Teacher Education in an Authentic Maker Space

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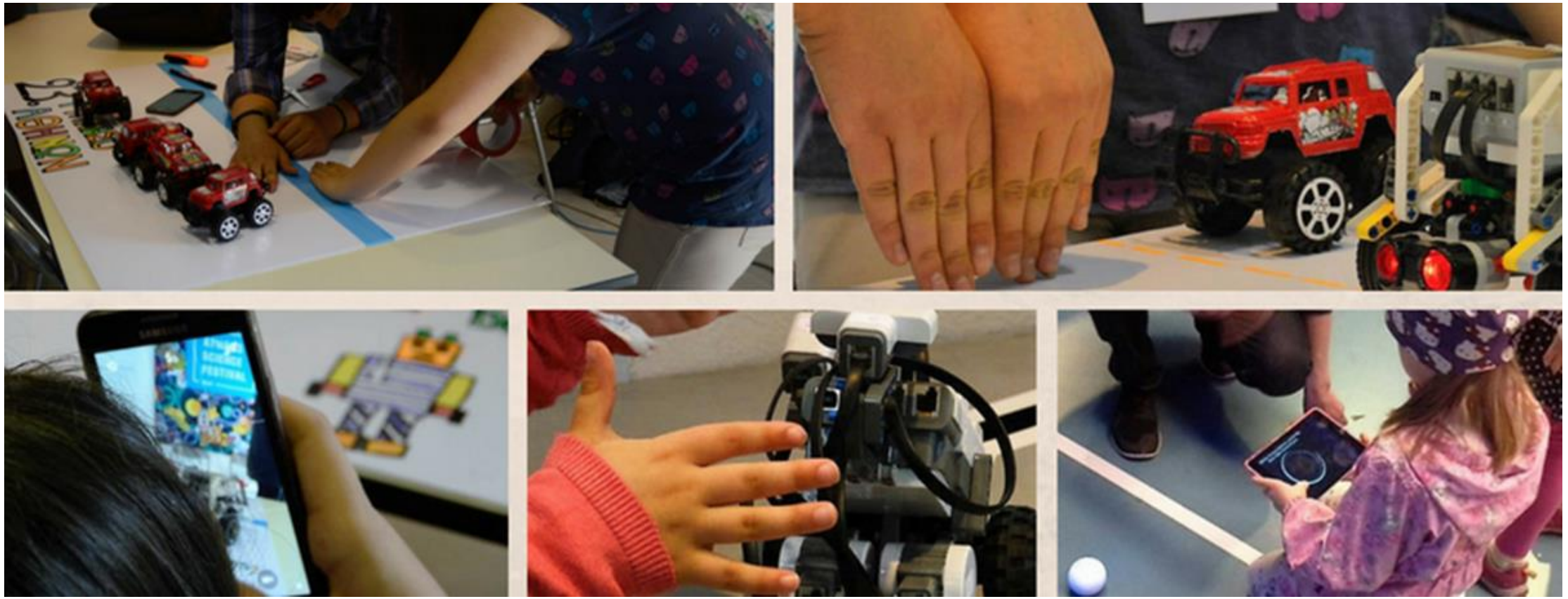


Research aim and questions

- Teacher education in classes and labs, in universities and training centres
- To explore an alternative training environment for STEAM student-teachers: an authentic maker space or “FabLab” with young learners in action.
- What opportunities and experiences can such an environment provide for student-teachers?
- Which roles they could undertake
- What is the added value?

The eCraft2Learn ecosystem

- eCraft2Learn research project H2020, 2017-18, https://project.ecraft2learn.eu/ **DIGITAL FABRICATION AND MAKER MOVEMENT IN EDUCATION: MAKING COMPUTER-SUPPORTED ARTEFACTS**
- digital fabrication in formal and informal education settings
- a paradigm shift in educational robotics and STEAM education from “black box” and silo products to the “white box” paradigm where learners become “makers” of transparent computer-supported artefacts

the driving forces behind the eCraft2Learn pedagogy

- Constructivist “learning by making” methodology
- “do-it-yourself” (DIY) philosophy
- the “maker movement” in education
- the 21st century skills: creativity, critical thinking, teamwork, and problem solving

The eCraft2Learn educational methodology

five stages:

