Interactive Classroom
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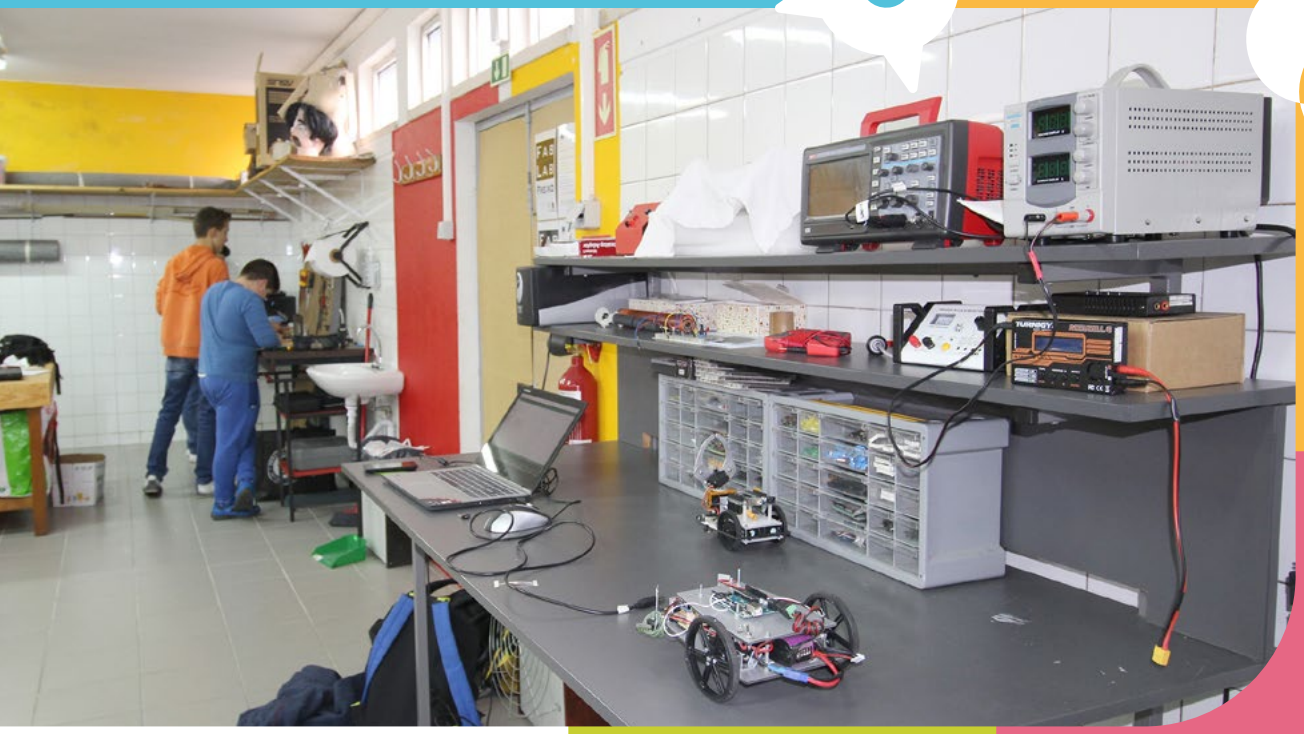
Makerspaces in schools

Practical guidelines for school leaders and teachers

Case Study

Agrupamento de Escolas de Freixo
(Freixo Schools Cluster), Portugal



European Schoolnet

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Picture credits:

(cover, pp. 3, 4, 6)

Introduction

Makerspaces, which are designed for hands-on, collaborative, creative work, are a fairly recent addition to some schools in Europe and worldwide. Students in school makerspaces can work with materials such as paper, cardboard, wood, metal, plastics, clay, fabrics, electronic components, microcontrollers, construction kits or programmable robots to create many different objects, and complete many different projects, using a variety of tools and machinery.

