE TEACHER/COACH AND STUDENTS

The eCraft2Learn learning ecosystem creates a collaborative, open, playful and non-judgmental environment that supports learners' creativity. Learners are encouraged to walk around and collaborate freely with other students and to share ideas and solutions with peers and teachers.

Students work together as peer learners with their strengths and weaknesses. As the project advances, they learn with and from each other. Students can take on roles during the process of building their personal skills. Everyone has a chance to participate with his/her own know-how. Design team members may work in different roles during the process, e.g. project manager, technology specialist, design partner, researcher, learning scientist, collaboration facilitator, etc. In this way, students learn that more heads are better than one and that different people have different expertise, which contributes to richness. They learn how to collaborate, communicate and reason (critical thinking skills) and how to be creative in a group. Students should be given the opportunity to try out different roles as each role will require different skills and develop a working knowledge of different elements of the eCraft2Learn ecosystem.

The role of the teacher or 'coach' is to facilitate and steer the learner and the project 'back on track' when needed. The teacher, who most likely already knows his/her students, encourages them to explore and seek information from different sources instead of giving complete answers. The teacher also encourages peer learning, discussion and exploration.

As part of the pedagogical considerations of the eCraft2Learn learning ecosystem, understanding the role of the teacher as that of a coach or facilitator of the learning experience is fundamental. When teacher acts as a coach, the focus shifts from teacher being the main actor in the classroom to the more student-centred approach where students have an active role in their own learning. A teacher can acquire the role of a coach when giving ownership to students and empowering them in the learning process. When taking a step back, teacher allows students to explore and find solutions to the challenges without providing direct answers. Thus, students will learn how to actively construct knowledge, rather than just mechanically copy and memorise the information.
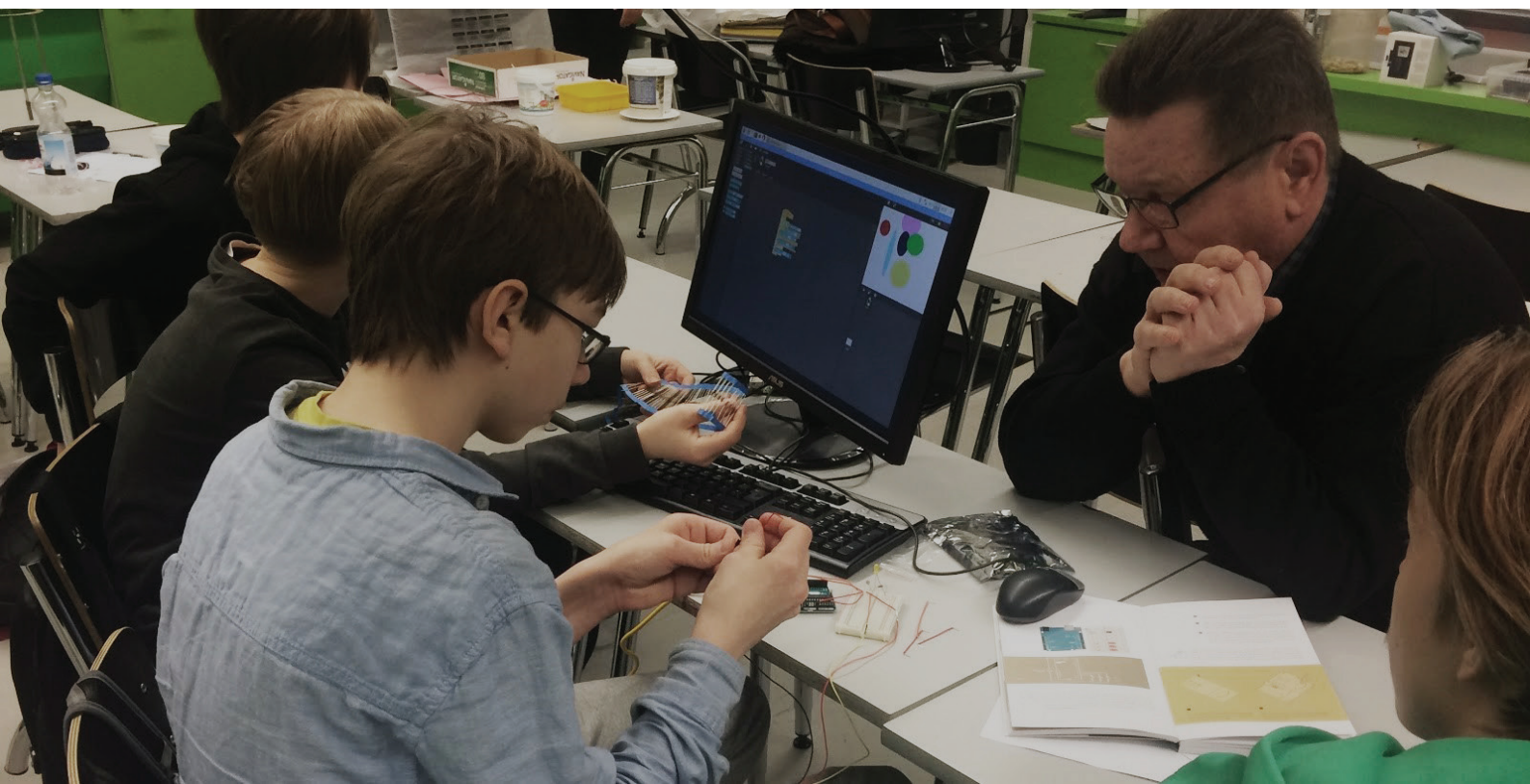
eCraft2Learn Technology, Tools and Resources