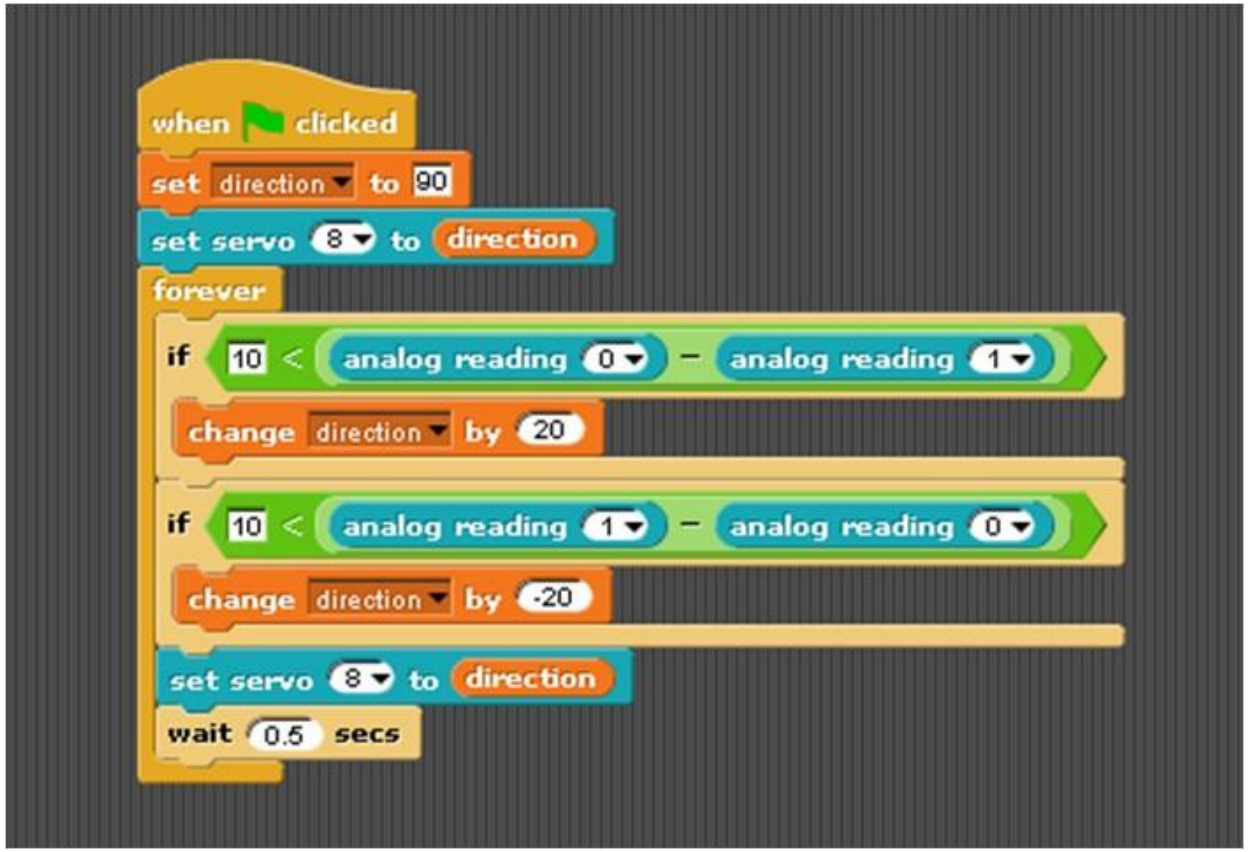
- imagine,
- plan,
- create,
- program,
- share

The eCraft2Learn Technologies

- Single board computers (Raspberry Pi 3, ASUS Tinkerboards) equipped with screens and keyboard-mouse sets.
- Arduino boards
- DIY electronic components (e.g. photoresistors, potentiometers, servomotors, LEDs)
- DIY modified parts brought from home during a recycling process, like broken toys, plastic bottles, pieces of paperboard, computer fans, speakers, etc.
- 3D printer used for preparing customised physical components of the artefacts.
- power supply equipment including power banks and solar panels.