This case study is one of 15 developed from interviews with school leaders, teachers and other staff who have set up makerspaces in their schools. The schools are located in nine countries i.e. Austria, Belgium, The Czech Republic, Ireland, Italy, Luxembourg, Portugal, Switzerland, and Turkey.

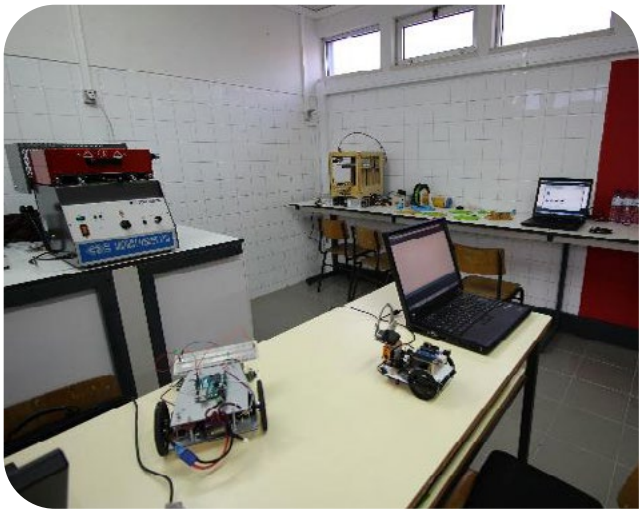
The interviews were part of research carried out by European Schoolnet's Interactive Classroom Working Group and the schools' experiences, the lessons they have learned and the good practice they have developed, have informed the development of a publication "Guidelines on Makerspaces in Schools".

Find the full report and other case studies here: *fcl.eun.org/guidelines*

The School

The Freixo Schools Cluster is a group of four public schools located in a rural landscape around the village of Freixo in Ponte de Lima council, district of Viana do Castelo in North West Portugal. The school cluster has 650 students from kindergarten to 9th grade, and 70 teachers and the main school has around 450 students. The school has strong connections with the local community and with local companies who have supported projects within the school. The school leaders believe in innovation and have invested in educational technologies. The school has taken part in national projects and João Carlos de Sousa Cunha, the schools deputy director and a Robotics Club teacher, says the school is "continually looking for external partners". In partnership with a local start-up, the school is working to create technological products in the area of ecological design.

Motivation and aims



The school had a successful Robotics Club which was very popular with the school's students and contributed to helping the school to develop a positive and modern image. In 2013 the school decided to exploit its accumulated experience and, anticipating the importance of offering students the opportunity to develop their programming and problem solving skills, introduced the subject of mechanics and robotics as part of the compulsory curriculum for students in the 7th and 8th grades. The numerous awards the school has won in robotics competitions together with its modern image and pedagogical innovation impressed a local product design and development company called WeProductise. The company offered the school some equipment and technical support so that the robotics club space could become a makerspace. The makerspace operates in the same space as the robotics club, sharing and leveraging all of its material and human resources.

Key aims of the makerspace are:

- To prepare students for the pursuit of studies in several areas facilitated by access to the latest technologies that are important for their future lives and employment.
- To develop autonomous projects linked to robotics and integrated into the curriculum.
- For the makerspace to be used throughout the school as well by people outside the school.

The implementation timeline

Planning and implementation of the makerspace were surprisingly quick but this was because the school was able to draw on the resources of the existing Robotics Club and the experience of the teachers who had been involved with the club.

The Robotics Club started in 2006 and a decade later, in 2016, became the makerspace. Planning, and obtaining funding for the makerspace took just one month.

