Interactive Classroom
Working Group

Future
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Lab
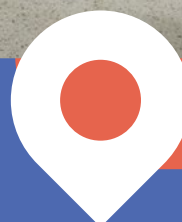
Makerspaces in schools

Practical guidelines for school leaders and teachers

Case Study

Second Comprehensive Institute
Montessori-Bilotta, Italy

European
Schoolnet

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Practical guidelines for school leaders and teachers

Case Study:

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Authors:

Samuele Borri, Leonardo Tosi, Lorenzo Guasti, Giovanni Nulli, Indire, Italy
Jill Attewell

Editor:

Anja Balanskat, European Schoolnet
Jim Ayre, European Schoolnet

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*

National context

In 2016 the Italian Ministry for Education issued an invitation to tender[1] under which schools could receive up to 28,000 euros to build "atelier creativi" (creative workshops), described as spaces in which students use different tools and acquire the knowledge needed to create real or virtual objects.

The school

The Second Comprehensive Institute Montessori-Bilotta is a school for students from kindergarten to lower secondary. It is located in the town of Francavilla Fontana which has a population of about 40,000 people and is located in a rural area in the region of Apulia in southern Italy. The school has 132 teachers and 1,401 students. The socio-economic background of students is typically lower than the national average. The school has a special focus on creativity and the school leaders believe that new technologies enable development of the students' creative potential.

Motivation and aims

The original idea to create a makerspace came from the Principal Tiziano Fattizzo, who had participated in Indire and EPALE projects. He then involved a small group of teachers and parents. He says "*we wanted to create a place where students can freely express their creativity*".

The school's curriculum for digital competence includes four topics which they aim to address through the use of the makerspace, thus helping students to develop skills in:

▶ Digital literacy and computational thinking

▶ Digital citizenship and emotional digital intelligence

▶ Digital creativity

▶ Communication and collaboration

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1   https://www.istruzione.it/scuola_digitale/prog-atelier.shtml

More generally the school aims:

▶ To enable more constructionist and constructivist learning.

▶ To introduce more informal ways to teach.

▶ To enable students to create artefacts from the idea to the final product or prototype.

▶ To add more creative problem solving strategies and collaboration to traditional learning, which emphasises uniformity and predictability.

The implementation timeline

The project team, consisting of the initial small group of teachers and parents, started to design the makerspace in 2015. Collecting funds, identifying and preparing an appropriate space, and then creating the makerspace took about two years.

Building and equipping the maker space

The project team found an underused warehouse space in the basement of the primary school building and near the kindergarten which they cleaned up and refurbished. The space has a separate entrance that allows access from outside when the main school entrance is closed. The size of the makerspace is 180 square meters organised as a large open space divided into these sub areas:

▶ Soft area for little children.

▶ Small tables for programmable robots for young children e.g. Bee Bots or Cubetto.

▶ Modular tables for different activities.

▶ Computer zone.

▶ Projector zone.

▶ Interactive white board zone.

▶ Machine zone, which can be isolated if necessary.

Parents, and other members of the team that the school describes as "proper makers", helped to design the makerspace, provided technical advice and helped to prepare a plan of equipment purchases required. As machines, and other equipment, are purchased the makers and teachers prepare training plans for these.

Equipment and technology

Equipment in the makerspace includes:

- 65 inch interactive monitor
- 4 x notebook computers
- 10 x iPads
- 1 x thermoforming machine
- 7 x 3D printers (1 to print with ceramic, 1 to print with chocolate)
- 2 x 3D scanners
- 1 x laser cutter
- 3 x cutting plotters
- 1 x multifunction robotic arm
- 6 x kit Lego Mindstorms Education
- 8 x kit Lego WeDo 2.0
- 4 x Fischertecnick construction kit

- 6 x kit littleBits
- Other robots: Bee Bots, Blue Bots, Cubetto, mBot, Ozobot, Dash
- Table saw
- Arduino boards with sensors, engines etc.
- Microbits
- Screwdrivers
- Drills
- Various small tools
- Software including: SugarCAD, Sketchup, Cura, Blender, Fusion 360, Scratch, G-Suite, Photoshop suite ; software for laser cutters and plotters

Cost and funding

The makerspace was mainly financed by external funding. This came from the Ministry of Education, European funds and private financing. Also parents organised fundraising activities. The total cost of creating the space was approximately 50,000 euros.

Sustainability

A group of teachers and parents with technical experience have created an association called Officine Creattive. A partnership between the school and the association should enable the makerspace to be sustainable. Tiziano Fattizzo describes this as a win-win situation in which "*the school has a well-organised and up to date makerspace, while the association has its own space and the educational reputation of the school*". The association also offers courses to external people for a fee outside of school hours.