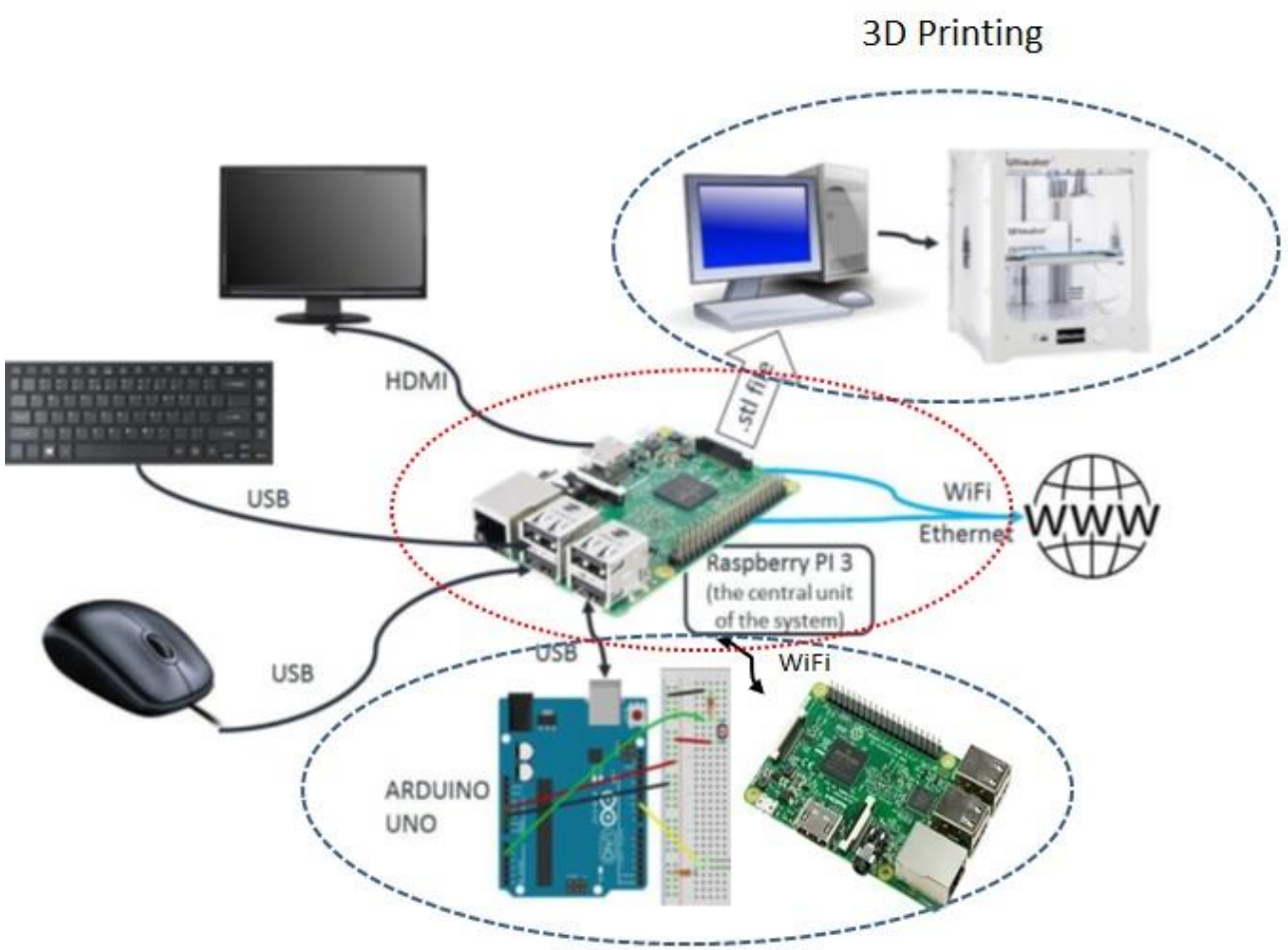
software tools

- visual programming tools Snap4Arduino (http://snap4arduino.rocks/
- 3D printing software allowing the design of models to be printed like the web based Tinkercad (https://www.tinkercad.com/).
- 3D printing software for the machine acting as manager of the printer like the Cura (https://ultimaker.com/en/products/cura-software)



unified user interface

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



Robotic Artefacts

The Unified User Interface

STEM education post-graduate students join the eCraft2Learn pilots

- When: academic year 2017-18
- Where: pilot site at Technopolis City of Athens (informal context)