Building and equipping the makerspace

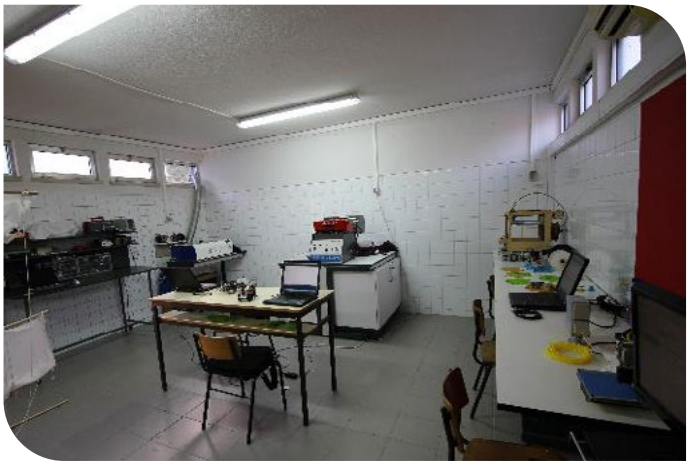
An old facility, detached from the main buildings of the school and previously used for physical education classes, was adapted to be the home of the new makerspace which is approximately five metres by ten metres. The makerspace is within the school but in its own autonomous building and there is a door which allows entrance to the makerspace from outside of the school.

Teachers involved in the Robotics Club and in other technical subjects were consulted concerning the planning and implementation of the makerspace.

The makerspace was equipped from several sources. Some equipment already existed in the school, some was provided by sponsors or partner companies and some was purchased by the school investing money obtained by winning educational prizes. Some equipment obtained from external organisations was due for replacement and therefore going to be scrapped or recycled, but it is still useful for makerspace activities.

Equipment and technology used

- Equipment in the school's makerspace currently includes:
- Work desks
- Hand tools for wood/metal work
- Lathes for processing wood and metal
- Electric tools for cutting, drilling and polishing
- Laser engraving/cutting machine



- 3D printer
- Plastic bending machine
- Vacuum plastic moulding machine
- Desktop computers
- Battery chargers
- Multimeter
- Oscilloscope
- Arduino boards
- Arduino compatible sensors
- Various electronic components
- Lego software
- Sketchup

Cost and funding

The makerspace has been financed by money from the school's budget and from various externally funded projects that allow the acquisition of equipment and materials. Some funding has also been obtained from the municipality and from Robotics Club prizes.

The total cost of setting up the makerspace was approximately 50,000 euros.

Sustainability

In order to ensure the continued operation of the makerspace, the school uses some of its budget for maintenance and continues to bid for funded projects that allow for acquisition of equipment and financing of activities.

Organisation and management

The teachers responsible for the day-to-day operation of the makerspace are those who have experience in the areas of robotics and informatics and technology. There is a designated manager who is responsible for the makerspace room and for the acquisition and maintenance of the equipment used in it.

Partner organisation WeProductise is a local company who share the philosophy of FabLabs and they provide support for the makerspace together with a team from within the school. The team includes former students who continue to use the makerspace and to collaborate in activities; they also help to provide technical support. The fact that the makerspace is not limited to traditional school hours allows for more flexible management.

The teachers are allowed a set number of hours each week to work with students using the makerspace. Students with greater experience can be allowed to work on their own and they help to support other students.

Training and support of teachers

Training for teachers is informal and delivered by those teachers who have experience in the robotics club and are used to working on projects with students. Within the school there is a strong culture of sharing knowledge and use of the makerspace is encouraged through teachers showing colleagues some of the work that has been done in space. Teachers and students also use social networks for sharing information and best practice.