Organisation and management

Officine Creattive, the maker association, is responsible for:

- ▶ Developing and maintaining the makerspace.
- ▶ Providing technical services and advice to the school.
- ▶ Planning which machines should be purchased.
- ▶ Dealing with suppliers and maintaining the equipment.
- ▶ Developing technical training plans for teachers.
- ▶ Providing training for teachers.
- ▶ Supporting teachers and students during lessons in the makerspace.
- ▶ Suggesting projects that are coherent with the school curriculum.
- ▶ Promoting entrepreneurship.
- ▶ Involving other schools in specific projects.

A teacher manages the makerspace timetable for teachers during the school hours and for the afternoon and evening courses. There is also a janitor who has been trained to help the teacher and to help to maintain the space.

Networking beyond the school

The school has a very close working relationship with Officine Creattive and occasionally collaborates with the Fab Lab in the Historical Museum of Lecce.

Training and support of teachers

The school and the Officine Creattive association organise technical courses for teachers on a regular basis. These courses are not mandatory, teachers attend them if they are interested and wish to.

Principal Tiziano Fattizzo has found that "*a word of mouth process makes more and more teachers aware and willing to attend training courses*". Also his focus on the makerspace, and pressure from parents for the kind of activities carried out in the space, is convincing for more teachers to take part.

In the makerspace teachers can observe each other's activities in action and use technical training events as sharing opportunities. The role of the Officine Creattive association includes supporting teachers during lessons with their students in the makerspace. The association staff member acts like a second teacher, helping the teacher to design activities and to manage these with students.

Teaching and Learning

The school's teachers have emphasised that activities carried out in the makerspace are designed to support the curriculum. The curriculum is the main focus for the teachers, but the difference is that they have to rethink how they teach and adopt "*learning by doing methods*".

One teacher explained "*usually we ask students to produce some artefacts to answer to a specific curricular question. For example there will be a theme that is the same for all levels in the school and we ask students to develop artefacts relevant to this theme. Then we can add language activities with students describing what they have done and maths and science activities measuring and exploring like scientists*".

Having a makerspace which is separate from the usual classrooms is seen as important. Teachers acknowledged that their teaching included some robotics and coding activities before the school had a makerspace. However, carrying these out in the makerspace is better as it is larger, more informal and more stimulating than the normal classroom. Also the proper tables and equipment are always available and the students enjoy working in the makerspace.

Teachers described the process of designing 3D printing activities. This starts with the teacher attending an internal technical course led by the expert who is one of the resident makers. The maker suggests an activity that can work technically. Then the teacher begins to design the associated curricular activities. During the design phase the teacher can ask the maker for advice and the maker will provide support in the makerspace when the students carry out the activities. This helps the teacher to feel confident that there will not be technical problems and enables them to concentrate on the curricular aspects of the activities. Later teachers share activity plans and experiences with each other.

Some teachers have introduced some more advanced electronics competences that go beyond the curriculum when lower secondary students have been interested to learn these using, for example, Arduino microcomputers.

Added value and benefits

An identified added value of the makerspace as a learning environment is its potential for interdisciplinary learning. In the space teachers can mix together elements of arts, literature, mathematics, science and social competences, because of the variety of materials and tools available.

In the makerspace there is an emphasis on students' own work, creativity and learning processes which makes their learning activities more meaningful. Also, whilst working collaboratively in this informal space, students develop social and transversal competences useful in their future lives and careers.

Benefits identified by teachers and the principal include:

▶ Students can build and reinvent knowledge, discovering as scientists do rather than just reproducing information presented to them.

▶ Students can build their own learning paths consistent with their own preferences and attitudes.

▶ Students in different years can be working in the makerspace together allowing younger students to start thinking about some things they will learn later and teachers to share ideas.

▶ Students enjoy the informality of the makerspace and feel comfortable working there.

▶ Students work more autonomously and become more self-confident.

▶ Students are very engaged in their learning activities and enthusiastic about using the makerspace.

Challenges

A key challenge for the school is spreading the use of the makerspace to the teachers who were not in the first group of innovators.

Tiziano Fattizzo says, *"even after teachers have been trained and achieved a very good integration of making activities into the curriculum, it is necessary to continue changing their approach to teaching and this is very challenging especially for teachers with little previous experience of technology".*

Future plans

The school is starting to build another makerspace inside the lower secondary school building.

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**

 European Schoolnet

 Future Classroom Lab

 Flanders State of the Art

 Czech National Agency for International Education

 PDST Professional Development Service for Teachers

 INDIRE Istituto Nazionale Documentazione Innovazione Ricerca Educativa

 SCRIPT Service de Coordination de la Recherche et de l'Innovation pédagogiques et technologiques

 direção-geral da educação / Governo de Portugal – Ministério da Educação e Ciência

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