- 1st session involved 11 student-teachers who were attending the 2nd year of the course
- 2nd session 17 student-teachers who were attending the 1st year of the course

eCraft2Learn
pilots in Athens

The content

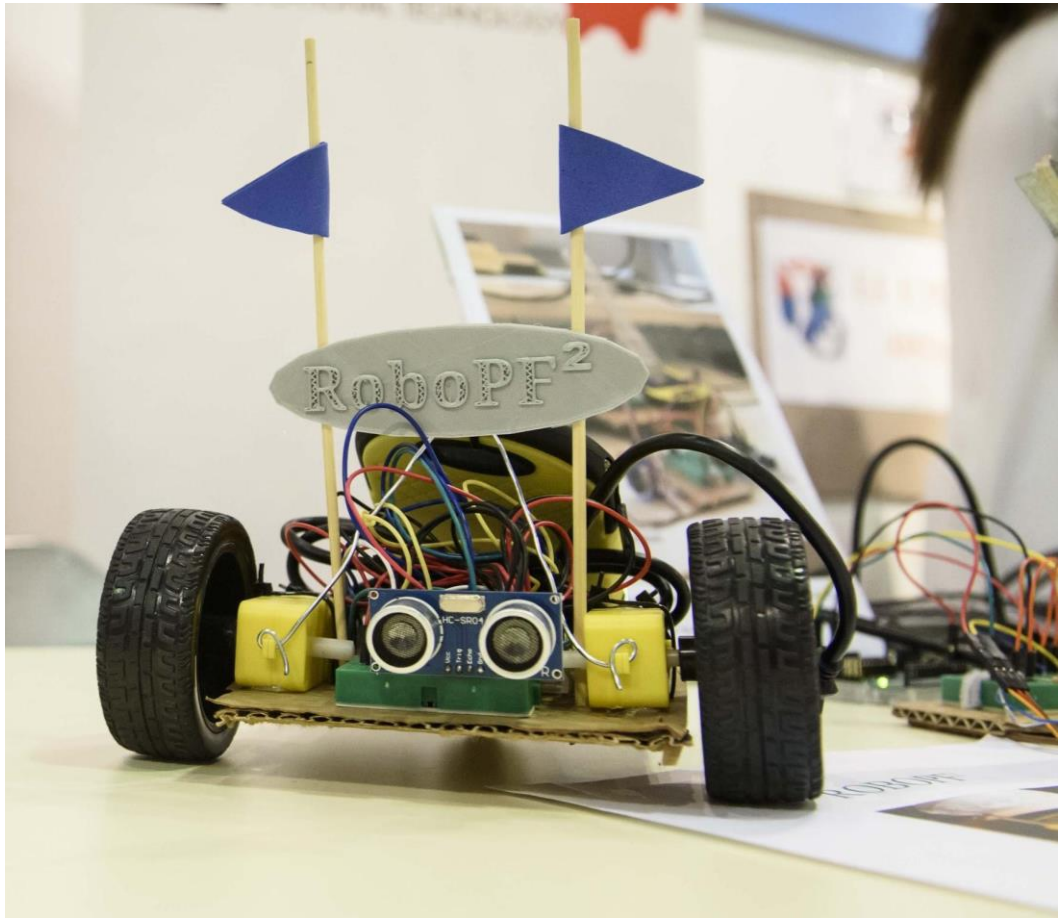
- In both cases the student-teachers were first introduced in the eCraft2Learn concept and methodology
- were invited to walk around the lab observing the children working on their project and to join a group and work as members of the group (3 hours).
- were separated in groups of 3-4 persons and had a 3 hours practice realising the same project
- a plenary discussion summarising experiences and impressions from the whole session
- Assignment of homework

The lighthouse project

The lighthouse blinks only in dark

https://youtu.be/tj_HaMKu3eY

The sensor-driven robotic car project



Several types of DIY automobiles

https://youtu.be/x6MKmQSq9CE

evaluation

- write a report focused on two topics/questions:
- Evaluate the eCraft2Learn environment: does it contribute and which way to STEM education? Which skills you think it develops for kids?
- Describe the role of the teacher you have seen in the eCraft2Learn lab. Is this different from the traditional role of teacher? Which differences you have seen?
- design your own STEM activity that might be realized in the eCraft2Learn environment: scenario of the STEM activity, learning objectives, students' role, teacher role, technologies to be used
- Finally, create a simulation of an Arduino-based circuit and relevant code to bring the circuit in life in the frame of your scenario using the simulator *Tinkercad Circuits* (https://www.tinkercad.com/#/?type=circuits&collection=designs).