The eCraft2Learn project incorporates a number of different technologies and tools, supported by extensive open education resources to assist in students learning.

This section gives a brief overview of these, however please refer to Teacher Guide 3 Setting up an eCraft2Learn learning environment - hardware, software, tools and materials to learn more at: https://project.ecraft2learn.eu/setting-up-an-ecraft2learn-learning-environment/

TECHNOLOGY

A number of different complementary technologies have been trialled and recommended to create an eCraft2Learn workspace.

These technologies include:

- Raspberry Pi - as a low cost solution to personal computers
- Arduino Uno - for the programming of DIY electronics
- Ultimaker 3D Printer - for fabricating 3D artifacts and parts

These technologies combined with DIY electronics, traditional craft materials and the eCraft2Learn software tools allow students to design and create functioning product prototypes.
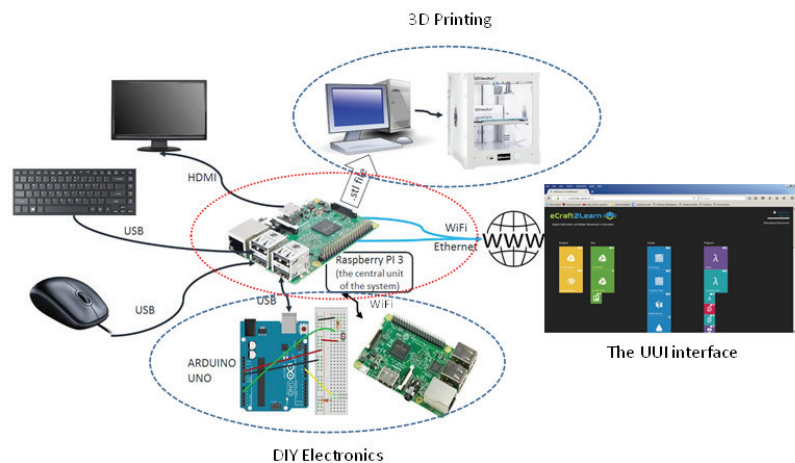
THE UNIFIED USER INTERFACE (UUI)

The UUI is the eCraft2Learn project digital platform. This provides a single user gateway to all the digital tools, software and resources students and teachers will require when participating in eCraft-2Learn projects. It also consists of a learning analytics teacher interface.

> **The UUI can be accessed at: https://ecraft2learn.github.io/uui/**
>
> **The Learning Analytics teacher interface can be accessed at:**
> **https://ecraft2learn.github.io/learning-analytics**

The software tools are organised into the five eCraft2Learn project stages, with a selection of software and interactive tools being available for each stage. Many of the tools are accessible directly in the UUI, others are linked to from the UUI. The education resources are also all available from within the UUI.

Students work and progress on each project are tracked and stored within the UUI, so students can revisit projects and continue at any time.

Please refer to Teacher Guide 4 Using the eCraft2Learn Project Platform (The UUI) to learn more at: https://project.ecraft2learn.eu/using-the-ecraft2learn-project-platform/

OPEN EDUCATION RESOURCES

To enable students to learn about the different technologies, software and tools a series of education resources are available within the UUI which can be accessed at any time alongside the UUI tools.

The resources are in a range of formats including text descriptions and images, videos, documents and worksheets and cover the following:

- Electronic Devices (including Arduino)
- 3D Printing
- AI programming
- Troubleshooting

There are also links to Arduino and 3D Printing communities to access further resources and support as well as the facility for teachers to upload their own resources to support the students projects.

You can learn more about the development of eCraft2Learn Open Education Resources in Project Report D3.3: https://project.ecraft2learn.eu/wp-content/uploads/2017/10/D3.3_eCraft2Learn_OER_M9_b.pdf

LEARNING ANALYTICS

The eCraft2Learn Learning Analytics (LA) tool is designed to help provide educators with data based insights into the progress students are making with their eCraft2Learn projects through their use of the various tools within the UUI.