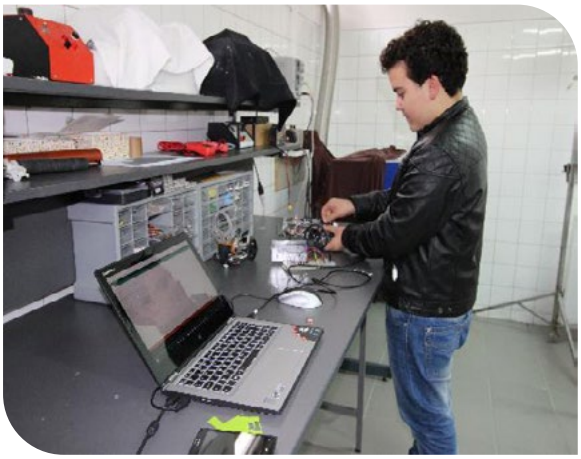
Teaching in the makerspace

The makerspace is used by teachers of mechanics and robotics, technology, ICT, Geography and Science and some projects carried out in the space are collaborations between 1st cycle (primary) pupils and older students. Collaboration is an important aspect of the use of the makerspace as Pedro Jorge Nogueira Correia, Robotics Club teacher and Makerspace Coordinator, emphasised "*collaboration always exists in most activities of space maker, including between teachers within the school and with colleagues from other schools*".

Currently about 10 teachers use the makerspace regularly, but João Carlos believes that "*a large percentage of teachers end up being involved indirectly and benefiting from the space*". Teachers interviewed stated that makerspace activities are developed from:

- Students' ideas related to a specific curriculum subject
- Students' ideas not related to a specific curriculum subject
- Ideas arising during Robotics Club activities
- Teachers' lesson plans to address specific curriculum goals
- Teachers' ideas to solve day to day problems
- Suggestions or proposals by teachers from other schools

Pedro Jorge observed "*The makerspace is seen as a resource to support the curricular activities of the group of schools, which is why many of the activities linked to the curriculum".*



Typical activities in the makerspace include:

- Construction of structures
- Electronic circuits
- 3D printing
- Laser cutting and engraving
- Bicycle maintenance

The pedagogy employed is a project-based methodology and teachers explained that activities in the makerspace:

- *"Highlight the skills of programming and use of digital tools, allied to the Internet of things".*
- *"Allow students to go beyond the formal curricula, favouring the development of individual and of collective projects with the use of current materials and tools".*
- *"Create a hotspot for developing competencies for the 21st century".*
- *"Include some activities developed as part of the students ' curriculum enrichment which usefully occupy their free time".*

Approximately 70 students use the makerspace every week. It is in use daily throughout the year and, according to João Carlos, "*There are students who even in the school holidays want to live in the makerspace".*

Added value and benefits

Interviewees at the school reported an added value of the makerspace as enabling students to develop competences in:

- the use of tools and materials.
- electronics and programming.
- the use of 3D drawing software and 3D printing for the construction of models.

Teachers also described wider benefits including:

- "*The makerspace encourages the use of more active methodologies and promotes a more informal relationship with students".*
- *"The special equipment enables differentiated activities with students learning by doing".*
- *"Increased development of collaborative work skills and sharing of both resources and knowledge resulting from projects based learning".*
- *"Students with more experience are encouraged to collaborate and to teach specific techniques to beginner learners".*
- *"The students have a more positive view of the school".*
- *"More students are motivated to continue studies in technological areas".*

Challenges

The main challenges mentioned by teachers were:

- Simultaneously managing very heterogeneous groups of students working on diverse projects.
- The limited number of hours available for teachers to supervise students in the space.
- After school and during weekends it is necessary for a teacher to volunteer to open the space to enable students and external users to work on projects.
- The number of hours allocated to teachers of the Robotics Club reduces the time potentially available for other teachers and this limits the extent to which use of the space can grow.
- Difficulty obtaining the minimum necessary funds for the elaboration of projects.

Future plans

The Freixo Schools Cluster intends to enlarge their makerspace with a specific aim being to increase its use by 1st cycle (primary) students.

The amount of available equipment will be increased, and the range of equipment extended to include larger 3D printers with special filament, CNC, welding stations, PCB laser engravers.

There will be a permanent zone for testing the developed projects, especially robots, and an increase in the number of users from outside the school.

The case study complements the European Schoolnet's publication "Makerspaces in schools / Practical guidelines for school leaders and teachers" (2020).

Find the full report and other case studies here: **fcl.eun.org/guidelines**

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