Findings from students' reports

- *"There was no table, no books and no seat. [The trainer] was sitting with the children in the groups and if it wasn't for the age difference that helped us understand who the teacher is, we would have thought there was no teacher, at first glance."*.
- *"there was a lot of hands-on activity on, a real making atmosphere with a lot of trial and error, shifts in the roles of the students, good collaboration; they were also noticed frequently to take initiatives to change their initial plan/design*

Findings from students' reports

- They found that "offers valuable opportunities for learning"; they recognised that "*the educational journey is more important than the accomplished tasks".*
- They found useful the scenario given to the children because *"inspiration through pre-developed scenarios is needed to help students see the main functionalities and the available tools and to start imagining their own more (or not) complex projects*".

Findings from students' reports…

- "*We have seen most of the teachers acting as real coaches during the pilots, sitting next to the students and becoming members of the group, helping discretely when it was needed, answering questions from students, pointing out resources on the web, encouraging and motivating students to work in inventive ways*".
- "*The children of the observed group did not participate in the construction of the circuit and the code for the lighthouse's activity. Instead, the circuit and the program were built by the group's trainer...*"

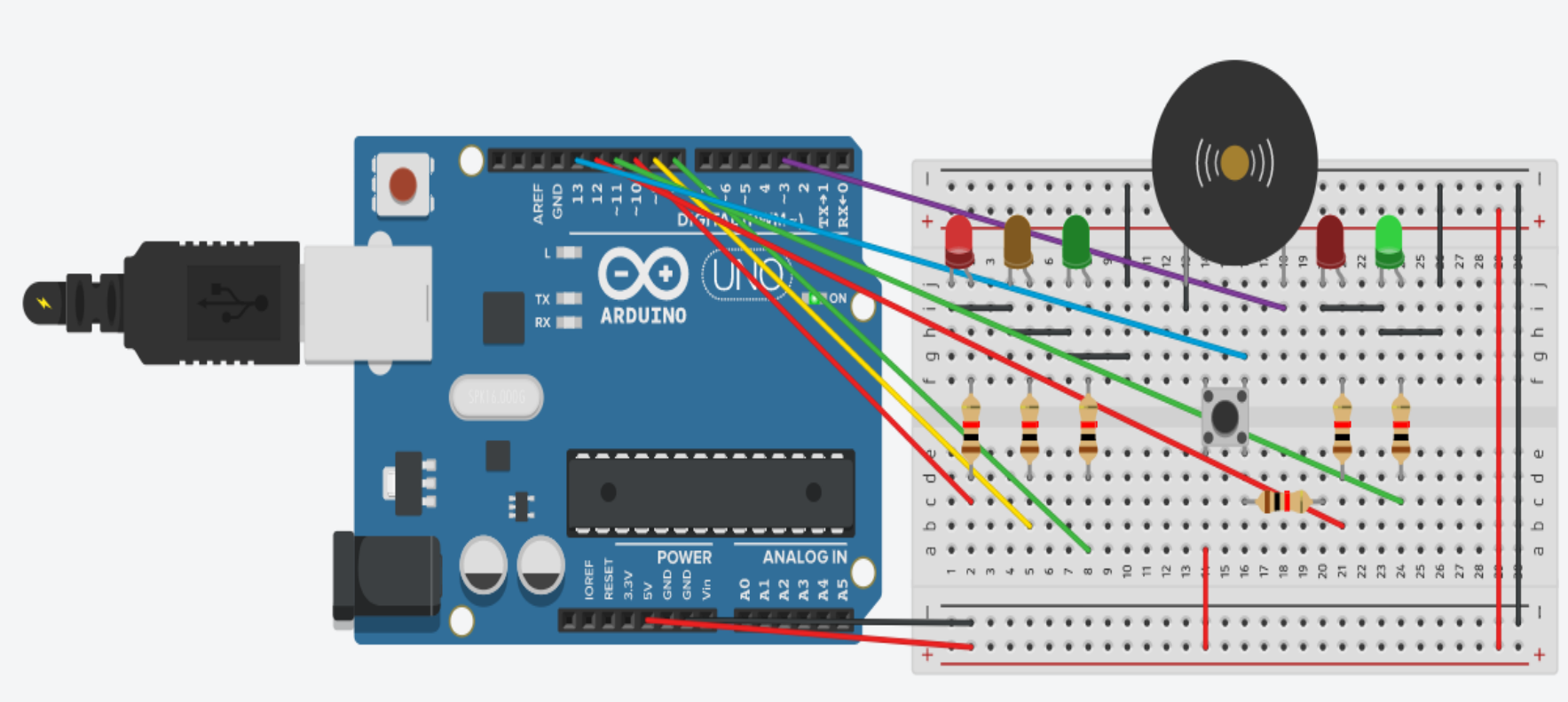
Findings from students' reports …

- *"There was a difficulty regarding the code writing; because of time limitation and increased difficulty, it was delivered to them as a typical lesson by the trainer*".
- *"he under took the task of the circuit creation and the programming task as well; His role in that case was the transmission of ready knowledge…*".
- *"it was observed that the group put more emphasis in the construction of the object (lighthouse) than in the creation of the operational program and circuits…*".

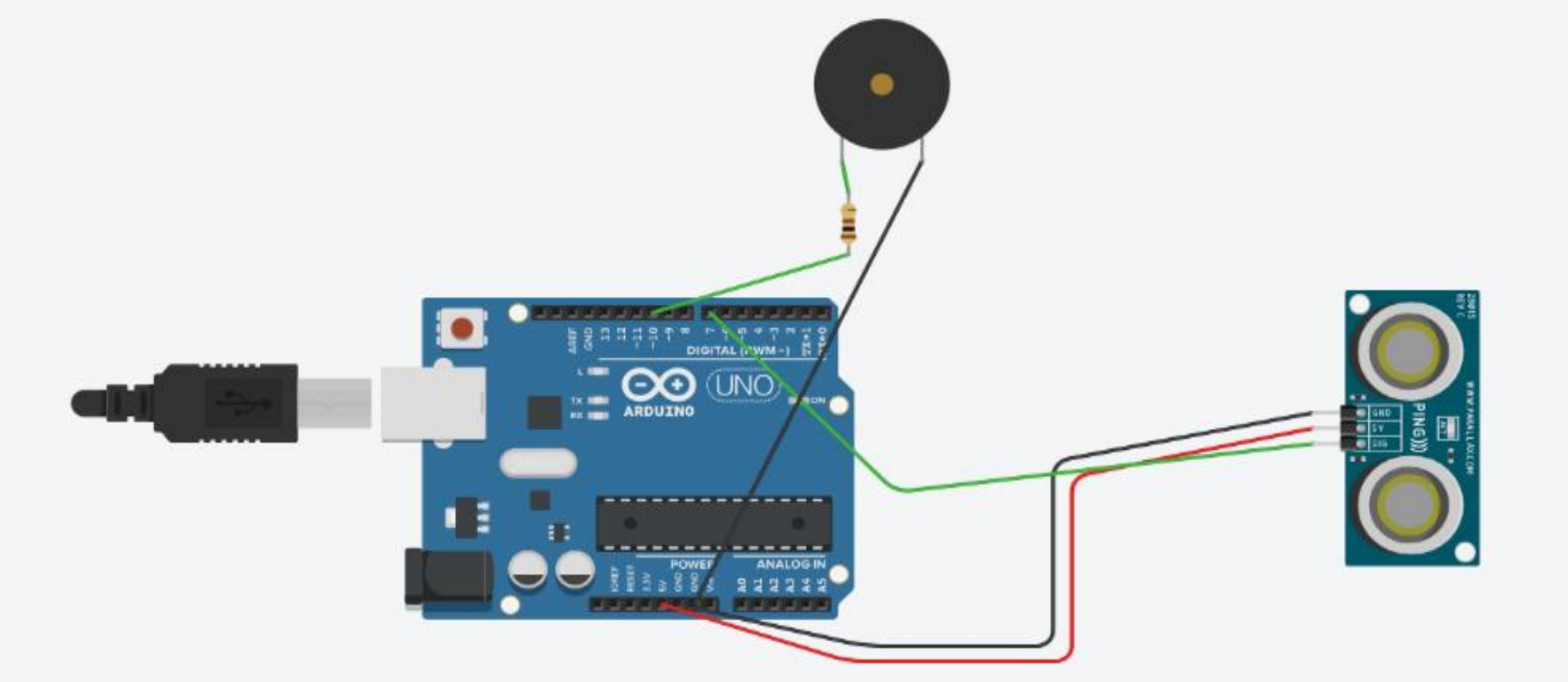
Findings from students' scenarios and simulations