The learning analytics (LA) aims to analyse the digital traces that the UUI and some of its tools collect from the students during the sessions. Ultimately, the ambition is to allow the teacher to use the LA to deepen their understanding in the context where the projects take place either in formal or informal settings.

Please refer to Teacher Guide 8 Using the eCraft2Learn teachers interface and learning analytics tools to learn more at:

https://project.ecraft2learn.eu/using-ecraft2learn-teachers-interface-learning-analytics-tools/

ECRAFT2LEARN EDUCATOR COMMUNITY (CREATE CONNECT)

CREATE Connect is a community platform for STEAM Educators to connect, communicate and collaborate with each other. The platform contains an eCraft2Learn Educator Community Group.

You can join the platform and the eCraft2Learn User Group at:
**www.connect.createeducation.com**

By joining the eCraft2Learn group you will be able to connect with other educators around the world who are also using eCraft2Learn. You can share tips, ideas and projects, ask questions, help and support each other. You can also link with other educators or schools to work on joint/collaborative projects. Once you are a member of the eCraft2Learn community you will also be able to invite other educators in your own networks to join the eCraft2Learn project group.

eCraft2Learn community members will have the facility to upload and share documents, images and videos to the group and access and download resources shared by other group members.

Please refer to Teacher Guide 9 Collaborating and sharing in the eCraft2Learn connected community to learn more at:

https://project.ecraft2learn.eu/collaborating-sharing-ecraft2learn-connected-community/
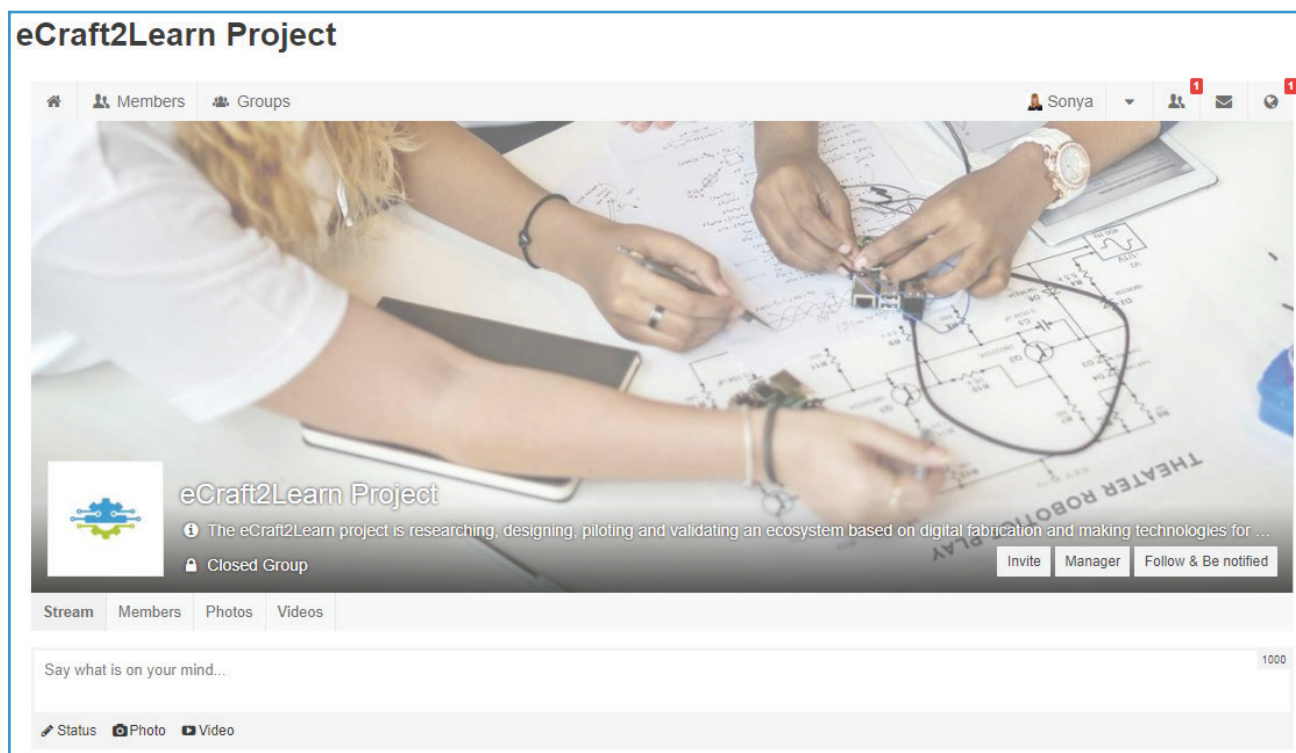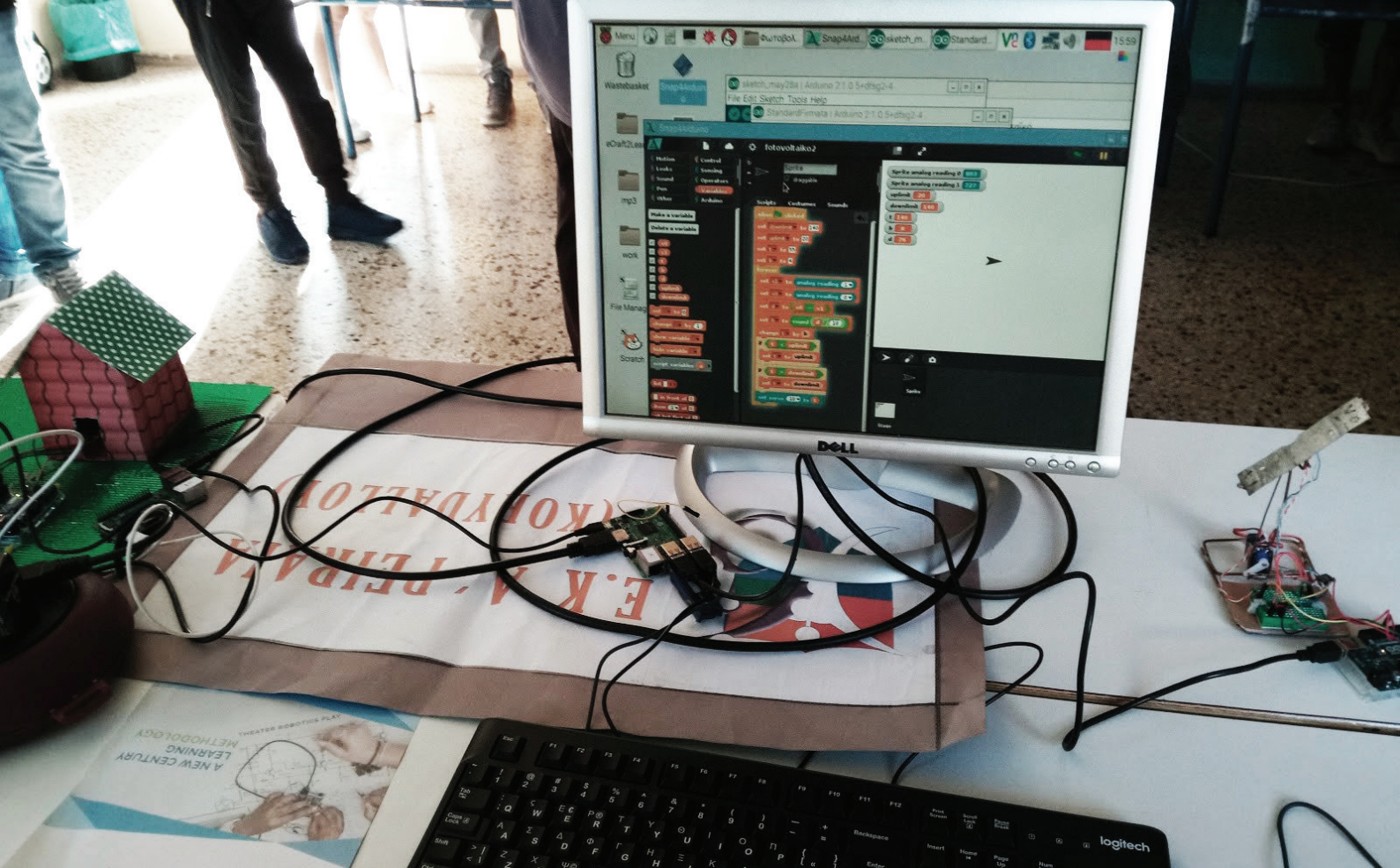
eCraft2Learn Research and Pilot Outcomes

A large part of the eCraft2Learn research project was to conduct two rounds of project pilots with groups of educators and students. These took place in both formal and informal education settings in Finland and Greece.

The main aim of the inquiry from the pilots was the impact of the eCraft2Learn methodologies on teachers and students when performing different projects. In addition eCraft2Learn was also interested in drawing in recommendations for teachers that could support the development of a sound pedagogical methodology.

The eCraft2Learn project was found to impact students in a number of ways, some of the positive outcomes from participation in the project included:

- Observed **improvements on students' collaboration skills, methodological skills, creativity, programming and robotics**.
- An increase in students' level of digital competency in multiple areas and on different levels.
- Students showed **increased motivation to find solutions** in emerging problems.

Please refer to Teacher Guide 10 The eCraft2Learn Research - documentation, outcomes, impacts and recommendations to learn more at: https://project.ecraft2learn.eu/ecraft2learn-research/

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