"*A blind pedestrian wants to cross a street in the city center. Make traffic lights appropriate for blind pedestrians adding a buzzer that, when light turns green for pedestrians, will emit a specific sound for blind people to cross the street either automatically or after pressing a button*"

Tinkercad simulation of traffic lights with Arduino board, breadboard, LEDs, buzzer, button



Tinkercad simulation of automatic parking aid for cars equipped with a distance sensor informing the driver for the distance from the wall



Conclusions…

- students have deepened their understanding of STEM education
- enriched their conceptions about teacher's role with that of a coach
- promising indications that STEM teacher training might be benefited if it combines the academic teaching with direct experiences and practical training in authentic maker spaces

Needs and future work…

- pre-workshops for those in need of covering key concepts and basic skills in assembling circuits, in using sensors and actuators before they are exposed to open projects
- a full training package available for teachers and teacher trainers who wish to introduce digital fabrication and the maker movement in formal and informal education
- This training package might be also integrated into academic STEM education courses for under- or post- graduate student-teachers to enrich the academic teaching practices with practical training in authentic maker spaces

Current and future work…

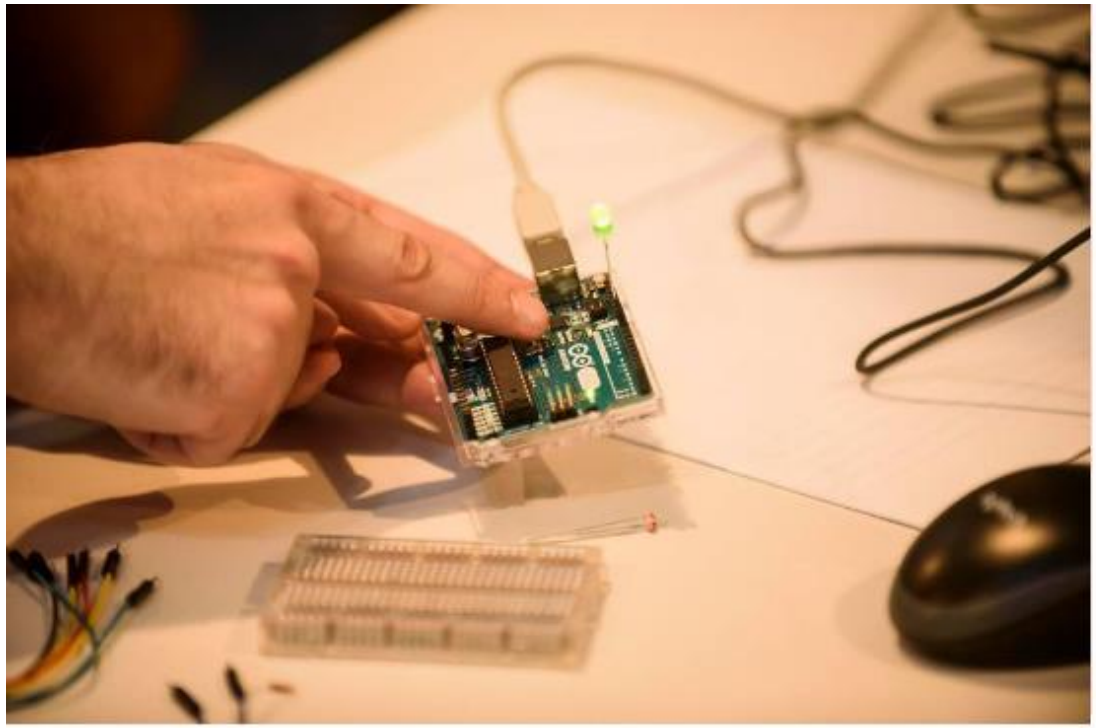
INBOTS CSA/H2020 project http://inbots.eu/ 2018-2020

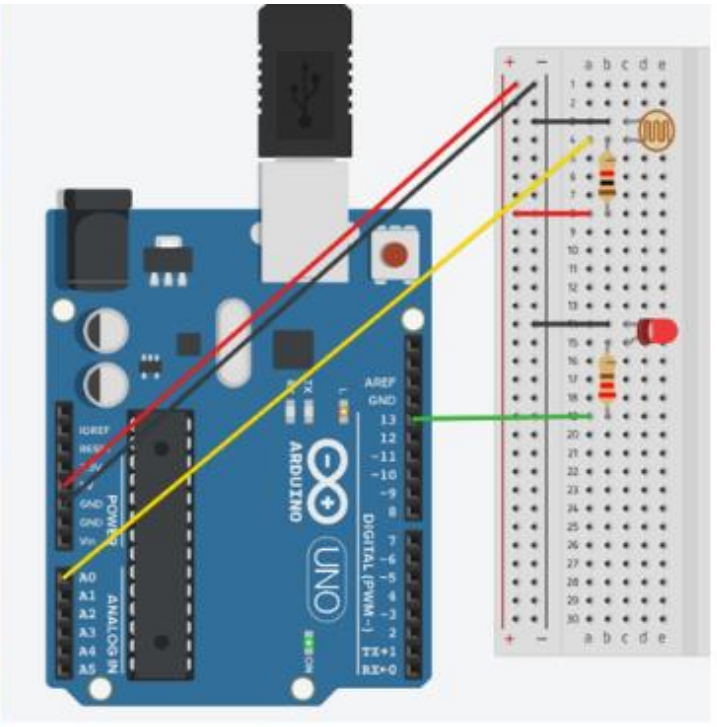
Identify specific training needs, organization of workshops and network building

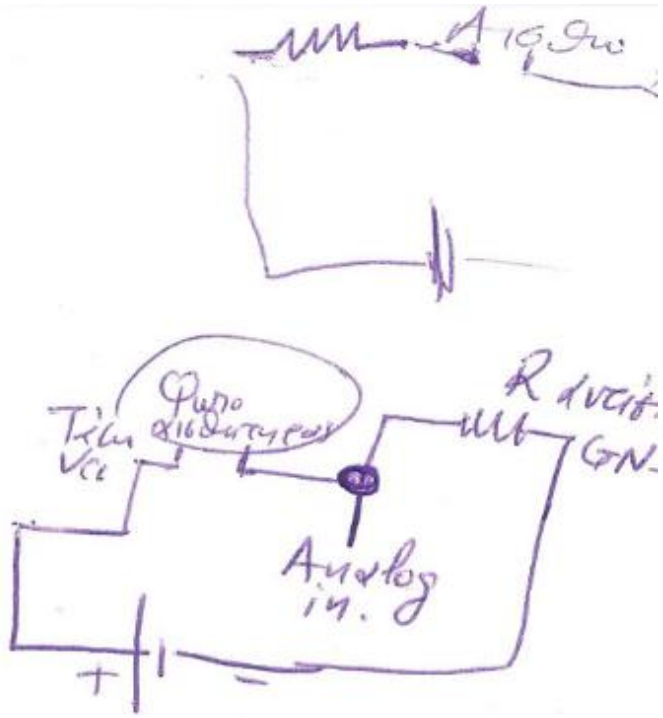
Create a sustainable framework to promote education in robotics and with robotics (from pre-school to university)

- Create curricula for introducing robotics in school education
- Create open educational resources
- Promote learning activities focused on interactive robotics, adapted to each education level

Current and future work: **ROBOSCIENTISTS** project (2018-2021) http://www.roboscientists.eu/







ROBO cientists

Erasmus+

ROBOSCIENTISTS project (ERASMUS+ 2018-2021) http://www.roboscientists.eu/

TEACHER PROFESSIONAL DEVELOPMENT:

Enact activities and workshops that promote teacher professional growth and development

Build synergies among schools, business and academia towards STEM Clubs establishment in school settings

Motivating secondary school students towards STEM careers through robotic artefact making

The WEMAKERS project
ERASMUS+ 2017-2020

- http://www.wemakers.eu/
- IoT in education
- Teacher training
- Learning scenarios
- Learning activities in schools

For more…

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visit

www.edumotiva.eu

www.inbots.eu

www.roboscientists.eu

www.wemakers.eu